MASTER THESIS

BULDING TRUST THROUGH THE PARK AND RIDE JOURNEY

Strengthening the NS App at Key Traveller Moments

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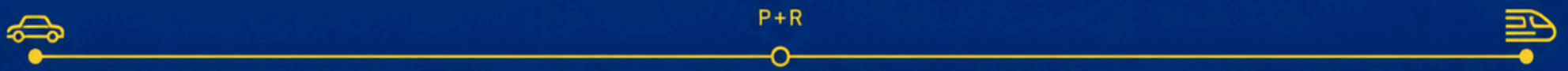

Summary

Park and Ride (P+R) allows travellers to combine the flexibility of the car with the train, but its value depends on more than parking and rail infrastructure alone. Previous research shows that P+R effectiveness is context-dependent and that customer experience develops through connected touchpoints instead of isolated services (Zijlstra et al., 2015; Lemon & Verhoef, 2016). For NS, this is relevant because P+R already forms part of its broader door-to-door mobility ambition (Nederlandse Spoorwegen, 2024).

This thesis investigated how the NS app can support travellers at key moments to build the trust needed to consider and use P+R instead of driving the full journey. A research-through-design approach combined stakeholder interviews, internal NS research and fieldwork at P+R locations in Rotterdam, Woerden and Amersfoort. Thirty-seven traveller encounters were included in the field analysis. The resulting design direction was developed iteratively and later evaluated through thirteen semi-structured online sessions and sixteen short sessions around Utrecht Centraal.

The research reframed the challenge from providing more P+R information to supporting a multimodal travel decision under uncertainty. Relevant information often exists, but travellers still need to determine what it means for their own journey. They move between navigation, parking and public-transport systems, compare costs and conditions themselves, and may remain uncertain whether important steps will work as expected. Information alone therefore does not create confidence. Travellers need to understand the combined journey well enough to judge whether it is reliable and suitable for their situation. Trust refers here to the willingness to rely on the journey despite uncertainty, while confidence describes whether the traveller feels sufficiently informed and supported to make that judgement (Mayer et al., 1995; Lee & See, 2004).

The strongest design opportunity lies before commitment, when travellers are still deciding if P+R makes sense for their trip. The project therefore focuses on choice travellers who are open to alternatives but are not yet convinced that the combined journey will work for their situation. Later transitions remain relevant because they can confirm or weaken the trust built at that decision moment.

These findings led to the **Travel Confidence Companion**, a guidance layer around the existing NS Reisplanner. DECIDE helps travellers compare relevant options before committing. **GUIDE** supports the chosen journey when circumstances change. REINFORCE relates the completed journey back to what mattered when the choice was made.

Evaluation provides the strongest evidence for Decide. Participants generally understood the recommendation, found the P+R option easier to judge and still experienced the final decision as their own. Guide was positively received in change scenarios but has not yet been tested in live travel, while Reinforce remains the least established layer. The study does not demonstrate repeated use, modal shift, long-term trust, full technical feasibility or financial viability. The recommended next step is therefore a bounded real-world test focused primarily on Decide.

Current Journey



Navigation · Parking information · P+R conditions · Public transport information

Travellers currently have to connect much of the journey themselves

KEY INSIGHT

Information alone does not create confidence.

The challenge is to help travellers judge if the combined journey is reliable enough for their situation

TRAVEL CONFIDENCE COMPANION

DECIDE
Before the choice

Which journey fits my situation?

Strongest evidence

→

GUIDE
During the journey

Does my chosen journey still work?

Promising

→

REINFORCE
After the journey

How did this choice work out?

Exploratory

NEXT STEP

Bounded real-world test, focused mainly on DECIDE

Abstract

Park and Ride (P+R) gives travellers the option to combine the flexibility of the car with the train. In practice, choosing P+R means assessing several parts of a journey at the same time. Information about parking, costs, transfers and train services may already be available, but travellers still need to understand how these elements come together for the trip they are planning. This thesis examines how the NS app can support travellers who see both driving and P+R as realistic options, and how that support can help build enough trust to consider P+R as an alternative to driving the full journey.

A research-through-design approach was used, combining stakeholder interviews, internal NS research and fieldwork at P+R locations in Rotterdam, Woerden and Amersfoort. Thirty-seven field cases were included in the traveller research. Insights from this work formed the basis for the design direction and the final concept. The concept was then evaluated through 13 semi-structured online sessions and 16 short sessions around Utrecht Centraal. Additional discussions with NS stakeholders were used to assess its relevance within the organisation and to identify conditions for further development.

A central finding was that the difficulty does not lie in finding the information alone. Travellers often have access to information about parking, trains, costs and travel time, but still need to judge the complete journey themselves. This is most relevant before commitment, when more travel options are still open. At this point, the NS app can help by comparing realistic options, relating them to the traveller's priorities and explaining what each option means in practice. The traveller remains in control of the final choice.

These findings led to the Travel Confidence Companion, a decision and journey guidance layer around the existing NS Reisplanner. DECIDE supports the choice before the journey by comparing realistic options in relation to traveller priorities. GUIDE supports the journey when circumstances change. REINFORCE connects the finished journey to what mattered when the original choice was made.

The strongest evaluation evidence relates to Decide. Participants generally understood the recommendation, found the P+R option easier to judge and still experienced the final decision as their own. Guide received positive responses in the scenarios that were tested, while Reinforce remains less established. ComIT Reizigers and NS Stations also saw relevance in the concept for future journey planning, personal travel advice and the further development of P+R in the NS app. The study does not establish repeated use during real journeys, long-term trust, changes in actual travel behaviour, full technical feasibility or financial viability. The next step is a focused real-world test centred on Decide.

Preface

This thesis marks the end of my Master's in Strategic Product Design at TU Delft. Looking back, I am glad that my graduation project brought me back to NS. I had already worked with the organisation during an earlier Master's course, which made me curious about how design works inside a big company that is so present in everyday life. Almost everyone in the Netherlands knows NS, uses it, or has an opinion about it. That made the project feel tangible from the start.

It started with the broad mobility topic on how to strengthen the relationship between the traveller and the NS app, but the project later became much more specific through P+R: how people make sense of a journey that moves between different modes, systems and organisations. Spending time at P+R locations, speaking with travellers and working with colleagues inside NS made the subject more concrete. At the start, I expected the problem to be mainly about missing information. The more time I spent with travellers, the more I saw that this was only part of it. People also needed to understand what the different parts of the journey meant together before they could feel comfortable choosing P+R. That change in perspective gave the project its direction.

I liked that the answer was not clear from the beginning. Some of the ideas I started with disappeared completely, while conversations and observations kept sending the project in new directions. There were moments when this was frustrating, especially when a direction I thought was right turned out not to be. I learned that these lessons are sometimes learned the hard way, especially because I was making most of the decisions on my own, but it was also one of the parts of the project I appreciate most.

One of the things I valued most was how willing people were to contribute. What started as my graduation project often became a shared effort. Colleagues joined field visits, helped me understand parts of the organisation that were unfamiliar to me, challenged assumptions and connected me with people who could move the project forward. I often came out of a conversation with a different view of the problem than I had going in. I also realised how much I enjoy this part of design: bringing people into a problem, connecting different views and turning those conversations into something concrete.

I would like to deeply thank my TU Delft supervisors, Stefan Persaud and Casper Koomen, for the way they supported me throughout this project. I was very fortunate to have such a strong connection with both of you. Your questions and feedback often helped me find direction again when I was stuck, and pushed me to look more carefully at the choices I was making. Even in the more difficult moments of the project, I always felt that I could rely on your guidance.

I am equally grateful to my company mentors, Bart Vijfhuizen and Peter Cuijpers. You gave me the freedom to explore the problem in my own way, while always helping me stay connected to the reality of NS. I greatly appreciated how welcoming, open and approachable you both were, and how easily I could come to you to test an idea, ask a question or better understand how things work within the organisation. I feel very lucky to have had such a strong team around me during this project.

My thanks also go to the many NS colleagues who shared their knowledge, joined research activities or took the time to discuss the project, and to the travellers who participated in the fieldwork and evaluations. Some of these conversations lasted only a few minutes, while others continued over several meetings, but all helped me see the P+R journey from a different angle. The project would not have become what it is without that input.

Finally, I want to thank my friends and family for putting up with the amount of space this project took up in my head over the past months. Thank you for listening when I needed to talk through yet another decision, and for reminding me that there was also life outside my thesis. Your support made the difficult periods much easier.

Finishing this thesis also closes a long chapter at TU Delft. I leave with a much clearer idea of the kind of designer I want to be. I enjoy working on problems that are not neatly contained, talking to the people who see those problems from different sides, and slowly finding a direction that makes sense. This project gave me plenty of chances to do exactly that.

I am grateful to everyone who was part of it and proud of what this thesis became.

Enjoy reading it.

Romeo Paolo Pace
Delft, September 2026



Reading guide

This thesis moves from understanding the current P+R journey to developing and evaluating a new form of support in the NS app. The report is divided into two parts, following the two diamonds of the design process.



Key terms

A small number of terms are used throughout this thesis. The definitions below explain what they mean in this project.

Park and Ride (P+R)
Dutch: Parkeer en Reisvoorziening
A journey in which a traveller drives to a parking facility and continues by public transport. This thesis mainly focuses on P+R journeys that combine car and train.

Multimodal journey
A journey that uses more than one mode of transport. In this thesis, this mainly means travelling by car and train, including the parking and transfer between them as part of the same journey.

Chain mobility / Ketenmobiliteit
A way of looking at a journey as a sequence of connected transport modes and transfers. At NS, this is linked to supporting the traveller from door to door, instead of focusing only on the train journey.

Choice traveller
A traveller who has more than one realistic way to make a trip and still needs to decide which option fits best. Giorgia is used in this thesis as a design lens for this type of traveller.

Trust
The willingness to rely on the combined journey even when some uncertainty remains.

Confidence
The feeling that the traveller has enough information and support to judge whether the combined journey fits the situation.

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Part I - Understanding the opportunity

1. Introduction

1.1 Project context

For many travellers, driving is a familiar and flexible way to travel. At the same time, Dutch cities face growing pressure on limited space. Road traffic in the Netherlands is expected to continue growing in the coming years, while growth in public transport use is less certain (Kennisinstituut voor Mobiliteitsbeleid, 2025). Journeys that combine different transport modes can provide an alternative when travelling the full distance by car is less suitable.

In this thesis, multimodal travel refers to a journey that combines more than one transport mode within a single trip (Hamersma & de Haas, 2020). Combining modes can extend the reach of public transport, but it also introduces a transfer between stages of the journey. Dutch research on chain mobility identifies transfers and the journey to and from public transport as recurring barriers. A transfer can add waiting, repeated boarding, an extra risk of delay or a missed connection, and additional payment steps (Hamersma & de Haas, 2020). For the traveller, these stages have to work together as one journey.

A train departure time, for example, describes only one part of a multimodal trip. The traveller may also need to judge how much time a transfer requires, if the preceding stage will be available and what happens when one part of the journey changes. Fu et al. (2024) found that greater multimodality was generally associated with higher perceived disadvantage and lower perceived accessibility, particularly among people who rely on cars. This makes the connections between journey stages relevant for travellers considering an alternative to driving the full journey.

Digital information can influence this assessment. Chorus et al. (2007) found that multimodal choice quality improved most when information introduced alternatives that travellers did not already know. Information that only warned about high travel times had much less effect. Digital support can therefore help travellers by making complete travel options easier to see and compare.

Park and Ride (P+R) makes this wider multimodal issue concrete. The basic sequence is simple: drive, park and continue by train. The journey is easy to describe. Choosing it still requires the traveller to judge how its different parts will work together for the trip. Before choosing it, a traveller may need to know if there will be a parking space, what parking will cost, how long the transfer to the platform will take and how the train connects to the rest of the trip. Within NS, P+R is also intended to extend a station's catchment area and attract travellers who might otherwise not consider the train (Internal company document D1, 2023). This thesis focuses on P+R journeys that combine car and train within the NS context.

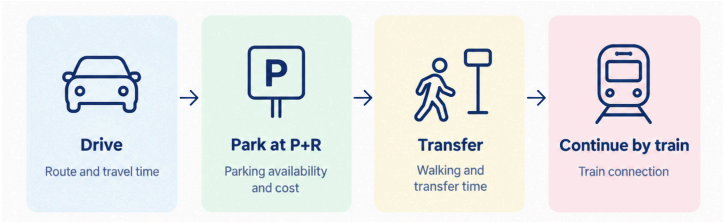


Figure 1.1. the P+R journey: a combined car-train journey

The effect of P+R varies by setting. A meta-analysis of 40 studies across 180 P+R sites found that public transport mode and the point at which drivers transfer were among the main factors affecting its effectiveness (Zijlstra et al., 2015). In the Netherlands, Mingardo (2013) surveyed 738 users at nine rail-based P+R sites near Rotterdam and The Hague and found unintended effects, including users who had previously cycled to the station. The contribution of P+R therefore depends on the journey, the location of the transfer and the alternative it replaces. This thesis treats its effect as context-dependent. For the traveller, this means that P+R cannot be judged from the parking facility alone because the car journey, transfer and train journey all affect whether the option makes sense for the trip.

Within NS, P+R forms part of the wider door-to-door travel offer (Nederlandse Spoorwegen, 2024). P+R information is also available through NS digital services, including information on locations, parking conditions and tariffs (Nederlandse Spoorwegen, n.d.). The NS app is one of the traveller-facing touchpoints through which this support can be provided. Customer experience develops across multiple touchpoints over time (Lemon & Verhoef, 2016). For a P+R journey, the experience of parking, transferring and continuing by train therefore contributes to how the journey as a whole is experienced.

NS had already conducted internal research on P+R before this project. This thesis uses that work as a starting point and adds field research on the traveller's decision process. P+R provides a concrete case for examining how digital support can help travellers judge a journey that crosses transport modes and service systems.

1.2 Problem statement

Within its door-to-door strategy, NS is working to improve the findability and usability of P+R and its position within travel advice (Internal company document D2, 2026). The physical network already exists at considerable scale. NS lists P+R at 270 locations across the Netherlands, with around 50 locations charging a parking fee (Nederlandse Spoorwegen, n.d.). At paid locations, automatic number-plate recognition records entry and exit. These records show what happens once a traveller reaches the P+R location. They say much less about the decision that came before it.

A rejected P+R journey can leave little trace. A traveller may consider parking at a station, compare that option with driving all the way, decide that the combined journey does not work well enough for the trip and continue by car. No P+R visit is then recorded, even though P+R was part of the decision. Transport-choice research describes a similar measurement problem, where consideration of alternatives is difficult to observe directly from choice behaviour (Capurso et al., 2021). NS can therefore observe use more easily than consideration or rejection before travel.

Car access to stations already occurs at a considerable scale. NS reported that around 6% of train travellers arrive at the station by car and want to park there (Nederlandse Spoorwegen, 2021). Using the annual figure of approximately 10.2 million unique NS travellers applied in this project, this corresponds to an order-of-magnitude estimate of roughly 600,000 people. This estimate is used only to indicate the scale of car access to stations. It should not be read as

an exact number of unique P+R users, because the underlying figures use different statistical units.

This thesis focuses on travellers for whom both a direct car journey and a combined car-train journey are realistic options, but for whom P+R is not yet an established choice. The study examines what makes P+R difficult to assess at the moment of choice and how the NS app can support that decision. For these travellers, the P+R facility may already exist and the relevant information may be available, but they still need to judge if the complete journey fits the trip they are planning. This makes the decision before commitment the focus of the design problem, while P+R is still one of several realistic travel options.

1.3 Research questions

Main research question: *How can the NS app support travellers at key moments to build the trust needed to consider and use P+R in combination with the train as an alternative to driving?*

The project began with a broader exploratory question. The main research question was refined after the first diamond, when the synthesis showed that confidence in the combined journey was central to the traveller problem. Section 3.2 explains this development in more detail.



Figure 1.2. The main research question and its five sub-questions

RQ1, ecosystem and policy:
How is NS's strategic ambition for chain mobility reflected in the current P+R offering and its integration in the NS app?

RQ2, traveller needs and frictions:
(a) Which needs, motivations and barriers influence travellers' decisions to use P+R?
(b) Where does the NS app currently fall short in supporting the P+R journey?

RQ3, strategic opportunity:
Which combination of target group, journey phase and friction point offers the most strategic opportunity for the NS app to add value to the P+R experience?

RQ4, solution direction:
What concept can strengthen the traveller's trust throughout the key moments of the P+R journey?

RQ5, validation:
To what extent does the proposed concept address the identified traveller tension, and what conditions would NS need to implement it?

1.4 Relevance for NS and the traveller

For travellers, the relevance of this project lies in the difficulty of judging a combined journey before committing to it. A P+R journey may be physically available while parking, transfer, cost and train information still have to be understood as one trip. The project therefore examines how digital support can help travellers make that judgement.

For NS, P+R can extend the reach of a station to travellers who may otherwise not consider the train, and it forms part of the wider door-to-door journey (Internal company document D1, 2023; Nederlandse Spoorwegen, 2024). The NS app already supports several parts of that journey. This makes it a relevant place to study how a combined car-train option can be made easier to judge before the traveller commits.

The project connects this NS ambition with the traveller problem defined in Sections 1.1 and 1.2. Its focus is on helping travellers judge P+R for the trip they are planning, including situations in which another travel option may fit that trip better.

1.5 Project team and stakeholder involvement

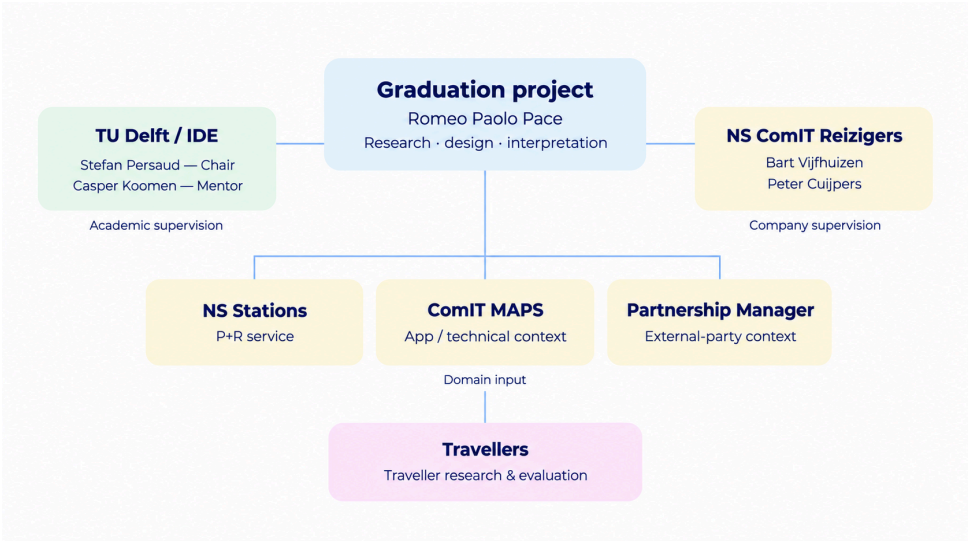


Figure 1.3. Project structure and stakeholder roles

The graduation project was carried out within NS ComIT Reizigers and supervised by TU Delft. Within NS, ComIT Reizigers provided the organisational setting for the project. Bart Vijfhuizen and Peter Cuijpers acted as company mentors and provided feedback on the direction of the research and its relation to the NS app and traveller experience.

At TU Delft, the project was supervised within the Faculty of Industrial Design Engineering. Stefan Persaud acted as chair and Casper Koomen as mentor. Their role was to guide the academic development of the project and challenge the reasoning behind methodological and design decisions.

As a graduate student, I am the executing party responsible for the research, the design process and the final outcome. My connection to NS began during an earlier master's course project for NS. That experience sparked a genuine curiosity about how an organisation of this scale operates from the inside, and how design can contribute to it in a meaningful way. What makes this project particularly valuable to me is its tangibility: NS is an organisation that virtually everyone in the Netherlands knows and has an opinion about. The work connects directly to the daily lives of real people, and that sense of relevance is what drives me as a designer.

Several other groups contributed knowledge to the project. NS Stations, which holds product responsibility for P+R within this project context, provided knowledge of the current service and its operational conditions. NS ComIT MAPS contributed technical knowledge about P+R within the NS app, while the Partnership Manager within ComIT provided information on the relationship between NS and external parties involved in the service. Travellers were the main user group studied in the project. Their experiences and decisions form the empirical basis for the traveller perspective developed in Chapters 5 and 10.

1.6 Source use and confidentiality

This thesis uses public literature, internal NS documents and evidence collected through stakeholder and traveller research. Public sources are cited in the reference list using the standard academic format applied throughout the thesis. Non-public NS documents are identified by the codes D1–D16 so that they can be referenced without disclosing confidential titles or document details.

Internal NS documents are cited in the text by document code and year. They are listed in a separate confidential source register, which records the original document title, date and source type. The register is kept outside the public version of the thesis and is available for academic review under the applicable confidentiality conditions.
Evidence from stakeholder interviews and traveller research is anonymised. Stakeholders are identified by participant codes such as S1–S5, and traveller participants are referred to by anonymised codes when individual evidence is reported. Chapter 3 describes how these sources were collected and analysed and explains how they were used in the research.

With the project scope and research questions defined, Chapter 2 turns to the current P+R service within NS. It examines how P+R is organised, how it appears within the NS app, and which organisational conditions shape the design context.

2. Context and background

This chapter describes the organisational and service context of P+R within NS. It introduces NS and its role in the door-to-door journey, explains how P+R is organised, describes its current support in the NS app, and places the service within the wider Dutch P+R context.

2.1 NS as an organisation

NS is a Dutch public limited company whose sole shareholder is the Dutch State. Its revenue comes mainly from transport and station-related activities, alongside government contributions linked to the rail concession and other arrangements. Around 21,000 people work for NS, spread across several divisions. These include **NS Operatie**, which runs the trains, **NS Stations**, which manages around 400 stations and their surroundings, and **Commercie & Netwerk**, which handles scheduling, marketing and customer service (Nederlandse Spoorwegen, 2026).

Since January 2025, NS operates under a new concession for the main rail network, running until 2033, with clear targets on punctuality and seat availability (Ministerie van Infrastructuur en Waterstaat, 2023; Nederlandse Spoorwegen, 2024).

NS and the wider journey

The concession defines the core requirements for the rail service, while NS's own strategy also addresses the wider journey around the train. Its three guiding principles are ‘Betrouwbaar’ (reliable), ‘Betaalbaar’ (affordable) and ‘Betrokken’ (committed) (Nederlandse Spoorwegen, 2026). The strategy places the train at the centre of NS's role, while also referring explicitly to stations, connections with other public transport modes, bicycle parking and car parking. P+R therefore sits within a broader door-to-door context in which access to the station forms part of the journey.

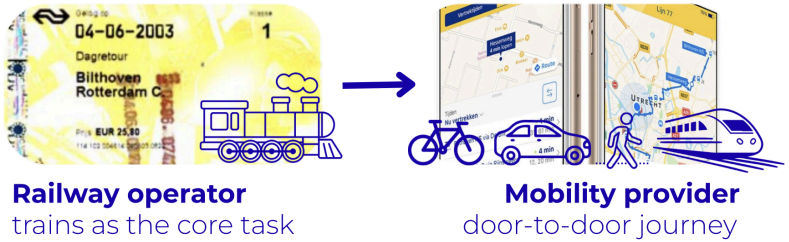


Figure 2.1. P+R is at the interface between NS's rail service and the wider door-to-door journey.

P+R is one of the station services through which this wider journey becomes concrete. NS explicitly includes car parking among the facilities it intends to maintain at stations and describes good connections between transport modes as part of its strategy (Nederlandse Spoorwegen, 2026). For this project, P+R is therefore relevant as the point where a car journey connects with the rail journey and with NS's traveller-facing services.

For NS, P+R is primarily situated within NS Stations, while its digital integration also involves ComIT, where commercial and IT teams work on traveller-facing digital services including the NS app (personal communication, April 2026).

P+R's financial contribution cannot be isolated from NS's published figures. Of NS's €3,920 million in revenue in 2025, €556 million was

related to station development and operations, while most of the remaining revenue was related to rail transport. P+R revenue is not reported separately (Nederlandse Spoorwegen, 2026). The published financial figures therefore do not allow the financial contribution of P+R to be assessed separately. Its relevance to this project is established through its place in NS's station and door-to-door strategy, not through a separate revenue measure.

P+R across organisational boundaries
P+R crosses several parts of the service system around the train. Rail operations, station management, digital information and parking do not all sit within the same operational domain. The P+R journey can therefore involve NS Stations, traveller-facing digital services and external parking partners. At regulated P+R locations, this division can be seen in practice. NS provides the rail journey and traveller-facing information, while parking operations can involve external partners such as Q-Park. Licence-plate recognition is used at 53 P+R locations to support entry, exit and payment (Q-Park, n.d.).

The NS app brings several parts of the journey into one digital channel, including journey planning, disruption information, crowding information and P+R information. P+R is one element within a digital service that supports several stages of the rail journey.

P+R sits at the interface between rail operations, station management, digital services and parking operations. This organisational context matters because the traveller moves through these elements as part of one multimodal journey, even though the service is delivered through several operational domains. Section 2.2 examines how the current P+R service is organised within this context.

2.2 P+R within NS

Why P+R exists
Park and Ride connects car access with public transport by allowing travellers to park near a station and continue the journey by train. Its effects depend strongly on location and on how the facility is used. Research in the Netherlands shows that P+R does not always replace a full car journey: some users would otherwise have reached the station by bicycle, on foot or by public transport (Mingardo, 2013; Zijlstra et al., 2015). P+R should be understood as one form of multimodal access whose effect depends on the travel context.

Within NS, P+R is also viewed as a way to extend a station's catchment area and reach travellers who might otherwise not consider the train, without expanding the rail network itself (Internal company document D1, 2023).

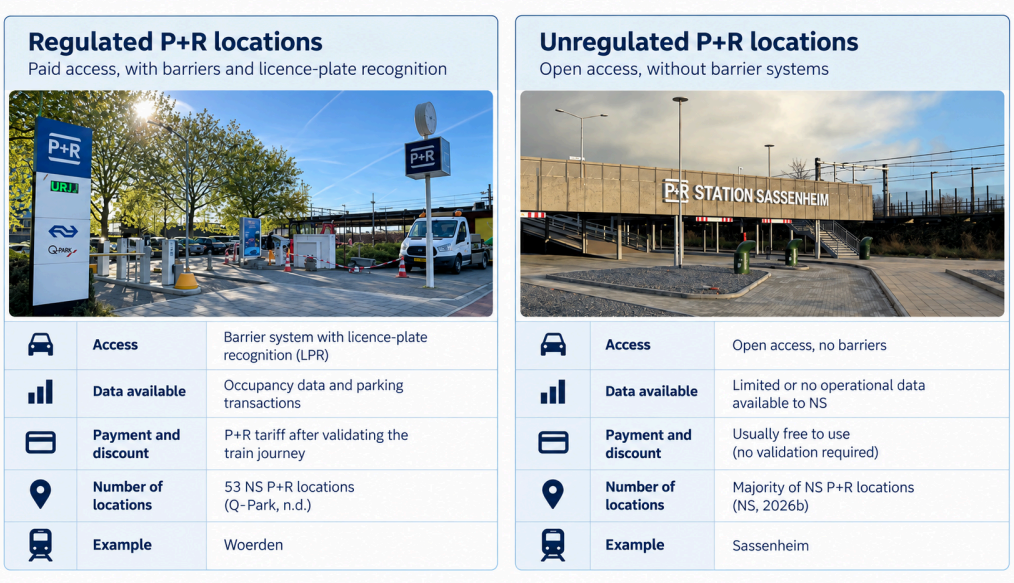
How P+R works
P+R is a parking area or garage at the edge of a city, or close to a station. NS lists more than 270 P+R locations across the Netherlands (Nederlandse Spoorwegen, n.d.). Most are unregulated parking locations. Q-Park reports that 53 NS P+R locations use licence-plate recognition, giving these regulated locations a different operational setup from the rest of the network (Q-Park, n.d.).
At regulated locations, travellers can receive the P+R tariff by validating their train journey at the payment terminal. The licence

plate is registered when the vehicle enters and is used again when the traveller leaves the facility(Nederlandse Spoorwegen, n.d.; Q-Park, n.d.).

P+R can also play different roles within a journey. Origin P+R is used near the start of the trip, allowing the traveller to reach a station by car and continue by train. Destination P+R is used closer to the final destination, allowing the traveller to leave the car before entering the destination area.

A separate difference concerns how the parking location is operated. Regulated locations use barriers and licence-plate recognition, which provide occupancy and transaction data. Unregulated locations do not have the same technical setup, so NS has less direct information about their use.

Figure 2.2. Operational differences between regulated and unregulated NS P+R locations.



Internal NS research reports that destination-oriented P+R is used more frequently than P+R near the traveller's origin within the cases studied (Internal company document D15, 2024). Other internal NS research identifies the cost and difficulty of parking at the final destination as important motives for destination-oriented P+R use (Internal company document D2, 2026).

The function of P+R also differs by station context. NS distinguishes five station classes, ranging from small stations to major hubs (Stations.nl, n.d.). Internal strategy material describes P+R at smaller stations mainly as a way to extend station access, while at larger urban stations it can provide an alternative to driving into the destination area (Internal company document D3, 2025).

What the data does and doesn't show

Nationwide, around 6 percent of train travellers arrive at the station by car, and NS Stations counts roughly 52,000 parking spaces at or near stations, of which 265 offer free P+R and 3 offer a discounted rate for travellers who continue by train (Q-Park, n.d.). The available operational data describes use of the service more clearly than the decision that precedes it. At regulated locations, occupancy and parking transactions can be observed. The public sources used in this thesis do not provide a network-wide measure of how many travellers considered P+R and then chose to drive the full journey instead.

NS does not report P+R revenue as a separate item in its annual financial reporting (Nederlandse Spoorwegen, 2026). Public operational sources do describe the regulated system, including licence-plate recognition and payment processes involving NS and

its parking partners (P1, n.d.; SKIDATA, n.d.). These sources do not provide a separate financial breakdown for P+R.

P+R facilities also exist outside the NS offer. Municipalities and other operators use their own tariffs, access rules and digital services. Section 2.4 examines these differences within the wider Dutch P+R context.

Section conclusion
The difference between regulated and unregulated P+R locations determines which operational data NS has available and which information can be provided digitally. At the same time, origin and destination P+R show that the same parking service can play different roles within a multimodal journey. Section 2.3 examines how this service appears in the NS app.

2.3 The current digital support for P+R

P+R in the NS app
The NS app supports several parts of a train journey. Travellers can use it to plan a trip, buy and store tickets and check current departure information. P+R information is also available in the app, including parking locations and information about individual sites. At locations with live occupancy data, the app can also show current parking availability (Nederlandse Spoorwegen, n.d.).

What information the app can provide
The amount of P+R information available in the app depends partly on the parking location itself. As described in Section 2.2, regulated locations use technical systems that can provide occupancy and transaction data. Unregulated locations do not provide the same data. Live parking availability can therefore be shown only where the underlying parking system supplies this information (Internal company document D5, 2023).

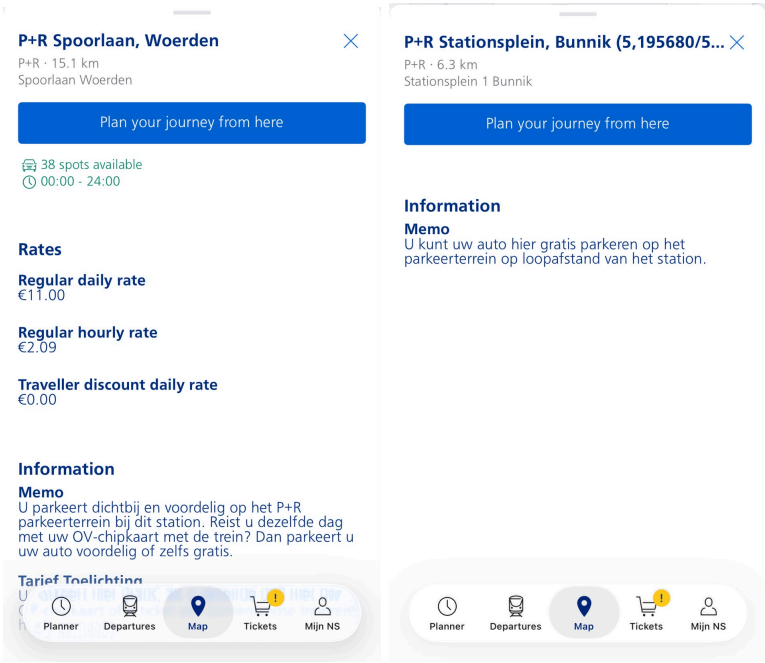


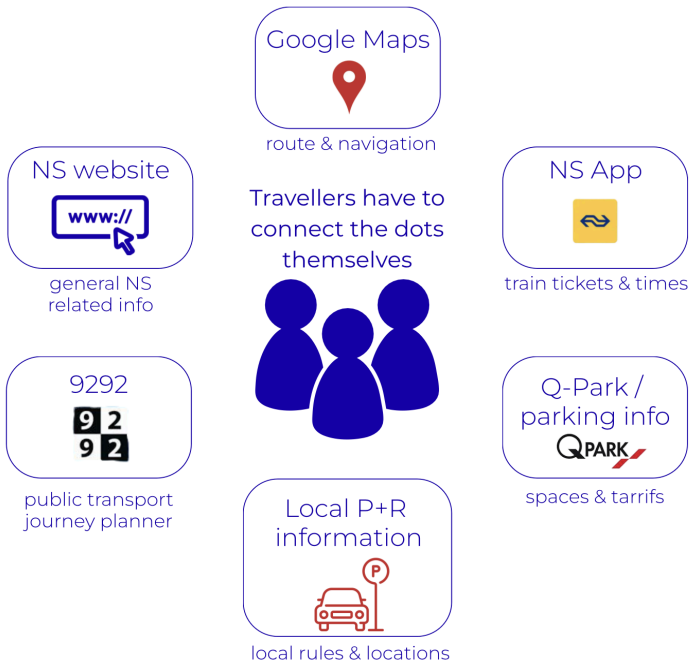
Figure 2.3. Regulated versus unregulated P+R in NS app. Screenshots captured by the author, 10 July 2026.

This difference means that P+R is not represented in the same way at every station. For some locations, travellers can see current parking availability. At other locations, the app can provide location and parking information without live occupancy data. The digital information available to the traveller therefore depends partly on how the physical P+R location is operated.

The NS app within the wider journey

The NS app covers the rail journey and provides information about P+R, but a combined car-train journey can also involve digital services outside NS. Road navigation, parking services and public transport planning are available through other applications. These services support different parts of the same journey. Section 2.4 describes this wider service context in more detail.

Figure 2.4. Travellers have to connect the dots themselves



2.4 The wider multimodal context

Multimodal travel and integration

Chapter 1 introduced multimodal travel as a journey that combines several transport modes and showed why the transitions between them can affect the traveller's assessment of the complete trip. P+R is one form of this journey: the traveller drives to a parking location, transfers to public transport and continues towards the destination. In Dutch mobility policy, this connection between successive journey stages is commonly described as *ketenmobiliteit*, or chain mobility (Hamersma & de Haas, 2020). Within NS, the related door-to-door ambition concerns the support of the complete journey around the train, including services such as shared mobility and P+R (Nederlandse Spoorwegen, 2024).

Levels of integration

The degree to which these journey stages are integrated can be described using the Mobility as a Service (MaaS) framework of Sochor et al. (2018). Their framework distinguishes five levels, from separate transport services to systems in which planning, payment and policy objectives are integrated. Figure 2.5 shows these levels.

The framework is used here as a descriptive lens. P+R does not operate as one service with a single level of integration. Parking, public transport, journey planning and payment can be connected to different degrees and can be provided by different organisations. This helps explain why a journey that is physically simple can still depend on several service systems.



Figure 2.5. Five levels of MaaS integration, adapted from Sochor et al. (2018)

Other ways to plan and pay

NS is one of several digital services that can support parts of a multimodal journey. Navigation services such as Google Maps can support the road journey and route choice. The 9292 app combines journey information from Dutch public transport operators and provides public transport planning, real-time information and ticketing (9292, n.d.). Internal NS research also identifies 9292 as an alternative used for planning the public transport part of a journey (Internal company document D13, n.d.).

Parking is also supported through services outside NS. EasyPark allows drivers to manage and pay for parking sessions (EasyPark, n.d.). Yellowbrick provides similar parking-payment functions (Yellowbrick, 2025), while ANWB Parkeren uses Yellowbrick within the ANWB Onderweg app (ANWB, n.d.). These services support the parking stage of a journey, while the NS app concentrates on public transport and NS-related P+R information. A traveller can therefore encounter several digital services during one combined journey.

P+R beyond NS

P+R in the Netherlands is not organised through one national service model. Local authorities and transport organisations also operate P+R facilities, with different purposes and conditions. In Rotterdam, P+R Kralingse Zoom is located next to a metro station and offers discounted parking conditions when parking is combined with public transport or shared mobility (Gemeente Rotterdam, n.d.). Its connection is to the urban public transport network, while NS P+R locations are organised around access to train travel.

Woerden shows that different parking arrangements can also exist close to the same station. P+R Spoorlaan has a regular parking tariff and a traveller discount linked to train travel. P+R Houttuinen is a separate municipal parking facility with different conditions (Gemeente Woerden, n.d.; ParkeerService gemeente Woerden, n.d.). The physical proximity of these facilities does not mean that they operate under the same P+R arrangement.

Responsibility can also be shared across organisations. At P+R locations in Amersfoort, for example, parking information and operations involve ParkeerService Amersfoort alongside the station context (ParkeerService gemeente Amersfoort, n.d.). A P+R location

can therefore involve more than one organisation even when the traveller encounters it as a single place.

Amsterdam uses another model. Its P+R facilities are organised around the edge of the city and provide reduced parking rates when visitors continue towards the centre by public transport (Gemeente Amsterdam, n.d.). The municipality also provides real-time parking availability through its digital channels (Gemeente Amsterdam, n.d.). In this case, P+R is primarily part of an urban access and parking policy, while station-based P+R connects car access directly to rail travel.

These examples show that the term P+R covers several service arrangements. The basic sequence of driving, parking and continuing by public transport is similar, while the tariff, digital support and responsible organisation can be different by location. This variation forms part of the service context investigated in the following chapters.

Section conclusion

P+R is part of a multimodal journey that can involve several transport services, digital channels and organisational arrangements. Chapter 3 explains how the research was structured to study this context from both the organisational and traveller perspective.



Figure 2.6. Different P+R service models in the Netherlands

3. Design method

This chapter explains how the project moved from an initial organisational challenge to an evidence-based design direction. It describes the approach that guided the work, the phases through which the project progressed, and how different sources of evidence were brought together throughout the process.

3.1 Research approach

Research through Design

The project started with a broad question about how P+R could be better supported through the NS app. At the beginning, the main traveller problem and the direction of the design were still open. The project therefore followed a Research through Design approach. Research and design were used throughout the project to understand the problem and explore possible responses (Stappers & Giaccardi, 2017).

Human Centred Design

The work was also guided by human-centred design. Travellers were studied in the situations in which they encountered P+R, and their experiences were used to adjust the project's direction (International Organization for Standardization, 2019). This became important early in the research. The project initially assumed that travellers mainly lacked information about P+R. Fieldwork showed that information could be available while the journey was still difficult to judge. This finding changed the focus of the later analysis and design work.

Contextmapping

The exploratory research in the first diamond was informed by contextmapping principles. Contextmapping aims to understand how people experience a situation, including their needs, motivations and concerns (Sleeswijk Visser et al., 2005). In this project, these principles informed the way the traveller context was studied. The research itself consisted of stakeholder interviews, field intercepts, observations and existing NS research. A full context mapping process was not conducted.

3.2 Overview of the research journey

The project followed an adapted Double Diamond structure, shown in Figure 3.2 (Design Council, n.d.). The first diamond focuses on understanding the organisational and traveller context and defining the design challenge. Chapter 4 examines the organisational perspective, Chapter 5 studies the traveller experience, and Chapter 6 brings these findings together into the strategic opportunity.

The second diamond develops a response to this opportunity. Chapter 7 translates the research findings into design principles. Chapter 8 develops the desired future experience, Chapter 9 develops the concept, and Chapter 10 evaluates it.

This chapter describes the methods used in the first diamond because they were defined before the main findings emerged. Methods used later in the project are introduced in the chapters where they are applied, since these methods depend on the design direction established in Chapter 6.

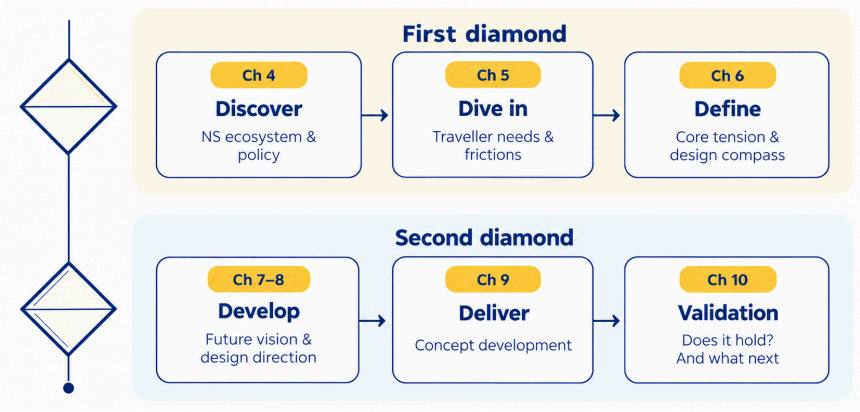


Figure 3.1. Project structure mapped onto an adapted Double Diamond.

3.3 First diamond: data sources and their role

The first diamond examined the project from two perspectives: the organisational context within NS and the experience of travellers using P+R. Three main sources were used: stakeholder interviews, field research and desk research. Each source had a different role in answering RQ1 and RQ2.

Stakeholder interviews

Stakeholder interviews were used mainly to understand the organisational context for RQ1. Five stakeholders from NS Stations and ComIT Reizigers took part in four semi-structured sessions. The semi-structured format provided a consistent set of topics while allowing follow-up questions when relevant (Kallio et al., 2016). The interviews covered the role of P+R within NS, current priorities, earlier work and expectations for its future development. The stakeholder scope remained within NS because the project focuses on what NS can influence through its P+R proposition and digital services. The wider roles of municipalities and parking operators are discussed in Section 2.4. The interview guide and session overview are provided in Appendix A.1 and A.2.

Field research

Field research was used mainly to study the traveller perspective for RQ2. Short intercept interviews and observations were conducted at P+R locations in Rotterdam, Woerden and Amersfoort. The sessions covered different parts of the day, including travellers beyond the morning and evening commuter peaks. Figure 3.3 shows the three fieldwork locations and the structure of the sessions across the day.

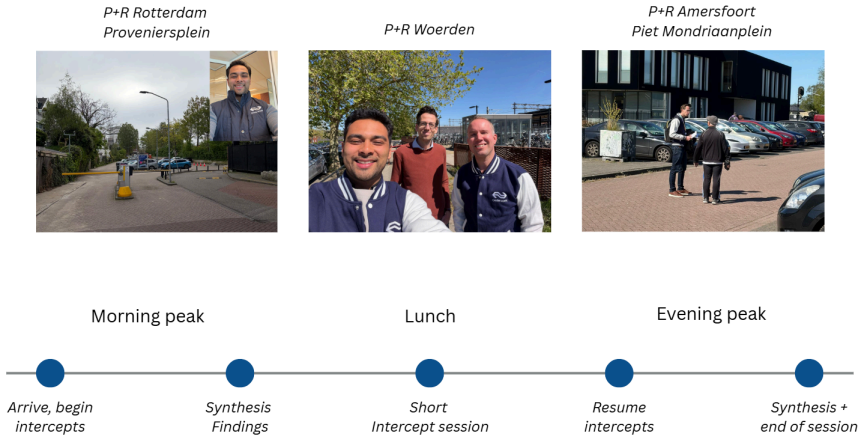


Figure 3.2. Fieldwork structure across three P+R locations.

A sampling frame with six traveller categories was prepared before the fieldwork. It was used to seek variation in P+R familiarity, travel behaviour and frequency of use rather than to produce a statistically

representative sample. The final sample is therefore weighted towards people who were already present at a P+R location, which limits what the fieldwork can say about travellers who never consider P+R. The interview structure is provided in Appendix B.3 and the sampling frame in Appendix B.4.

Outside Rotterdam, the fieldwork was generally conducted with at least two researchers present. One researcher led the conversation while another recorded answers and observations. The Rotterdam session was conducted by one researcher, so the observations from that session rely on a single observer. This limitation is considered further in Section 3.5.

Desk research

Desk research was used differently for RQ1 and RQ2. Twelve internal NS studies and reports relevant to P+R were reviewed during the project. In addition, four strategic documents were analysed separately for RQ1 and later compared with the stakeholder interviews. For RQ2, existing NS research on P+R use and traveller behaviour was used after the initial fieldwork analysis to compare the fieldwork findings with earlier research. Relevant external studies were used for the same purpose. Confidential internal sources are cited throughout the report using the D-codes introduced in Section 1.6.

Table 3.1 summarises the role of each source. RQ1 draws mainly on stakeholder interviews and strategic documents, while RQ2 draws mainly on field interviews and observations, supported by existing research. RQ3 brings the findings from both research questions together to define the strategic opportunity. The way these sources were analysed and combined is explained in Section 3.4.

Source	RQ1: Organisational context	RQ2: traveller experience
Stakeholder interviews	Primary	Supporting
Field intercepts and observations	Supporting	Primary
Desk research	Primary and supporting	Supporting

Table 3.1. Data sources and the research questions they inform.

3.4 Analysis and synthesis approach

The material was not analysed in the same way for every research question. RQ1 focused on the organisational context, while RQ2 focused on the traveller experience. The analysis therefore followed different steps for each question before the findings were brought together in RQ3.

Analysis for RQ1

For RQ1, stakeholder interviews and strategic documents were analysed separately. Interview transcripts and notes were coded without a predefined coding scheme, using short labels to capture relevant observations (Saldaña, 2021). The strategic documents were treated as qualitative source material and coded for recurring

themes (Bowen, 2009). The two sets of material were clustered independently before they were compared. This reduced the risk that patterns found in one source would shape the analysis of the other too early.

The comparison focused on where stakeholder perspectives and strategic documents supported each other, differed, or addressed different parts of the same issue. This process led to the organisational findings presented in Chapter 4. The detailed analysis process is documented in Appendix A.3.

Analysis for RQ2

For RQ2, interview material and observations were first organised across the P+R journey. Related observations were then grouped through affinity clustering (Sanders & Stappers, 2012; Tassoul & Buijs, 2007). The clusters were compared and interpreted to identify recurring patterns in how travellers planned, experienced and assessed the journey.

This thematic interpretation drew on reflexive thematic analysis (Braun & Clarke, 2021). The analysis was primarily data-led. Existing NS research and relevant external studies were used alongside the fieldwork to compare the emerging interpretation with earlier findings. Theory was introduced after the main empirical patterns had been identified and was used in later chapters to interpret these findings more precisely.

The analysis moved from raw material to clusters, relationships between clusters and, finally, the four dominant themes used in Chapter 5. Appendix B.10–B.14 documents these steps in more detail.

Comparing evidence across sources

Evidence from different sources was compared throughout the analysis. Where sources addressed the same issue, they were compared for agreement and difference, following a triangulation logic (Carter et al., 2014). Agreement between interviews, observations and existing research increased confidence that a pattern was not limited to one dataset or location. A finding was not excluded simply because it appeared in only one source. Findings with a narrower evidence base were retained when relevant, but were interpreted more cautiously.

The sources also served different purposes. A strategic document can show an organisational ambition that travellers would not be expected to mention, while a field observation can reveal an experience that does not appear in strategy material. Source comparison was therefore used to understand the strength and scope of a finding, not as a simple measure of how many sources repeated it.

From RQ1 and RQ2 to RQ3

RQ3 did not introduce a new primary dataset. It brought together the organisational findings from RQ1 and the traveller findings from RQ2. Chapter 6 compares these perspectives and narrows them into a design focus by examining which traveller problem, journey phase and design opportunity are most relevant to the scope of the project. The development from traveller patterns to design profiles and the selection of the primary design lens are documented further in Appendix C.

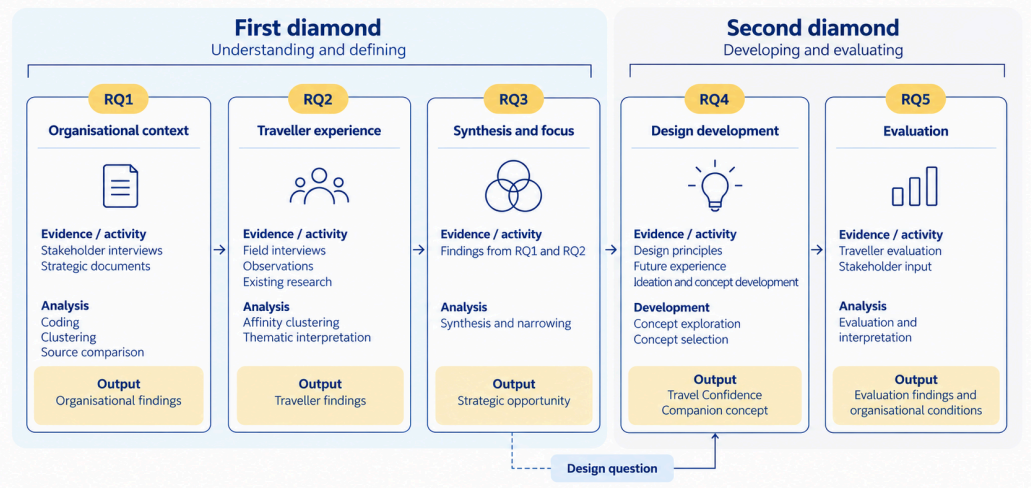
Design development and evaluation

RQ4 and RQ5 are addressed in the second diamond. Because their methods depended on the design direction established in Chapter 6, they are described in detail in the chapters where they are applied.

RQ4 is addressed through the design process in Chapters 7 to 9, from design principles and future-experience development to concept exploration and selection. The supporting design work is documented in Appendix D.

RQ5 is addressed through concept evaluation in Chapter 10. This combines thirteen participants in semi-structured online sessions, sixteen short field sessions at Utrecht Centraal and separate stakeholder input on the organisational conditions for the concept. Traveller material is documented in Appendix E and stakeholder material in Appendix F.

Figure 3.3. Research questions, evidence and outputs during the project.



3.5 Research quality and ethical considerations

Research quality

The analysis was kept traceable by documenting the main coding, clustering and synthesis steps in the appendices. Evidence from different sources was compared as described in Section 3.4. Findings with a narrower evidence base were not removed, but were interpreted with more caution. Where AI tools supported transcript processing, coding or clustering, their output was reviewed and adjusted manually before it was used in the analysis.

Participant consent and anonymity

Participants were informed about the purpose of the research before taking part, and participation was voluntary. Verbal consent was obtained before each conversation. Audio was recorded only when participants gave separate permission. Stakeholder and traveller material is reported anonymously. Stakeholders are identified as S1–S5, while traveller participants are referred to by anonymised participant codes when individual examples are used.

The research was approved through the TU Delft HREC procedure, with the consent procedure and data handling documented in the accompanying Data Management Plan.

Confidential sources

Non-public NS research and strategy documents were treated as confidential. As explained in Section 1.6, these sources are identified by D-codes instead of their original titles. This allows the documents to remain traceable within the research without disclosing confidential information in the public thesis.

Study limitations

The fieldwork used purposive sampling and was intended to explore different traveller experiences, not to produce a statistically representative sample. Because participants were recruited at P+R locations, the fieldwork provides less direct evidence about travellers who never consider P+R. Most field sessions involved more than one researcher, while the Rotterdam session was conducted by one researcher and therefore relied on a single set of observations. Some sessions were documented through notes instead of recordings, which reduced the level of detail available during later analysis.

The organisational research focused mainly on stakeholders within NS because the project concerns what NS can influence through its service and digital channels. As a result, the perspectives of municipalities, parking operators and other external parties were not studied to the same depth. This limitation is taken into account when interpreting the findings and is discussed further in the final limitations section.

4. Discover: Ecosystem and Strategy (RQ1)

This chapter focuses on understanding the strategic context surrounding P+R within NS. Before identifying opportunities for improvement, it is important to understand how P+R fits within NS's broader ambitions for chain mobility and the intended role of the NS app within this ecosystem.

To explore this, the following research question is addressed:

> **RQ1.** *How is NS's strategic ambition for chain mobility reflected in the current P+R offering and its integration in the NS app?*

This chapter draws on stakeholder interviews and a review of strategic documents to identify organisational priorities, strategic ambitions, and assumptions relevant to the future development of P+R within the NS app.

4.1 Aim and Approach

To answer RQ1, two complementary research methods were used: semi-structured stakeholder interviews and a strategic document review. The interviews provided insight into stakeholder perspectives, organisational priorities, and project-related considerations, while the document review offered a broader understanding of NS's strategic ambitions and the intended role of P+R within the mobility ecosystem. Using both sources made it possible to compare current stakeholder perspectives with the strategic direction described in internal NS documents.

Semi-structured stakeholder interviews

Three experts from NS Stations and two from ComIT Reizigers were interviewed across four semi-structured sessions at the start of the project. These groups were selected because NS Stations covered the P+R service and its operational context, while ComIT Reizigers covered its digital integration and traveller-facing role in the NS app. As the project was entering a new phase, the interviews focused on understanding individual roles, priorities, and areas of expertise, while identifying key opportunities and challenges relevant to the project (See Appendix A.1). The interviews were conducted together with a fellow researcher. One interviewer led the conversation while the other documented insights and observations.

Two stakeholder interview sessions (3 participants in total) were recorded with participants' consent and subsequently transcribed. The remaining interviews were documented through handwritten notes and written up afterwards. All interview data were analysed using open coding and thematic clustering to identify recurring themes, insights, and patterns.

The project was still in an early exploratory phase, and detailed knowledge about user needs, pain points and customer behaviour was not yet available within the project. The interviews therefore covered the wider project context, organisational priorities, perceived opportunities, existing knowledge and stakeholder expectations. This provided the organisational context for the research that followed.

Source Type	Description
Stakeholder interviews	Five stakeholders from NS Stations and NS ComIT Reizigers were interviewed across four semi-structured sessions to gather perspectives on project goals, organisational priorities, and the strategic role of P+R.
Strategic documents	Four internal strategy, vision, and programme documents related to chain mobility, digital strategy, traveller experience, and P+R were reviewed to understand the broader organisational context and ambitions.

Table 4.1. Ecosystem and strategy sources

Document review

Alongside the stakeholder interviews, four internal NS documents (D1–D4) were reviewed to examine the strategic direction around chain mobility, digital services, traveller experience and P+R. The documents provided a second source of evidence for RQ1 and made it possible to compare stakeholder perspectives with broader organisational ambitions.

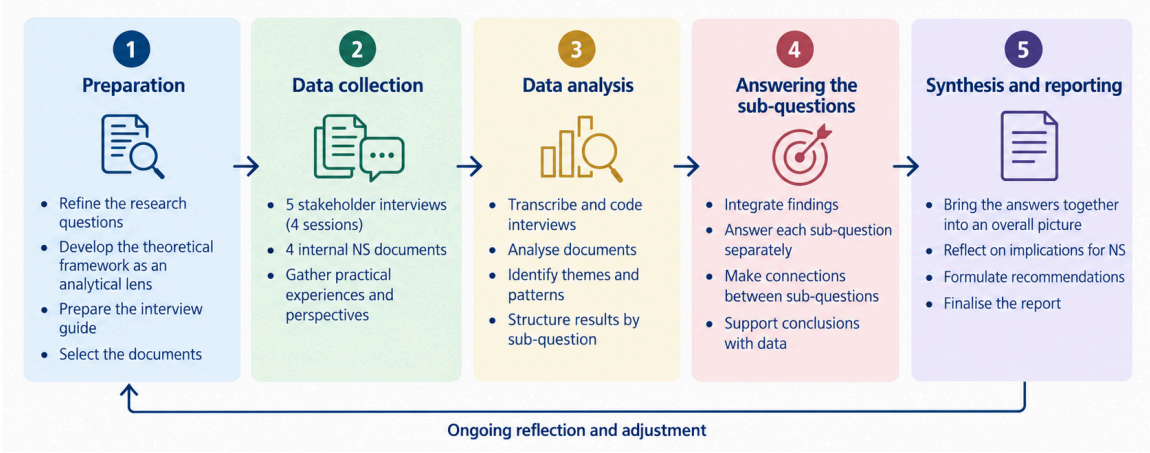
4.2 Synthesis of strategic Insights

Following data collection, the stakeholder interviews and strategic documents were analysed separately before the findings were compared. Interview and document data were coded and clustered independently (see Appendix A.3).

Interview transcripts and notes were open-coded for observations relevant to RQ1. Document excerpts were coded separately for recurring strategic concepts. The two datasets remained separate during coding and clustering so that patterns in one source did not guide the analysis of the other. They were compared only after this step and then grouped into broader themes concerning organisational ambitions, strategic priorities, assumptions and the role of P+R within the wider mobility ecosystem.

The resulting themes were then compared across both sources. This showed where stakeholder accounts matched the strategic documents and where the two sources described different priorities or levels of development.

Figure 4.1. Analysis process for RQ1



4.3 Findings

Comparing the strategic documents with the stakeholder interviews showed both areas of agreement and areas where the two sources placed different emphasis. Table 4.2 summarises these findings. For each theme, it compares the direction described in the strategic documents with the stakeholder accounts and shows the source coverage. The five findings are discussed in more detail below.

A note on the interview material below: quotations from recorded stakeholder sessions were translated into English by the researcher and kept close to the original wording. Material from sessions without a transcript is presented as a paraphrase based on interview notes. Appendix A.2 shows which sessions were recorded.

Summary

Theme	Strategic view	Stakeholder view	Relationship	Evidence
Findability	Increase visibility	Travellers struggle to understand P+R	Partial: visibility may not solve the understanding problem	3/4 docs · 3/4 sessions
App integration	Integrate P+R into the NS app	Experience and technical details still being shaped	Partial: direction agreed, experience undefined	4/4 docs · 2/4 sessions
Capacity management	Explore capacity solutions	Current usage not well understood	Low: ambition ahead of evidence	3/4 docs (self-flagged) · 3/4 sessions
Collaboration / chain integration	Strengthen chain mobility collaboration	Learning through ongoing implementation	High: ambition matched by practice	4/4 docs · 2/4 sessions
Personalised guidance	Offer context-aware traveller support	Barely reflected in interviews	Low: limited evidence across sources	1/4 docs (concentrated) · 1/4 sessions

Low / Partial / high alignment between strategic ambition and current practice

Table 4.2. Summary of findings for RQ1

1) Improving visibility alone does not resolve how travellers understand P+R

> *"Park & Ride is difficult to find and needs a stronger online presence."*
> **Stakeholder S1**

> *The combined discount is not yet always clear to users, and the difference between a municipal Park & Ride and NS's own parking-and-travel offer is unclear.*
> **Stakeholder S4**

Interpretation. The sources point to two related issues. The strategic documents mainly focus on making P+R more visible, while stakeholder accounts also describe uncertainty about the offer itself. Making P+R information easier to find can improve access to that information. Travellers may still need to understand the parking conditions, the available offers and how P+R applies to their journey.

Design relevance. Visibility should therefore not be treated as a sufficient design outcome. The next research stage should examine what travellers need to understand before they can judge P+R as a travel option.

Evidence base. *3/4 documents, 3/4 interview sessions.*

2) App integration has a clear direction, but the intended traveller experience remains open

> *"Technical aspects of implementation are still early in the collaboration. No hard constraints have been established yet, but technical elaboration and the maturity of the collaboration are points of focus."*
> **Stakeholder S3**

> *" It is important for the data of parking spots availability to be accurate, otherwise traveller trust could decline."*
> **Stakeholder S1**

Interpretation. The strategic direction towards app integration is clear across the documents, while the intended traveller experience is still being worked out. The stakeholder accounts show that technical and organisational details are also still under development. This means that the open question is what role the NS app should play for travellers using P+R, and what support it should provide across the journey.

Design relevance. The next design step should therefore focus on the traveller role of the app, not on defining the technical integration itself. This requires understanding where travellers need support and what information or guidance is useful at those moments.

Evidence base. *4/4 documents, 2/4 interview sessions.*

3) Future development requires a better understanding of current P+R use

> *"Reservations are interesting, but demand and value to explore."*
> **Stakeholder S2**

> *"Usage figures exist, but they are difficult to interpret at the moment."*
> **Stakeholder S2**

Interpretation. The stakeholder accounts show that possible future features, such as reservations, are already being discussed while questions remain about current P+R use and the value of such features for travellers. Chapter 2 showed that NS already has considerable operational knowledge about the P+R network. What is less clear is how that use should be interpreted and what it means for traveller decisions. A better understanding of these patterns would provide a stronger basis for deciding which future features are useful and in which situations.

Design relevance. Future feature decisions should be informed by a clearer understanding of current P+R use and the differences between locations and traveller situations. This is especially relevant for features such as reservations, where the value may depend on when and why travellers need more certainty.

***Evidence base**. 3/4 documents, 3/4 interview sessions.*

4) Chain integration is being developed through collaboration between NS Stations and NS ComIT

> *"The greatest opportunity lies in collaboration of ComIT and NS Stations; There is also an opportunity to bring active users into the digital channel through app integration and parking transactions."*
> **Stakeholder S3**

> *Parallel discovery and implementation of the P+R service; Lessons from discovery must feed back into implementation.*
> **Stakeholder S4**

Interpretation. The stakeholder accounts show that collaboration between NS Stations and ComIT is part of how P+R is being developed. They also describe discovery and implementation as parallel activities, with lessons from discovery feeding back into implementation. In these accounts, parts of the service are therefore still being worked out while implementation continues. The strategic documents describe collaboration as part of the intended direction for chain mobility, while the interviews show how this is taking shape in the current P+R work. The data does not establish how or when this way of working was introduced.

Design relevance. For this project, the design work should remain connected to the teams involved in developing P+R. Findings from traveller research can then be considered while the service and its digital integration are still being worked out.

Evidence base. *4/4 documents, 2/4 interview sessions (S3, S4).*

5) Personalised guidance is visible in strategy, with limited support in the interview data

> *Travel advice incorporating P+R, reservations, and clear explanation of rules and touchpoints.*
>
> **Stakeholder S4**

Personalised guidance also came up in informal project discussions. These conversations were outside the formal dataset and are therefore not used as evidence for this finding.

Interpretation. Personalised guidance is present in the strategic material, but the evidence is concentrated in one document and one interview session. The data therefore supports its presence as a strategic idea, but does not show how broadly it is shared within NS. The current evidence is also too limited to treat personalised guidance as an established organisational requirement for P+R.

Design relevance. Personalised guidance can therefore be explored as a design direction, but it should first be tested against traveller needs. The traveller research in Chapter 5 provides the next source of evidence for judging where guidance is useful and what form it should take.

Evidence base. *1/4 documents (concentrated, 18 of 20 codes from one document), 1/4 interview sessions.*

4.4 Answering RQ1

RQ1 asks how NS's strategic ambition for chain mobility is reflected in the current P+R offering and its integration in the NS app.

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NS's ambition for chain mobility is reflected most clearly in the move to integrate P+R more closely into the NS app and the wider door-to-door journey. Throughout the reviewed documents and stakeholder interviews, P+R is treated as part of a combined car-train journey. The direction towards closer integration is therefore relatively clear.

The traveller-facing role of this integration is less settled. The strategic material gives attention to visibility and app integration, while the stakeholder interviews also raise questions about how travellers understand the P+R offer and what support they need when using it. The findings also show that current P+R use is not always easy to interpret when deciding which future features would be useful. Personalised guidance appears as one possible direction, but the evidence in this study is too limited to treat it as an established organisational requirement.

The development of P+R also involves NS Stations and ComIT. Stakeholders describe discovery and implementation as parallel activities, with findings from discovery feeding into ongoing development. The traveller experience is therefore still being worked out while the service and its digital integration continue to develop.

In answer to RQ1, NS's chain-mobility ambition is already visible in the direction of P+R and its closer integration with the NS app. The specific support that travellers need from this integration is still open. Chapter 5 examines this question from the traveller perspective.

5. Dive In: Traveller Needs and Frictions (RQ2)

Now that the organisational perspective has been discussed in Chapter 4, this chapter turns to the perspective of the traveller. While the strategic review revealed a broadly shared ambition for the future role of P+R in chain mobility, it left an important question unanswered:*how do travellers actually experience and evaluate P+R as part of their journey?*

To make this tangible, the research moved into the field. Observations and intercept interviews were conducted across three P+R locations and complemented by existing internal and external studies. The study explored travellers with different levels of P+R familiarity and use, including frequent users, occasional users and travellers for whom P+R was still an unfamiliar option.

The analysis examined how problems at individual touchpoints develop over the full P+R journey. It found recurring moments in which travellers had to search for information, interpret it, or check if they had understood it correctly. These difficulties also varied between travellers, especially depending on how familiar they were with P+R.

This chapter follows that process. It starts by reconstructing the P+R journey, identifying where gains and frictions occur and how familiarity with the system shapes each phase. It then shows how these field insights and existing research were synthesised into broader clusters and dominant themes. The chapter concludes by weighing those themes and establishing the traveller-side foundation for the strategic opportunity developed in Chapter 6.

5.1 How the traveller perspective was studied

Research setting

To answer RQ2, field research was conducted at three P+R locations: Rotterdam Proveniersplein, Woerden and Amersfoort Piet Mondriaanplein. The locations were chosen to cover different P+R and station contexts, not to obtain a statistically representative sample of the Dutch P+R network. Rotterdam represents a large urban station, Woerden a smaller regional context, and Amersfoort a large station in a medium-sized city. The full station classification and location characteristics are provided in Appendix B.2.

Location	Station type	Capacity	Tariff with train journey
Rotterdam Proveniersplein	Large station, city centre	102 spaces	€9.00
Woerden	Station near a small town	172 spaces	Free
Amersfoort Piet Mondriaanplein	Large station, medium-sized city	491 spaces	€7.00

Table 5.1. Fieldwork locations and context.

Data collection and sampling

The fieldwork combined short intercept interviews with observations on site. The interviews focused on why travellers used P+R, how they planned their journey, which information they relied on, and where they experienced advantages, uncertainty or friction. Observations were used to record behaviour around entering and

leaving the facility, wayfinding, and interaction with parking and payment infrastructure. The full interview structure is included in Appendix B.3.

In total, **37 field cases were included in the analysis**: 13 in Rotterdam, 20 in Woerden and 4 in Amersfoort. A further 18 conversations involved people who used the parking location but did not continue their journey by train. These were excluded from the P+R journey analysis because they did not experience the combined car–P+R–train journey studied in this chapter. Their presence was still noted as contextual information about how the parking locations were used (Appendix B.5).

Fieldwork used a purposive sampling frame with six traveller categories to seek variation in familiarity, travel behaviour and P+R use (Appendix B.4). The categories guided recruitment. The final sample therefore includes frequent, occasional and less familiar P+R users, but is naturally weighted towards people who were already present at a P+R location. The fieldwork can therefore say less about travellers who never consider P+R in the first place.

Outside Rotterdam, field sessions were generally conducted with at least two researchers present. One researcher led the conversation while another recorded answers and observations. The Rotterdam session was conducted by one researcher, which means that these notes rely on a single observer.

Triangulation and analysis

The fieldwork was considered alongside existing NS research and relevant external studies on P+R use, parking behaviour, digital travel support and travel choice. These sources were used to check whether patterns found in the field also appeared in earlier research, or whether earlier findings suggested a different interpretation.

Interview material and observations were first mapped across the P+R journey and grouped through affinity clustering, following the reflexive thematic analysis approach described in Chapter 3. Connections between these clusters were then examined alongside the supporting research to identify recurring patterns across sources. This process led to the four dominant themes presented in Section 5.3. The detailed journey reconstruction, analysis boards and development from clusters to themes are included in Appendix B.6–B.14.

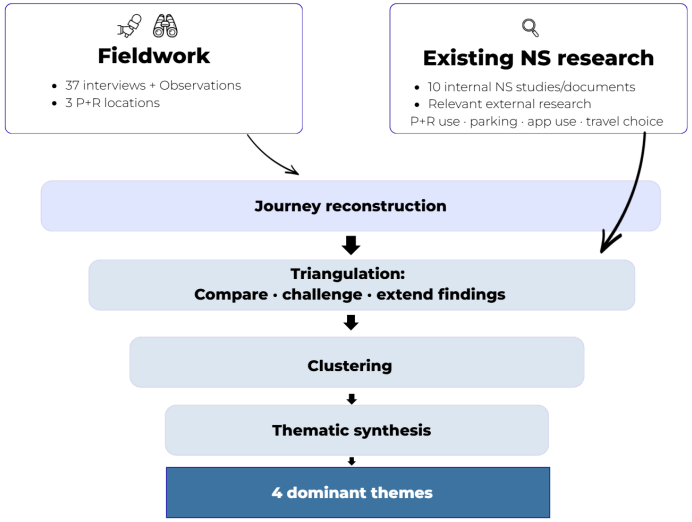


Figure 5.1. Analysis synthesis

5.2 Frictions in the P+R journey

The interview material and observations were first mapped across the full P+R journey, from considering P+R before departure to leaving the parking facility after the return journey. The detailed reconstruction distinguishes the main stages and transition points and is documented in Appendix B.6–B.9. For the main report, these observations were then grouped into broader journey patterns. Figure 5.2 shows where similar forms of friction recur, rather than reproducing every individual touchpoint. It indicates where travellers had more to work out and where they were less certain that the journey would proceed as expected. The figure is a qualitative synthesis, not a measured scale of effort or uncertainty.



Figure 5.2. Effort and uncertainty across the P+R journey

P+R is judged as part of the full journey

Travellers discussed P+R in relation to the full journey. They considered what the combined journey would mean for reaching their destination. Congestion, parking at the destination, travel time, cost and the benefits of continuing by train all influenced this judgement. One traveller chose Woerden to avoid congestion towards Utrecht (W-R07), while another used P+R because her home town, Oudewater, has no railway station (W-J08). One Rotterdam traveller saw less reason to use P+R because local public transport already provided a convenient alternative (R-11).

The same pattern appeared in the benefits mentioned during the fieldwork. Travellers referred to avoiding congestion and parking stress, paying less for parking and retaining access to the car while being able to work or relax on the train. External research on station parking reports similar motives, including parking costs at the destination and total travel time (Van der Hoek, 2026). These findings suggest that travellers judge P+R by how well the combined journey fits the wider trip.

Friction concentrates around choice and transitions

What travellers need to work out changes over the course of the journey. Before departure, they may need to recognise P+R as an option, compare it with driving, choose a suitable location and

understand costs, availability and conditions. Participants used combinations of Google, the NS app and website, 9292, navigation tools and parking websites. Familiar users could often rely on previous experience, while less familiar users had to collect and combine more information themselves. Existing NS research also found that travellers use several applications when planning a single journey (Internal company document D14, 2023).

At the P+R location, the type of difficulty changes. At regulated facilities, licence-plate recognition can make entry quick and require little action. Earlier NS research described this process as fast and convenient (Internal company document D7, 2022). Less familiar travellers were nevertheless not always sure whether the parking session had been registered correctly or whether another action was required (R-04, R-09). The fieldwork adds that a successful technical process is not always clear to the traveller.

The train leg contained relatively little P+R-specific friction. Once travellers had reached the platform, they continued within the regular rail journey. Some routine travellers knew their departure times by heart and barely needed the app (W-R04). For these travellers, the P+R-specific part of the journey required little attention once the transfer had been completed.

Uncertainty returned at the end of the journey. Travellers had to confirm that their train journey had been recognised for the P+R discount and that payment and exit worked as expected. Participants reported failed card reads, unexpected tariffs and cases in which the full parking price had to be paid before the difference could be reclaimed. Earlier NS research also found that travellers were sometimes unsure whether the discount had been applied correctly, even when the process itself had worked (Internal company document D8, 2023). A later survey of 350 users of regulated P+R also reported problems with discount settlement and exit (Internal company document D9, 2024). The return journey introduces another moment where the traveller needs confirmation that the different parts of the trip have been connected correctly.

Familiarity changes what travellers need to work out

In the fieldwork, travellers with previous P+R experience needed to search for and interpret less information. Regular users often know suitable P+R locations, train times, routes through the station and the parking procedure.

Less familiar travellers had fewer reference points. Some searched across several sources or asked others for help. Two international participants used ChatGPT to understand tariffs or procedures when information was unclear or only available in Dutch (R-12, W-R05).

Previous experience did not remove uncertainty when something went differently from what travellers expected. Regular users also reported failed card readers, missing discounts and problems when leaving a facility. In these cases, familiarity mainly changed how easily travellers could interpret what had happened. A regular user may recognise an unexpected amount as an error and know what to do next, while a first-time user has less basis for making that judgement.

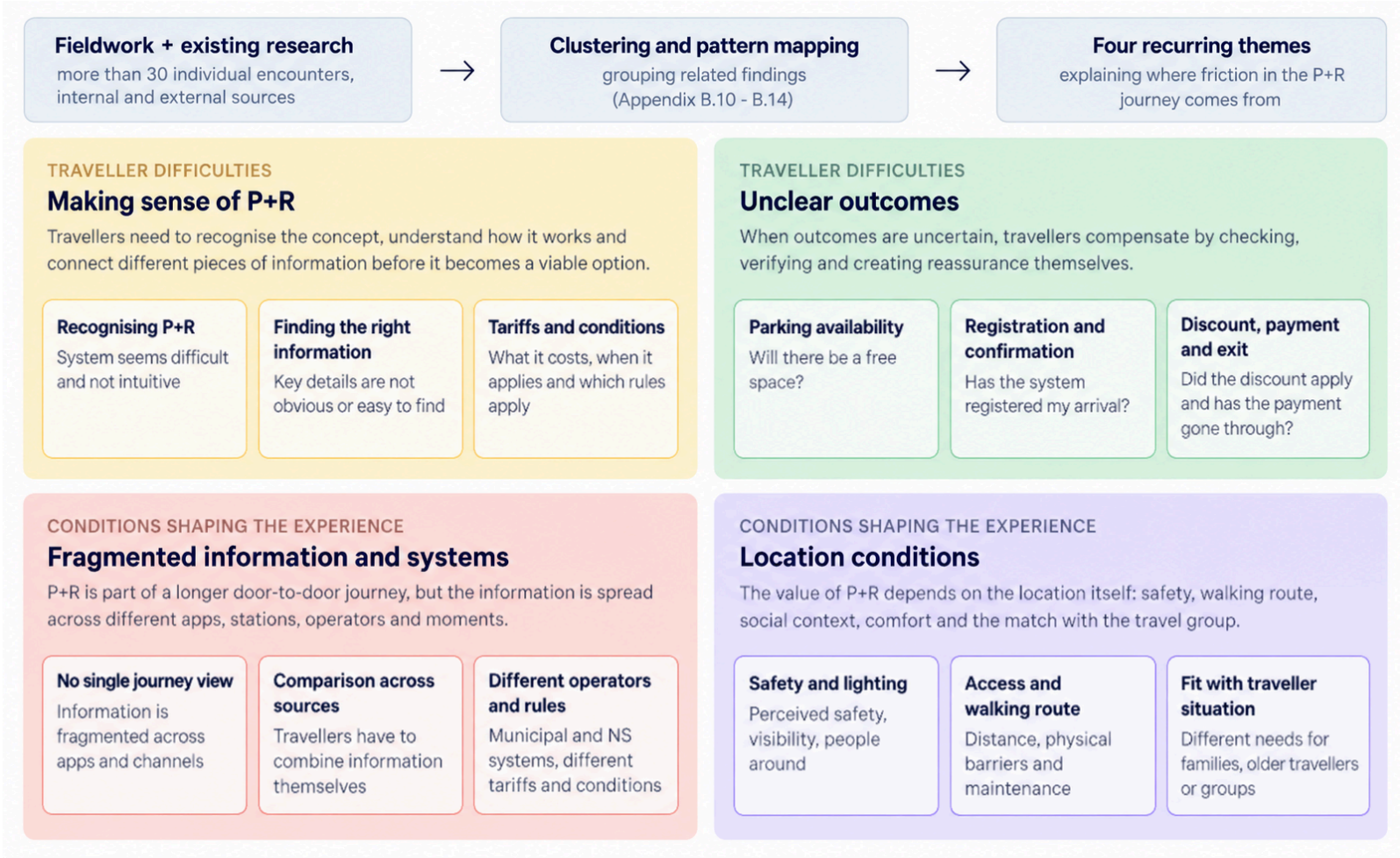
Figure 5.2 separates two related difficulties: having more to work out and being unsure whether a step has worked. They can occur at the same moment, but they describe different problems.

In the reconstructed journey, friction is concentrated before travellers commit to P+R and at moments where car, parking and train need to connect. Familiarity reduces the amount travellers need to work out for themselves, but unclear outcomes can still create uncertainty. Section 5.3 examines the recurring causes behind these patterns and groups them into four themes.

5.3 Synthesising findings

To move from individual observations to broader patterns, the fieldwork was compared with existing internal and external research and analysed through clustering and pattern mapping (Appendix B.10–B.14), following the approach described in Chapter 3 (Braun & Clarke, 2021). Four themes were developed from this analysis. The first two describe difficulties experienced directly by travellers, while the other two describe conditions that help explain why these difficulties occur or become more pronounced.

Figure 5.3. Synthesis from fieldwork and existing research into four recurring themes



Theme A: Making sense of P+R

For less familiar travellers, using P+R often starts with having to work out what the service is, if it is relevant to their journey and how the different parts fit together. Information was sometimes available but difficult to find or combine. Several travellers did not know where to find information that already existed, or had difficulty bringing separate pieces together into a clear picture of the journey.

The fieldwork showed this at different stages. Some travellers were not aware that a location functioned as P+R at all. One participant who knew the system in Arnhem had not recognised P+R as an option in Rotterdam (R-06). At Amersfoort, two visitors understood the site primarily as a car park rather than as part of a combined car–train journey (A-J02, A-R04).

Similar problems appeared with information that was already available digitally. Travellers who asked for live parking occupancy were surprised to learn that this information could already be found in the NS app. One described the feature as “well hidden” (W-R02), while another said she would still need to work out how it functioned (R-08). Participants also moved between Google, the NS website, 9292, navigation tools and previous experience when trying to understand how P+R applied to their trip. Internal NS research found a similar split between apps: Google Maps was commonly used for car routes, while the NS app was used for train information (Internal company document D15, 2024).

Tariffs and conditions added further interpretation. One participant only discovered afterwards that parking had been free in combination with the train journey (W-R10). Another was still unsure how licence-plate registration worked on her second visit and said that a clear step-by-step explanation would have helped (R-09). Earlier internal design work also identified the need to explain P+R possibilities before the journey begins (Internal company document D5, 2023).

Internal concept work points in the same direction. It describes future options in which occupancy information is easier to access and parking, reservation and train travel are more closely combined (Internal company document D12, n.d.). This does not by itself establish the current traveller problem, but it shows that NS has already identified the need to reduce the amount travellers have to work out across separate parts of the journey.

Theme A concerns how travellers make sense of the information available to them. Travellers need to recognise P+R as an option, find the information that applies to their situation and understand what it means for their trip. Familiar users can often rely on previous experience. Less familiar users have to build that understanding themselves so they have more information to find, combine and interpret before they can assess P+R as a travel option.

Theme B: Unclear outcomes

A second source of friction appears when travellers understand what they are supposed to do but cannot tell whether the journey will work as expected. This begins before arrival. Parking availability matters because reaching a full facility can disrupt the rest of the journey. In a 2024 survey of 350 users of regulated P+R facilities, 97% rated the availability of a parking space as important or very

important. When entering the facility, 61% said they paid attention to parking availability (Internal company document D9, 2024).

At entry, the uncertainty concerned confirmation more than the intended procedure. Earlier NS research describes licence-plate recognition as a fast and convenient process at regulated facilities (Internal company document D7, 2022). In the fieldwork, however, less familiar travellers were sometimes unsure whether their arrival had actually been registered or whether another action was required. They understood what should happen, but could not always tell whether it had happened correctly.

This becomes more visible during discount, payment and exit. Participants reported cards that had to be presented several times before they were recognised and cases in which the P+R discount was not applied. Several regular users then paid the full tariff and submitted proof of their train journey to Q-Park afterwards to recover the difference (W-J06, W-J08, W-R06). An internal study in 2024 also reported problems with exit, payment and the settlement of the P+R discount (Internal company document D9, 2024). One traveller in Rotterdam presented a card six times before the terminal responded (R-10). Regular users also experienced uncertainty when a technical step failed or gave little feedback. Knowing how the system should work did not tell them whether the expected outcome had actually occurred.

Earlier NS research found a similar problem even when the process had technically worked. Travellers were not always certain that the correct P+R discount had been applied (Internal company document D8, 2023). The fieldwork and earlier research therefore show two different situations: a step can fail, or it can succeed without making that success clear to the traveller. A technical step can succeed without giving the traveller clear confirmation. When the outcome is unclear, the traveller may need to check the amount, try again or resolve the issue afterwards.

Theme B concerns confirmation at moments where the traveller depends on an outcome. Travellers need enough certainty about availability before committing to the journey. Registration needs to be clear at entry, and discount and payment need to be understandable at the end. Familiarity can help travellers interpret an unexpected result, but it does not prevent a step from failing or make unclear feedback easier to verify. This distinguishes the theme from **Making sense of P+R**: Theme A concerns understanding how the journey works, while Theme B concerns knowing whether it has worked as expected.

Theme C: Fragmented journey support

P+R is one part of a longer door-to-door journey, but travellers often need information from several systems and organisations to plan it. NS's own design work treats P+R as part of the wider trip rather than as a destination in itself (Internal company document D5, 2023). The fieldwork reflected this. Travellers used P+R to address broader travel needs, such as avoiding congestion, reaching the railway network from a place without a station or reducing parking costs at the destination.

When P+R became an option, travellers often had to compare different parts of the journey separately. One participant described how his partner compared several stations by weighing parking costs against the onward train fare before deciding which P+R made

most sense for their trip (R-06). Other participants moved between Google, the NS app and website, 9292, navigation tools and parking websites. Among 1,253 travellers in a 2024 NS study, 50% said they sometimes used more than one app for the same journey. Around two-thirds recognised the lack of a single app containing all the travel information they needed (Internal company document D15, 2024).

Earlier qualitative NS research found that travellers often saw switching between apps as a normal part of the journey (Internal company document D14, 2023). The 2024 study also found that different apps served different parts of the trip, for example Google Maps for car or walking routes and the NS app for train information. For Theme C, the issue is the extra work created when information needed for one decision is split between several sources.

The journey is also divided across organisations. P+R locations can be operated by different organisations, with different tariffs, rules and payment systems. Travellers do not necessarily recognise these organisational boundaries. During the fieldwork, some participants treated municipal parking and NS-related P+R as parts of the same travel system, even when the underlying arrangements differed.

This fragmentation helps explain parts of Themes A and B. When information and responsibilities are divided across several systems, travellers have to make more connections themselves. They have to work out how the separate parts fit together and may have more difficulty finding out what happened when a step fails or gives an unclear result.

Theme D: Location and traveller context

The experience of P+R also depends on the location itself. Safety, walking distance, the route between the car park and the station, and the condition of the site all influence whether a location feels suitable for a journey. These factors appeared in both the fieldwork and the supporting research.

A survey of more than 1,200 travellers identified perceived safety as one of the most important considerations when choosing a P+R location, together with availability and affordability (Van der Hoek, 2026). In another internal 2024 survey of 350 users of regulated P+R facilities, 94% rated a smooth connection between the car park and station as important or very important, while 87% gave the same rating to feeling safe themselves and about their car (Internal company document D9, 2024). The open responses in the same study also show that local conditions can alter this experience. Respondents mentioned unclear walking routes, maintenance issues and problems with accessibility, including a lift that did not work.

The fieldwork found similar differences between locations and situations. In Woerden, one participant described feeling unsafe when the lighting switched off after dark (W-J03). Cars parked on the pavement could also obstruct the walking route at busy times. In Rotterdam, one traveller described the entrance as "hidden behind the station" (R-06). These examples show that proximity to the station alone does not describe the quality of the transfer. The route itself also affects how easy and comfortable the connection feels.

Personal circumstances can make the same physical setting more demanding. One family travelling with a baby needed additional

time and space to prepare a stroller before continuing towards the station (R-04). The suitability of a P+R location can therefore depend on who is travelling and what the transfer requires in that situation.

Theme D is therefore best understood as a contextual condition. The first three themes concern how travellers understand the journey, judge its outcomes and deal with information spread across systems. Location conditions affect how that journey is experienced in practice. Some of these conditions can be made visible before travel, while their underlying quality depends on the physical site and its operation.

5.4 Weighing the themes clarifies the design challenge

The four themes do not play the same role in explaining traveller friction. Some describe difficulties experienced directly by travellers, while others describe conditions that contribute to those difficulties or affect how strongly they are felt. The themes were therefore compared qualitatively to clarify their role in answering RQ2. This comparison considered three points:

1. How directly does the theme affect travellers' ability to understand, use or consider P+R?
2. How consistently does the theme appear across both the fieldwork and the existing literature?
3. What role does the theme play in producing or intensifying traveller friction?

Figure 5.4 summarises these different roles. The figure represents a qualitative interpretation of the findings and does not imply a numerical ranking of the themes.

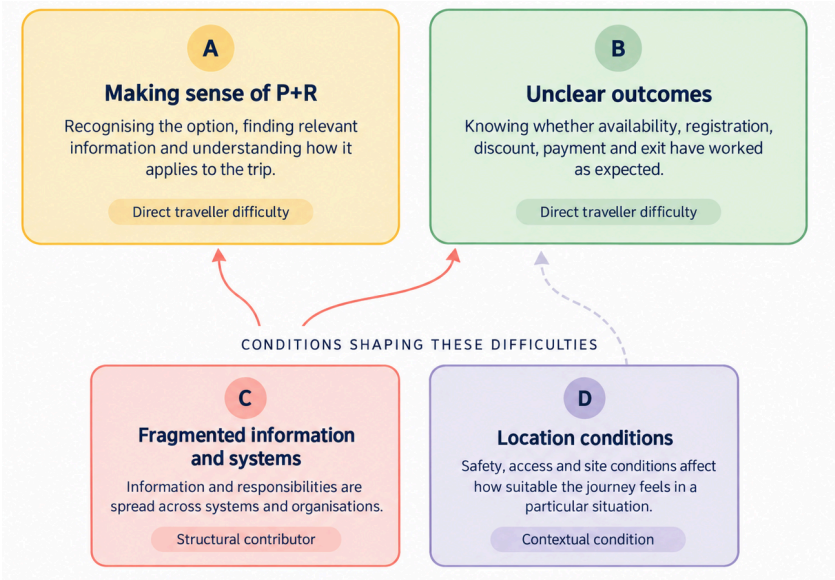


Figure 5.4. Roles of the four themes in traveller friction

(A) Making sense of P+R and **(B) Unclear outcomes** are the main direct traveller difficulties identified in this synthesis. Theme A affects whether travellers can recognise P+R as relevant, understand how it applies to their trip and judge whether the combined journey is suitable. Theme B becomes important when travellers depend on an outcome that they cannot easily verify, such as parking availability, registration or the application of a discount. Both themes recur at several points in the journey and were found among travellers with different levels of familiarity with the system.

The two themes stay distinct. Familiarity generally reduces the amount travellers need to search for and interpret, which weakens some of the difficulties described in Theme A. Theme B remains relevant for experienced users. Regular travellers who understood the parking process still reported failed card reads, missing discounts and uncertainty when the system gave an unexpected result. Previous experience can help travellers interpret such situations, but it does not determine if the underlying step will succeed.

(C) Fragmented information and systems have a different role. It helps explain why travellers often have to assemble the journey themselves and why confirmation can be difficult when several systems are involved. Using several apps was not always a problem in itself. Friction showed when travellers had to connect information themselves or could not easily trace what had happened when a step was unclear. Theme C therefore helps explain parts of Themes A and B. When information needed for one decision is divided between systems, travellers may need additional searching and interpretation, while unclear outcomes can be harder to trace back to a specific part of the journey.

(D) Location conditions shape the experience in a more situational way. Safety, accessibility, walking routes and the condition of the site can affect whether a P+R location is suitable for a particular traveller or journey. These factors can be decisive in individual cases, but their relevance depends more directly on the physical location and the traveller's situation. Their underlying quality also depends largely on the physical site and its operation.

5.5 Answer to RQ2

RQ2a: Which needs, motivations and barriers influence travellers' decisions to use P+R?

P+R becomes relevant when it helps travellers solve a wider travel problem. Participants used it to avoid congestion or expensive parking at the destination, reach the rail network from places without a convenient station connection, or combine the flexibility of the car with travelling further by train. Its relevance depends on how the combined journey compares with the alternatives available for that trip.

For P+R to become a realistic option, travellers need to recognise it, understand what the journey involves and judge if it fits their situation. Barriers arise when travellers must search several sources, interpret unclear tariffs or conditions, or rely on outcomes such as parking availability, registration and the P+R discount that remain uncertain. Familiarity reduces the amount of information travellers need to work out, while location and traveller context affect how well a specific P+R option fits the trip. Previous experience makes the journey easier to interpret, but does not prevent problems when a system gives an unclear or unexpected result.

P+R becomes a realistic option when it adds value to the wider trip and the combined journey is clear enough to assess. The decision becomes harder when travellers have to assemble that journey themselves or cannot confirm important steps.

RQ2b: Where does the NS app currently fall short in supporting the P+R journey?

The NS app already supports parts of the P+R journey, particularly once travellers know that P+R is relevant to their trip. It provides train-planning information and, for some locations, parking information such as occupancy. The research also showed that travellers use other sources to understand the full journey. Information about the car leg, parking conditions, costs and the onward train journey is not always brought together in a way that allows travellers to assess P+R as one option.

One clear gap appears before travellers commit to the journey. Less familiar travellers may first need to recognise P+R as relevant, identify a suitable location and understand how parking and train travel work together. Existing information can be difficult to find or apply to a specific trip. Travellers may therefore need to compare several sources before they can judge if P+R fits their situation.

A second gap appears at connected steps in the journey. The app provides limited support for confirming that parking has been registered correctly, that the train journey has been linked to the parking session, and that the expected discount has been applied. When an outcome is unclear or a step fails, travellers may need to verify it through another system or resolve it afterwards.

The NS app supports individual parts of the journey more effectively than it supports the connections between them. Its main limitations concern helping travellers assess P+R before departure and giving clear confirmation when parking and train travel depend on one another. Physical conditions such as lighting, accessibility and the walking route can also affect the journey, but the app cannot resolve the underlying site conditions. Digital support can help travellers anticipate them.

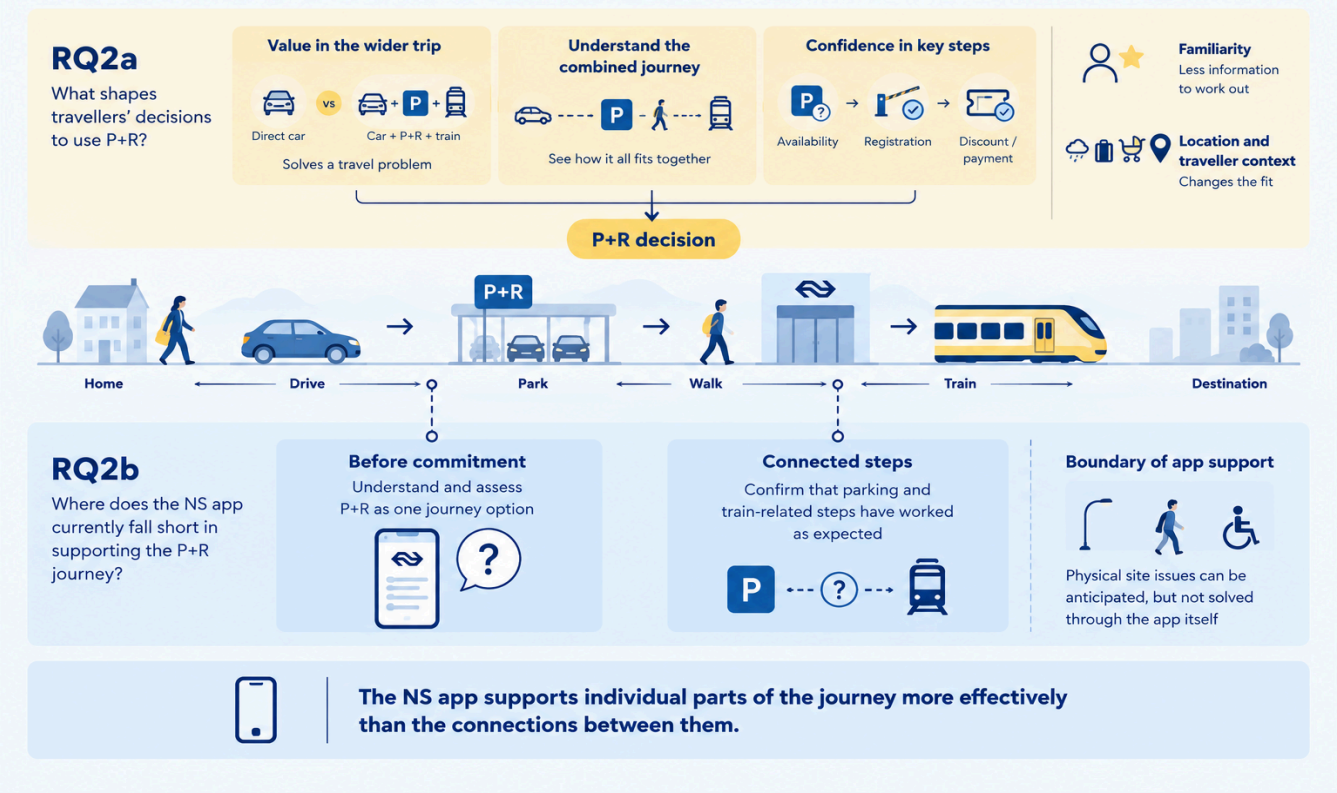


Figure 5.5. Visualisation of the findings for RQ2a and RQ2b over the P+R journey.

6. Define: The Strategic Opportunity (RQ3)

> *RQ3: Which combination of target group, journey phase and friction point offers the most strategic opportunity for the NS app to add value to the P+R experience?*

The previous chapters showed that P+R sits at the intersection of NS strategy, physical mobility, digital support and traveller experience. They also revealed a gap between what NS aims to provide as part of a door-to-door journey and what travellers actually experience. This chapter defines where within that gap the most meaningful strategic opportunity for the NS app lies and formulates an answer to RQ3.

6.1 Finding the right design lens

As described in Section 3.1, this project follows a research-through-design and human-centred approach (International Organization for Standardization, 2019; Stappers & Giaccardi, 2017). Chapter 5 established the main frictions in the current P+R journey. The next step was to turn these findings into a design focus that could guide the development phase.

Existing NS traveller labels, such as commuter or off-peak traveller, describe travel behaviour at an operational level. They say less about how travellers approach a P+R journey, what creates doubt and what they need before they can make a choice. A design lens was therefore developed from traveller research.

During synthesis, sixteen provisional traveller perspectives were created from recurring behaviours, needs and frictions identified across the research. Each perspective brought a particular P+R situation into view, such as comparing costs, searching for missing conditions, relying on routine, planning around traffic or dealing with accessibility constraints. Their purpose was exploratory. They were not treated as fixed traveller segments or as representations of individual participants.

Figure 6.1 shows examples of these perspectives. Appendix C1 documents the full set and the clustering process.

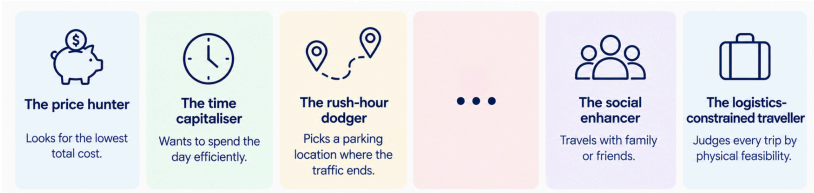


Figure 6.1. Examples of the sixteen traveller perspectives

From sixteen perspectives to four profiles

Several of the sixteen perspectives addressed closely related problems. Keeping all sixteen as separate design targets would have made the design scope too fragmented. They were therefore clustered into four composite profiles, each centred on a different type of P+R challenge: Giorgia on information and uncertainty, Ruben on routine and reliability, Sam on strategic planning, and Lilly on comfort, accessibility and travelling with others (Figure 6.2).

The four profiles are design constructs based on recurring research patterns. They do not describe demographic groups or form a segmentation of the P+R population. Their purpose is to make

different forms of friction easier to compare during the design process.

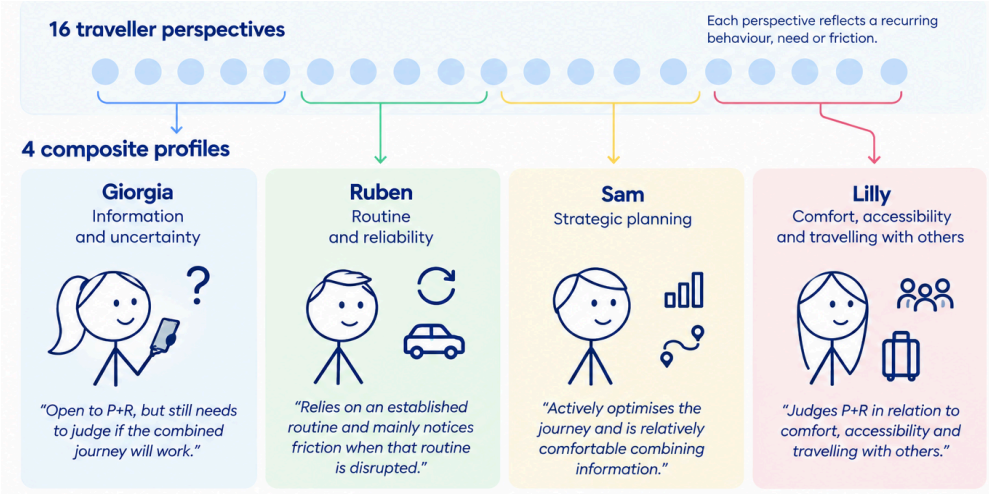


Figure 6.2. From sixteen perspectives to four design profiles

At this stage, Giorgia and Ruben were taken forward for deeper exploration through empathy mapping; Sam and Lilly stayed at profile level. The method organised the existing findings around what each traveller tries to achieve and what they see, hear, say, do, think, and feel in relation to that goal (van Boeijen et al., 2020). The maps did not add new participant evidence. They brought together patterns already present in the fieldwork and synthesis.

This moved the analysis from broad profile descriptions towards the decision situations that design could address.

This step clarified a central difference between the two profiles. Ruben has an established P+R routine and gives little attention to the journey while that routine works. His need for support becomes stronger when something disrupts it. Giorgia is still making the choice itself. She searches, compares and checks information before committing because she still needs to judge if the combined journey will work for the trip she is planning. Figure 6.3 summarises the main elements of Giorgia's empathy map. Appendix C2 contains the complete maps for Giorgia and Ruben.



Figure 6.3. Giorgia empathy map

Selecting the primary design lens

The four profiles describe relevant traveller problems, but RQ3 requires a more specific choice of target group, journey phase and friction point. The profiles were therefore compared using three criteria derived from RQ3 and the preceding research: openness to an alternative travel option, the potential for digital decision support

to reduce the identified friction, and the direct relevance of that friction to the decision to use P+R (Figure 6.4).

These criteria assess the fit between each profile and the design scope of this thesis. They do not indicate that one traveller or one type of need is more important than another.

Profile	Openness to alternatives	Potential for digital decision support	Relevance to the P+R choice
Giorgia	High	High	High
Ruben	Low	Low	Low
Sam	High	Low	Medium
Lilly	Medium	Medium	Low

Figure 6.4. Selecting the primary design lens

Note: The ratings are used as a qualitative design comparison and are not measured scores.

The comparison shows why the profiles lead to different design opportunities. Ruben already uses P+R as part of an established routine. His main friction appears when that routine fails, so his situation is less directly connected to the initial decision to use P+R. Sam is open to different travel options and actively optimises his journey, but he is already relatively comfortable combining information and adapting his plan. Lilly's needs concern accessibility, comfort and travelling with others. Digital support can help travellers anticipate some of these conditions, but several of the underlying problems depend on the physical service and location.

Giorgia is still at an active choice point. P+R is a realistic option for her, but she still has to judge if the combined car, parking and train journey makes enough sense for the trip she is planning. This connects directly to the pre-commitment friction identified in Chapter 5, where travellers had to assemble information themselves before they could judge the journey. It also connects to the opportunity identified in Chapter 4 for the NS app to support a broader door-to-door journey.

Giorgia was therefore selected as the primary design lens for the next stages of the project. She does not represent an average P+R traveller. She is a composite profile that brings together the decision patterns most relevant to the question this thesis investigates. Section 6.2 uses her situation to examine this decision in more detail and to make the underlying tension concrete.

6.2 Giorgia as the design lens

Section 6.1 selected Giorgia because her situation brings the pre-commitment problem into focus. She is a composite design lens built from recurring patterns across the traveller research. She is not a record of one participant and is not intended to describe an average P+R traveller.

Earlier in the project, Giorgia was developed as a more conventional persona, with emphasis on traits, needs and behaviours. During the analysis, this format proved too static for the problem emerging from the research. The profile was therefore developed into a Character Experience Profile for this project, with more attention to the decision she is trying to make, the uncertainty she experiences

and the conditions she needs to judge the journey. Pruitt and Adlin (2006) describe personas as research-based design tools that keep user needs and behaviour present in design decisions. The Character Experience Profile kept this function and focused more directly on Giorgia's decision situation. The profile also draws on the Vision in Design emphasis on defining the qualities of an intended interaction before developing a specific solution (Hekkert & van Dijk, 2011). Appendix C3 documents the profile and the supporting synthesis material.

Figure 6.5 places Giorgia at the point where P+R becomes a realistic alternative to the familiar car journey. It shows how the choice becomes more difficult once she has to assess the combined journey as a whole.



Figure 6.5. Giorgia at the moment of choice.

Making the decision concrete

To examine this decision in context, Giorgia is placed in a plausible journey scenario based on the patterns found in the traveller research. It is Friday evening, and she is planning a trip from Nootdorp to Utrecht for a busy event the following day. She has a car available and knows what a direct car journey involves. Expected parking pressure and parking costs in Utrecht make another option worth considering.

P+R becomes relevant at this point. Giorgia knows how to drive and she understands train travel. The combined journey is less familiar. She needs to work out where to park, how the parking conditions apply, how the transfer connects to the train and what the journey means for the rest of her trip. Figure 6.6 shows the choice situation at this point.

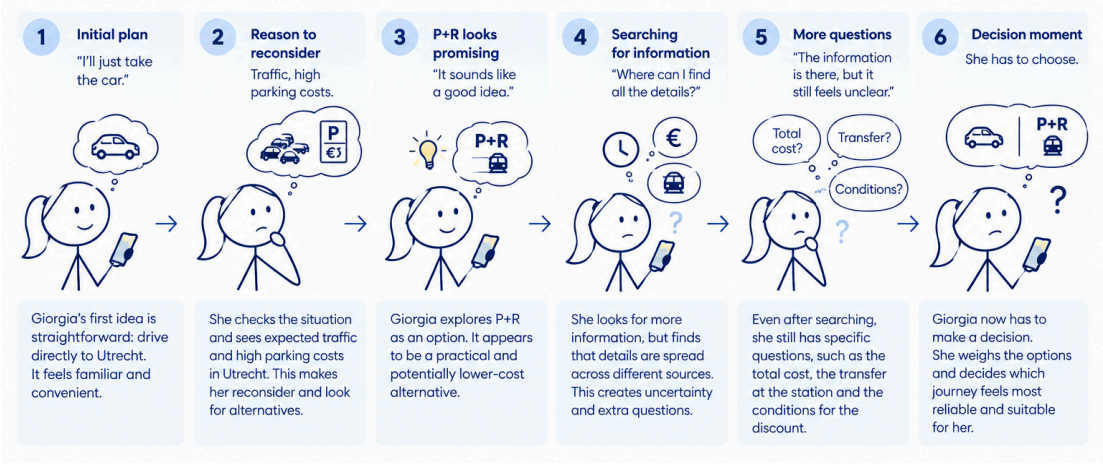


Figure 6.6. Giorgia's decision journey.

This destination-led view is consistent with mobility research. Hamersma and Roeleven (2024) describe travel decisions as choices about reaching a destination under particular time and travel conditions. For Giorgia, the design question therefore concerns the full journey she is trying to make. P+R has to be judged as one

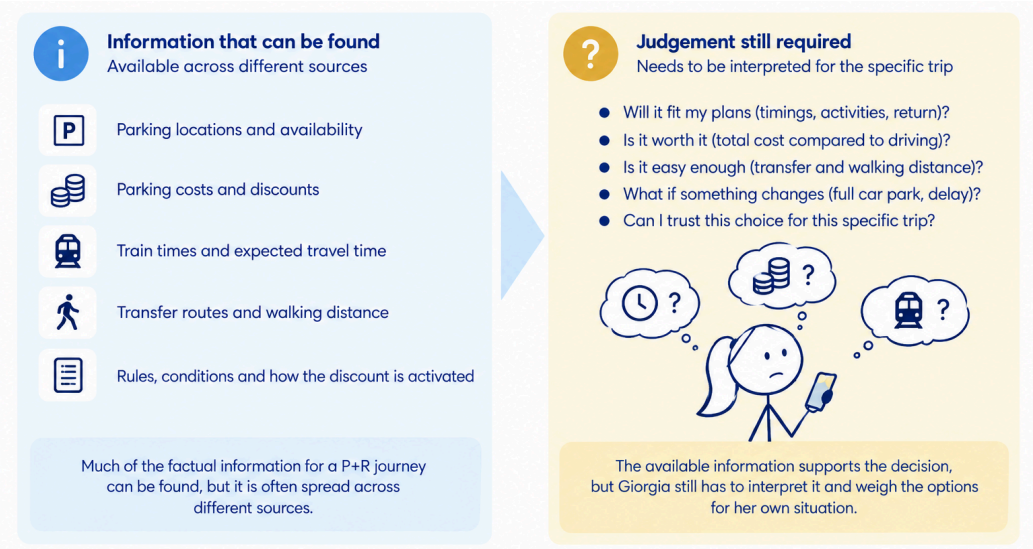
possible way of reaching Utrecht alongside the option she already understands.

The decision moment

From a distance, P+R appears simple: drive to a station, park and continue by train. At the point of choice, Giorgia has to resolve more than those three steps suggest. She needs to know which P+R location fits her route, if a space is likely to be available, what the parking will cost, how a traveller discount works, how long the transfer takes and how frequently trains continue towards her destination. She also needs some idea of what happens if one of these conditions changes.

Much of this information can already be found. The difficulty is that the separate answers still leave the final judgement to Giorgia. A parking tariff says little about the full cost of the trip. A train departure does not explain the effort involved in reaching the platform from the car. Parking availability at one moment does not tell her how dependable that option will feel by the time she arrives.

Figure 6.7. Information available vs judgement still required



She has to combine these separate pieces into an expectation of the journey herself.

Figure 6.7 makes this tension visible. The left side shows information that Giorgia can find. The right side shows the judgement that remains after those facts have been collected.

Research on travel choice helps explain why comparing alternatives matters. Chorus et al. (2008) model choice as partly shaped by anticipated regret when alternatives are compared. For Giorgia, the familiar car journey is compared with a less familiar combined journey whose consequences are harder to assess in advance. The uncertainty surrounding P+R therefore becomes part of the choice itself.

From information to confidence

Chapter 5 showed that planning a P+R journey can require information from several sources. In Giorgia's case, finding those pieces is only part of the task. She still has to interpret them and form an expectation of the journey as a whole. The remaining question is one of reliance: does she have enough basis to commit to the combined journey?

Trust provides a useful conceptual lens for this distinction. Mayer et al. (1995) conceptualise trust in an organisational setting as a willingness to accept vulnerability based on positive expectations of another party's actions. Their model concerns interpersonal and organisational trust, so it is not used here as a direct model of traveller behaviour. Its relevance lies in the distinction between having information and being prepared to rely on something under uncertainty.

Lee and See (2004) make a related distinction in the context of reliance on automated systems. Trust becomes relevant when a person cannot fully inspect or predict how a system will perform before relying on it. Research on traffic information applications also indicates that trust affects use in situations where users depend on the reliability of the information provided (Hosseini Shoabjareh et al., 2024).

In this thesis, trust describes the traveller's willingness to rely on the combined P+R journey despite remaining uncertainty. Confidence is used as a descriptive term for the traveller's sense that there is enough basis to make the choice.

Figure 6.8 translates this interpretation into a qualitative confidence curve for Giorgia's decision process. The curve is a synthesis of the uncertainties found in the research. It is not a measured scale. At the start, Giorgia has high confidence in the familiar car journey. Conditions at the destination create a reason to consider P+R, but the combined option starts from a less certain position. Finding information can increase her confidence, while unclear conditions or missing links between the different parts of the journey can weaken it again. The curve therefore shows where confidence is vulnerable during the choice process.

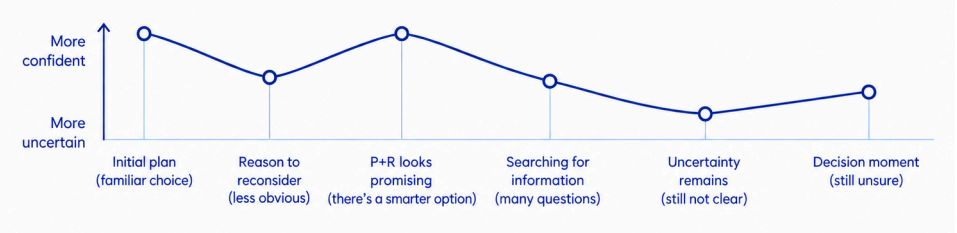


Figure 6.8. Qualitative confidence during Giorgia's decision process.

Using Giorgia as the design lens makes the pre-trip problem more specific. She needs enough basis to judge the combined car, parking and train journey as one travel option before committing to it. Section 6.3 extends this lens through the rest of the journey to examine what happens after the choice has been made and the traveller moves between the different systems involved.

6.3 Mapping the current experience journey

Section 6.2 focused on the decision before commitment. At that point, the traveller can still compare P+R with other ways of reaching the destination. Once the traveller has chosen P+R, the analytical focus shifts. The rest of the journey can then show how the basis for that choice is confirmed or weakened as the traveller moves through the different parts of the trip.

Figure 6.9 combines the journey reconstruction developed from the Chapter 5 fieldwork and synthesis with the Giorgia design lens. The detailed journey stages are documented in Appendix B.6–B.9. Appendix B.10–B.14 documents how the field material was clustered and synthesised into the themes used in Chapter 5. Figure 6.9 brings these findings together at journey level and shows where confidence may be more vulnerable during the journey, including after the initial choice. The confidence curve is a qualitative synthesis of the research findings. It is not a measured scale.

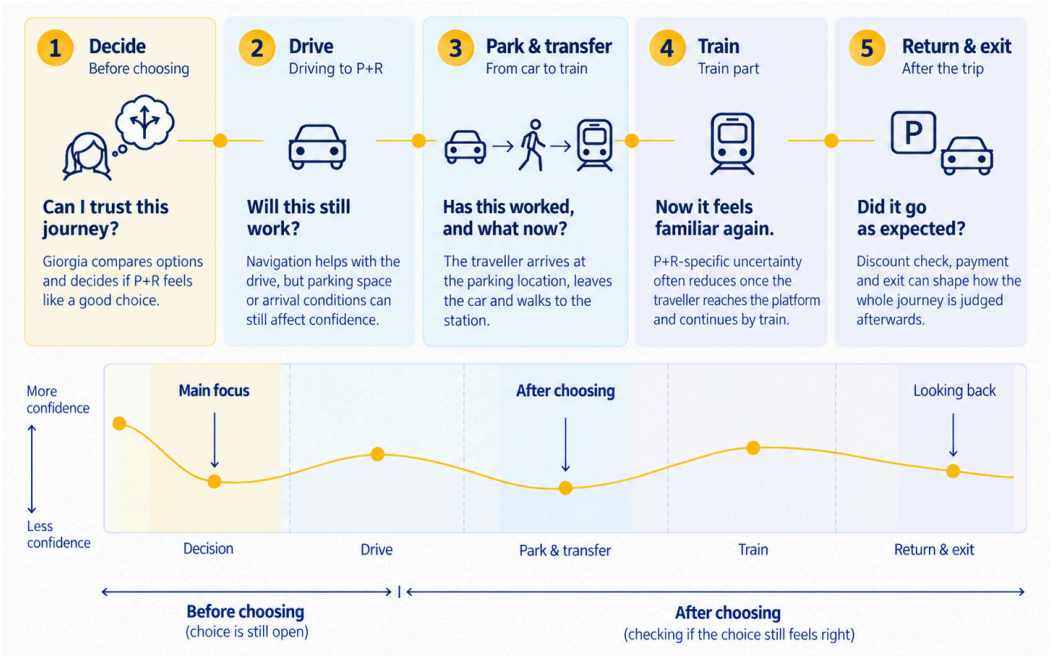


Figure 6.9. Giorgia's current P+R journey and qualitative confidence across the journey.

The journey reconstruction shows that a P+R trip depends on several systems and interfaces. The traveller moves from planning and car navigation into the parking environment, then continues through the station and train system. Information, actions and responsibilities change during this process. Chapter 5 showed that familiarity affects how much effort these changes require. Experienced travellers can rely on previous knowledge, while less familiar travellers spend more effort checking what has happened and what they need to do next.

Two moments are especially relevant to the design question in this chapter. The first is the pre-trip decision discussed in Section 6.2. This is the point where the traveller still has to decide if the combined journey is a credible option. The second appears after commitment, when the traveller moves between systems during the trip. At the second moment, the traveller has already chosen P+R, but still needs enough confirmation that the journey is proceeding as expected.

System switch during the journey

The change from car and parking to the station and train makes this second moment visible. The fieldwork does not identify this transfer as the largest operational friction in the P+R journey. In fact, P+R-specific difficulties generally decreased once travellers reached the train. Its relevance lies in the change between systems and in the interpretation this can require from the traveller.

Entry into the parking facility often involved few actions. Licence-plate recognition could make the process appear almost automatic. For less familiar travellers, that simplicity could create uncertainty about what had already happened. Some were unsure if their entry had been registered correctly or if another action was still required. After parking, they also had to find the route to the station and continue with the train journey. Familiar travellers could rely on routine at these points. Less familiar travellers had less experience to confirm that the steps still matched the journey they had planned.

Once travellers reached the platform and train, this uncertainty largely reduced. The train system was familiar to many participants and onward travel rarely appeared as a major P+R-specific difficulty. This makes the transition itself relevant. Confidence in the original choice can depend on receiving enough confirmation while moving from one system to the next.

Alyavina et al. (2020) discuss a related integration problem in their research on Mobility as a Service. They describe the integration of functions such as journey planning, booking, ticketing and real-time information within a digital mobility service. P+R is not treated as a MaaS service in this thesis. Their work is used here to place the observed system changes within the wider problem of organising information and services around a multimodal journey.

Evaluation after the journey

The P+R system becomes more visible again when travellers return to the parking facility. Some of the stronger operational frictions found in the fieldwork occurred during discount validation, payment and exit. Travellers described failed card recognition, uncertainty about the applied discount and cases where an incorrect payment had to be recovered afterwards.

These events take place after the original travel choice has been made. They can still influence how the completed journey is judged. A journey that worked for most of the day may be remembered less positively when its final steps create uncertainty or unexpected effort.

Kahneman et al. (1993) provide a general perspective on retrospective evaluation. Their controlled experiments found that the end of an experience can disproportionately influence later judgement. Their study was not about P+R or travel behaviour and does not establish that the same effect occurs in this context. It is used here to explain why the final stage remains relevant when considering how a completed P+R journey may be evaluated afterwards.

Figure 6.9 keeps the final stage visible because it can contribute to the traveller's later judgement of the completed experience. This chapter focuses on the decision before commitment and on continuity after that choice has been made.

Current digital manifestation

To examine how this continuity issue appears in the current digital flow, a screen-by-screen researcher walkthrough was conducted using Giorgia's journey as the scenario. The walkthrough did not involve participants and should therefore be read as an analysis of the current interface, not as a usability test. Appendix C3.5 includes the full walkthrough.

During planning, the NS app brings together information about the train journey and the selected P+R location. When the traveller starts car navigation, the route is handed over to an external navigation application. The digital environment then changes: car navigation continues elsewhere, while information about the P+R location and train journey remains in the NS app. The walkthrough ends at this hand-off, so it provides no evidence about digital support after arrival at the parking location.

Figure 6.10 makes this transition visible. For the traveller, the trip remains one combined P+R journey, while its digital support moves between separate environments. This does not in itself show that the flow fails, but it makes the continuity issue identified in the wider journey analysis visible in the current digital experience.

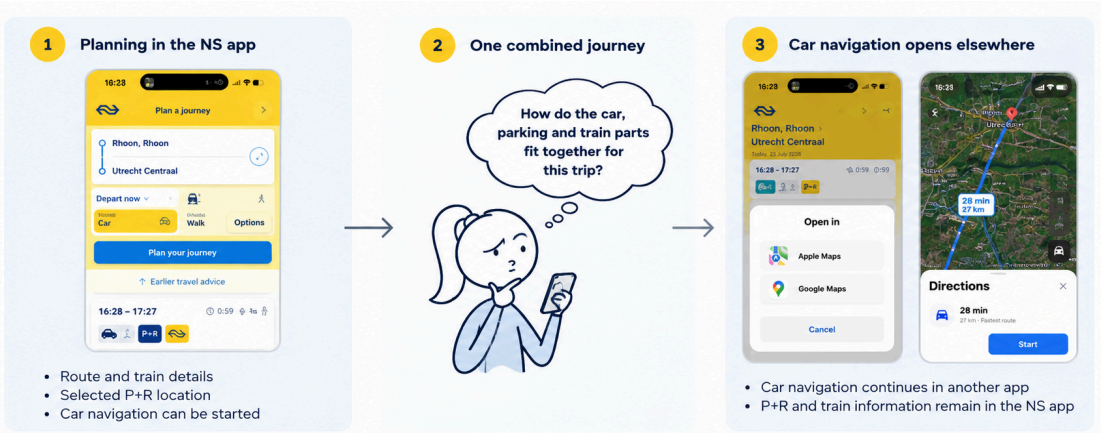


Figure 6.10. Current P+R planning flows through the Giorgia lens.

6.4 Core Tension

Sections 6.1–6.3 narrow the traveller findings to Giorgia's situation. She is open to P+R, but still has to decide if the combined car, parking and train journey makes sense for the trip she is planning. Finding the necessary information is only part of this difficulty. She also has to interpret separate pieces of information and judge the journey as a whole. This matters most before commitment, while other travel options are still available. After the choice has been made, later system changes can confirm or weaken the expectation formed during planning.

Giorgia wants to make a sensible choice to reach her destination, but must build trust in a P+R journey that she has to understand, compare and piece together herself before she can confidently experience it as one coherent journey.

Figure 6.11 shows how this core tension appears over the journey. The pre-trip decision is the main focus because the traveller can still choose another travel option at this point.



Figure 6.11. Core tension across the P+R journey

The same tension stays visible as the journey continues, although its role changes. Before commitment, Giorgia needs enough basis to judge P+R as a credible option. During the journey, especially when moving from car and parking to station and train, she needs confirmation that the journey still matches what she planned. Friction at the end of the trip can also affect how the completed experience is judged. The research, however, does not support treating this final stage as an equal design opportunity.

The main design focus therefore remains the decision before commitment, with continuity during the journey supporting the confidence built at that point. Section 6.5 uses this tension to define the target group, journey phase and friction point that together answer RQ3.

6.5 Answer to RQ3

Which combination of target group, journey phase and friction point offers the most strategic opportunity for the NS app to add value to the P+R experience?

The analysis points to travellers represented by Giorgia: people for whom P+R is a realistic option, but who still have to decide whether the combined journey suits the trip they are planning. The most relevant phase is the decision before commitment, while other travel options are still open.

At this point, finding information is only the first step. Travellers have to combine information about driving, parking, transfer and train travel and judge what these parts mean together. This is especially difficult when P+R is less familiar and previous experience offers little basis for that judgement.

The opportunity for the NS app is to help these travellers understand and compare P+R as one combined travel option before they choose. Support later in the journey remains relevant because the transfer between systems can confirm or weaken the expectations formed during planning. The pre-trip decision remains the main design focus.

This opportunity also connects the traveller findings to the organisational direction identified in Chapter 4. NS is already moving towards closer integration of P+R within the app and the wider door-to-door journey, while the traveller-facing role of that integration is still being worked out. The opportunity identified here gives that open question a specific focus: helping travellers judge whether a combined P+R journey is suitable for the trip they are planning.

PART II - Developing the solution

SECOND DIAMOND

7. Develop: Design Direction

This chapter moves the strategic opportunity from Chapter 6 into a design direction for the rest of the project. The aim is not to introduce the final concept yet. Instead, this chapter defines what a future solution must support if it is to answer the trust problem identified in Giorgia's current P+R experience.

Role in the Double Diamond

The second diamond moves from defining the design direction to developing and evaluating possible responses to it. This phase required a different type of evidence from the first diamond. The earlier chapters focused on understanding the current P+R experience and identifying the design opportunity. The second diamond examines how that opportunity can be translated into a future experience, developed into concepts and evaluated with travellers.

Ideation involved NS colleagues and fellow graduation students working on mobility-related topics. NS colleagues contributed knowledge of the organisation, current digital services and practical constraints, while the graduation students provided perspectives less shaped by existing NS structures. The sessions were organised around a Miro board and used layered *How might we* questions.

These moved from broader traveller situations towards more specific P+R applications, helping to avoid moving too quickly towards existing solutions.

The design goal, principles and criteria defined in this chapter provide the basis for the following development work. Chapter 8 describes the intended future experience, Chapter 9 develops and compares concept directions, and Chapter 10 evaluates the resulting concept with travellers and stakeholder evidence. The supporting future-experience and ideation work is documented in Appendix D.1–D.3, while the evaluation methods are described in Chapter 10 and Appendix E.

7.1 From Strategic Opportunity to Design Opportunity

Chapter 6 showed that access to information alone does not resolve the decision problem. Travellers can often find information about cost, availability and conditions, but they still have to interpret these separate pieces and judge what the combined journey means for their own trip. This makes it harder to decide whether P+R is a travel option they can rely on.

The opportunity lies in helping travellers understand if a P+R journey is a sensible and reliable option for their trip. The app should make clear how the combined journey fits their destination, timing and personal circumstances, so they have a stronger basis for making that judgement.

Central to this shift is the traveller, not the P+R location itself. From

Giorgia's point of view, the key consideration is whether a P+R journey aligns with her travel needs and expectations for a particular trip.

> ***Design shift***
>
> *From: How does P+R work?*
>
> *To: Is this the right choice for my trip?*

This shift from product thinking to journey thinking forms the starting point for concept development. The future solution should support travellers throughout the process of evaluating and choosing a travel option, helping them build confidence in a P+R journey as part of the wider travel experience.

> ***Design goal***
>
> *Help travellers like Giorgia build enough trust in a P+R journey to confidently choose it as a sensible way to reach their destination.*

This goal focuses on the decision before commitment, while recognising that the experience that follows can confirm or weaken the expectations formed during planning. A future solution should help travellers understand what the combined journey means for their situation, compare it with reasonable effort and form realistic expectations before making their choice.

7.2 Design Principles

To translate the design goal into a concrete direction, five design principles were formulated. These principles describe the qualities that any future solution should have. They do not define the final concept yet, but they create a design compass for Chapter 8 and Chapter 9. The five principles translate the research findings into a design direction for concept development, following the use of design goals and criteria described by van Boeijen et al. (2020). Figure 7.1 gives an overview of the five principles.



Figure 7.1. Five design principles guiding concept development.

1. Build trust before the choice

A solution should help travellers build confidence before they commit to the journey.

The journey analysis showed that the decision moment is the most fragile point in Giorgia's experience. This is where she has to decide if the journey is worth trying, while several parts of that journey are still uncertain.

Design implication: The app should reduce uncertainty before the decision is made. It should clarify the most important expectations, trade-offs and conditions early enough for travellers to use them in their choice.

Built on the decision analysis in Figures 6.6–6.8 and the core tension defined in Section 6.4

2. Make the journey understandable as one whole

A solution should present car, P+R and train as parts of one connected journey.

The current journey requires the traveller to connect information and actions from several systems. Car navigation, the parking location, P+R conditions and train information are provided through different parts of the journey. The traveller therefore has to make some of these connections herself.

Design implication: The app should make the relation between the journey parts visible. The traveller should not have to mentally build the combined journey from separate pieces of information.

Built on Theme C in Section 5.3 and the journey analysis in Figures 6.8 and 6.9.

3. Support decision-making

A solution should help travellers interpret information and turn it into a choice.

More information does not automatically create more trust. Giorgia may be able to find details about parking, departure times or costs, but that does not mean she knows what those details mean for her own situation.

Design implication: The app should translate information into practical meaning. It should help travellers understand trade-offs and answer the question behind the search: is this a good option for my trip?

Built on Theme A in Section 5.3 and the distinction between available information and required judgement in Figure 6.7.

4. Reduce mental effort

A solution should make it easier to compare options without adding more work.

The research showed that comparing options, sources and conditions can require considerable interpretation from the traveller. This adds effort to the decision and can make P+R more difficult to consider alongside a familiar alternative like the car.

Design implication: The app should reduce the amount of mental work needed to understand and compare alternatives. Comparison should support the decision, not become another layer of complexity.

Built on the planning frictions described in Section 5.2, Theme A in Section 5.3, and Giorgia's decision journey in Figure 6.6.

5. Help travellers form expectations

A solution should help travellers understand what will happen before they experience it.

Expectations formed before the journey can be confirmed or weakened as the traveller moves through it. Clear expectations therefore give the traveller a better basis for judging whether the journey is proceeding as expected.

Design implication: The app should prepare travellers for the experience of using P+R. This includes where they are going, how the transfer works, what they need to pay attention to and what will happen after parking.

Built on Theme B in Section 5.3 and the journey-level tension described in Section 6.4 and Figure 6.11.

Together, the five principles translate the core tension from Chapter 6 into qualities that can guide the design process. They remain grounded in Giorgia's decision situation while also defining how the NS app could support a combined P+R journey.

7.3 Design Criteria

The design principles describe the qualities that a future solution should support. They provide direction for the design process and express the key insights derived from the research. To evaluate and compare concept directions in a more structured way, these principles were translated into a set of design criteria. The design principles guide the creation of concepts, while the design criteria help to assess them. The criteria are based directly on the principles and do not add new requirements. Instead, they turn the principles into clear questions that can be used to compare different concept directions. Using the same criteria for each concept direction makes the basis for comparison explicit and allows the selection reasoning to be traced back to the design direction.

Criteria	Definition	Based on
Immediate understanding	Can the traveller quickly understand what the travel option means?	Principles 3 and 4
Journey coherence	Does the journey feel like one connected whole?	Principle 2
Uncertainty reduction	Does the concept reduce important doubts before the traveller makes a choice?	Principles 1 and 5
Ease of comparison	Does the concept make it easy to compare relevant travel options?	Principle 4
Clear expectations	Does the concept help the traveller form a realistic picture of the journey?	Principle 5

Table 7.1. Design criteria based on the design principles.

The criteria will be used in Chapter 9 to compare concept directions in a structured way. By evaluating concepts against the same set of criteria, it becomes possible to explain why certain directions are taken forward and why others are not. This keeps the concept comparison connected to the research findings that defined the design direction.

Chapter conclusion

This chapter translated the strategic opportunity from Chapter 6 into a design direction for the rest of the project. The core tension describes the difficulty Giorgia faces when judging the combined journey before commitment, while later parts of the journey can confirm or weaken the expectations formed at that point. This tension was translated into a design goal, five design principles and a set of criteria for comparing concept directions.

The principles describe the qualities a future solution should support, while the criteria provide a basis for comparing how different concepts respond to them. This keeps the reasoning from research findings to concept selection visible.

For Giorgia, the direction focuses on making the combined journey easier to understand and judge before she commits to it. For NS, it defines a role for the app in helping travellers make sense of the different parts of a P+R journey and maintain enough continuity as the journey progresses.

The design goal, principles and criteria define what the future solution should support. Chapter 8 develops this further by describing how the desired experience should unfold across the journey. Figure 7.2 summarises the design foundation used in the following chapters.

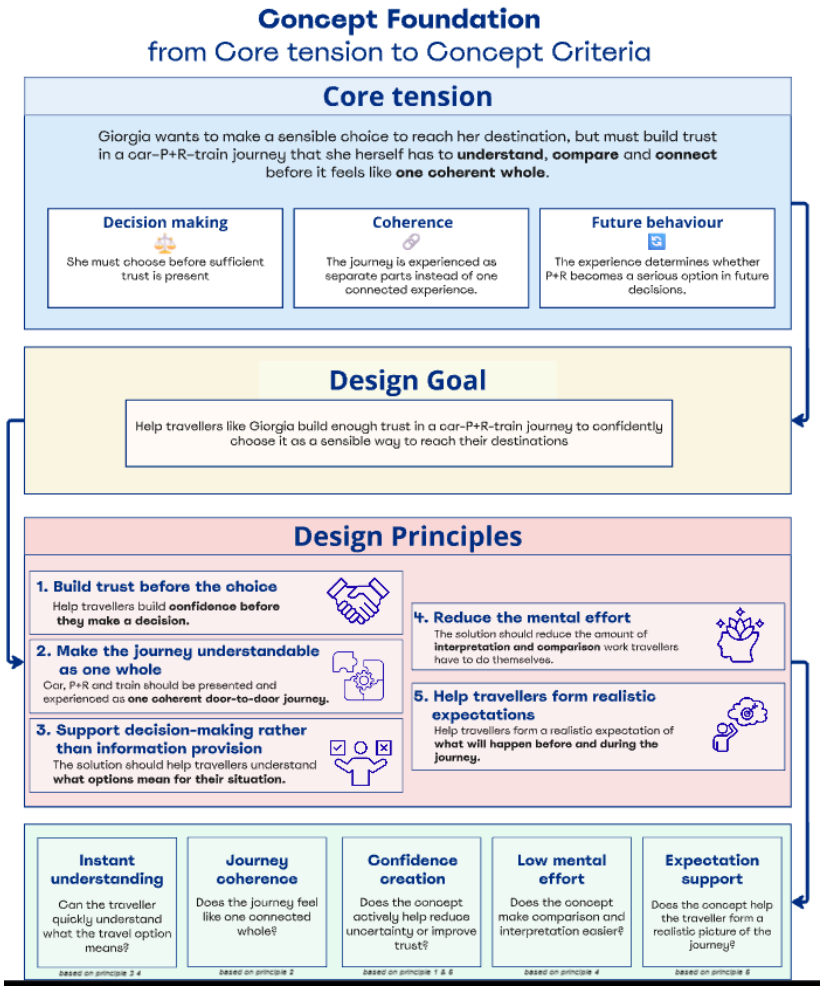


Figure 7.2. Concept foundation overview

8. Develop: Future Experience Vision

Chapter 7 moved the strategic opportunity into a design goal, principles and criteria. This chapter takes the next step by describing the experience those principles should create. No specific concept is selected at this stage. This follows the logic of Vision in Product Design, which separates the envisioned experience from the product or service that may later enable it (Hekkert & van Dijk, 2011). The chapter therefore examines how Giorgia's journey should unfold when the uncertainties identified in the current experience are better supported.

8.1 The desired experience

Building on the design goal and principles from Chapter 7 and the Giorgia profile developed in chapter 6, the desired experience can be summarised as follows: a relevant combined journey becomes visible early enough for Giorgia to consider it. She can understand what the option means for her trip and judge it alongside her other choices without having to assemble that meaning herself. Once she commits, the transition from car to train remains understandable as part of the same door-to-door journey. After the journey, the experience gives her a clearer basis for deciding whether she would consider the same type of journey again.

For Giorgia, confidence does not require certainty about every detail. She needs enough clarity to judge whether the option makes sense for her trip. She also needs to understand how the different parts of the journey connect and what she can reasonably expect after she commits.

The desired experience builds on the two statements that emerged while developing Giorgia as an experience profile: "*I want to leave with the feeling that I made a sensible choice*" and "*I want to experience my journey as one logical whole.*" Together, these statements describe two parts of the desired experience.

- Giorgia should be able to judge the combined journey before committing to it.
- The journey should remain understandable as she moves between car, P+R and train.

This responds directly to the fragmentation described in Chapter 2 and the current journey in Chapter 6, where travellers still have to connect information and actions across several systems themselves. The design focus is therefore the quality of Giorgia's door-to-door journey, with P+R treated as one part of that journey.

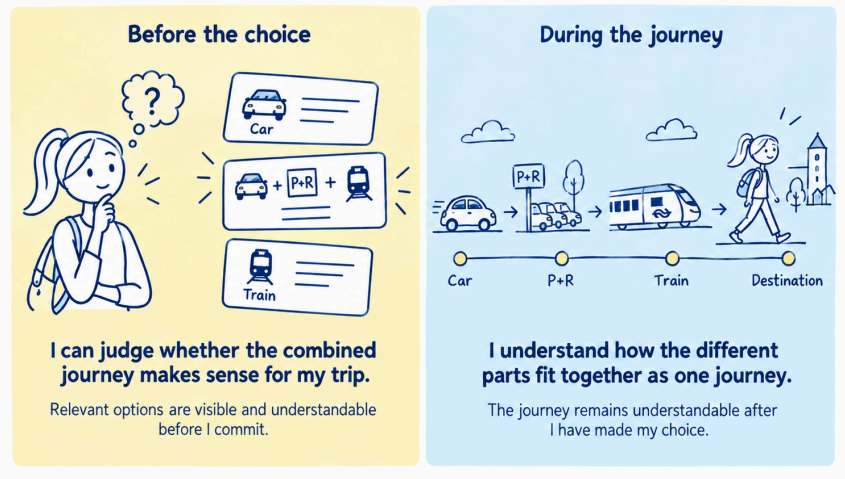


Figure 8.1. Desired experience statement

8.2 From current journey to future journey

The current journey showed that trust is the most fragile before the trip, when Giorgia has to decide if the combined journey is worth trying. It also showed that confidence in that choice can weaken when she has to move between separate systems, especially around the P+R transfer and during the return journey. The Future Journey keeps the same travel context, but changes how Giorgia is supported at these moments. It describes how the journey could become easier to judge before commitment and remain understandable once she starts travelling.

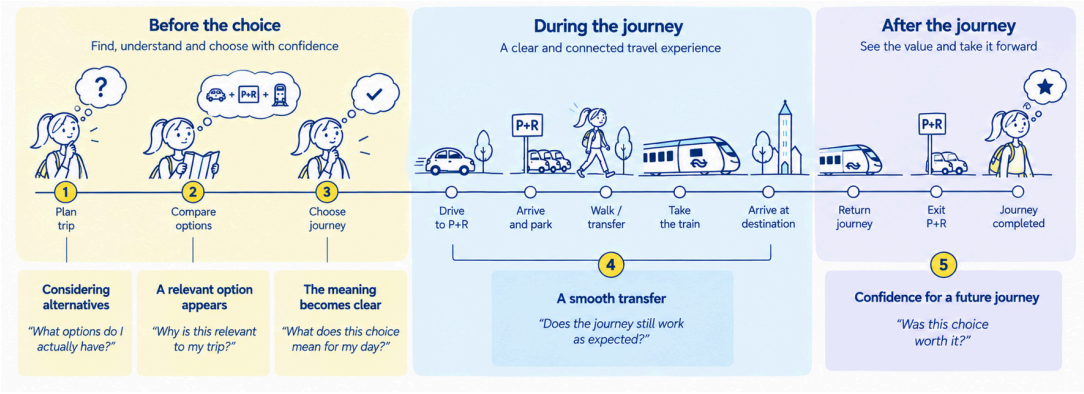


Figure 8.2. Future Journey with identified key moments

The Future Journey was developed by comparing Giorgia's current experience with the desired experience described in Section 8.1. The same journey stages were used so that the change in experience could be examined without changing the travel scenario itself. The design principles from Chapter 7 were then used to ask

what Giorgia would need at the moments where the current journey requires the most interpretation, judgement or coordination. The detailed exploration behind this step is documented in Appendix D.1.

Identifying moments that matter

The comparison between the current and desired journeys identified five moments where the experience needed to change. These moments were selected because Giorgia currently has to do important interpretive or coordination work herself: noticing that an alternative is relevant, judging whether it fits her situation, understanding what it means for the trip, connecting different parts of the journey, and deciding afterwards what the experience means for a future choice.

Each moment was then explored from Giorgia's perspective by asking three questions. *What does she currently have to work out herself?, what should be different in the desired experience?, and what type of support could enable that change?* This kept the exploration connected to the design principles from Chapter 7 while allowing the requirements to become more specific to each stage of the journey.

Figure 8.2 shows the Future Journey and the five moments selected for further development. The aim was not to redesign every touchpoint in the journey. The focus remained on the points where Giorgia currently has to make sense of the option, make a judgement or reconnect parts of the journey herself. Figure 8.3 then summarises the corresponding shifts from the current to the desired experience.

The five selected moments therefore form a connection between the broad design principles and the more specific experience requirements developed in the next section. They do not yet define a solution. They show where the desired experience needs to change and provide the basis for deriving the design mechanics used later in concept development.

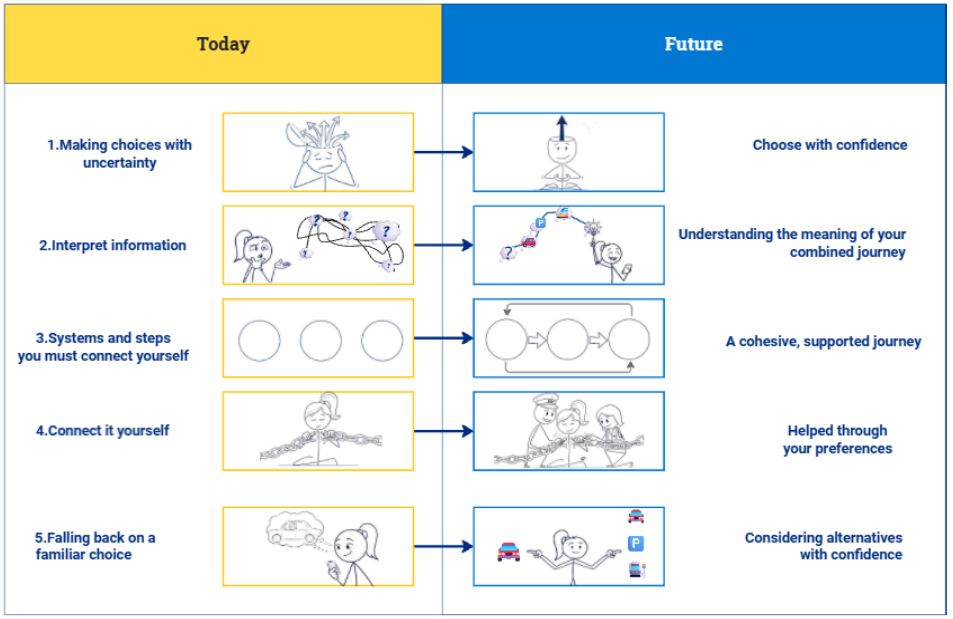


Figure 8.3. experience shifts

8.3 Five key moments in the future experience

The five moments below develop the desired experience at the points selected in Section 8.2. Each starts from a question Giorgia faces at that stage of the journey. A design mechanic then describes

the type of support that is needed to change the experience at that moment. The mechanics were derived from the Future Journey, the design principles from Chapter 7 and the moment-specific exploration carried out from Giorgia's perspective. This follows the human-centred approach used throughout the project, in which the traveller experience remains the starting point for design development (IDEO.org, 2015).

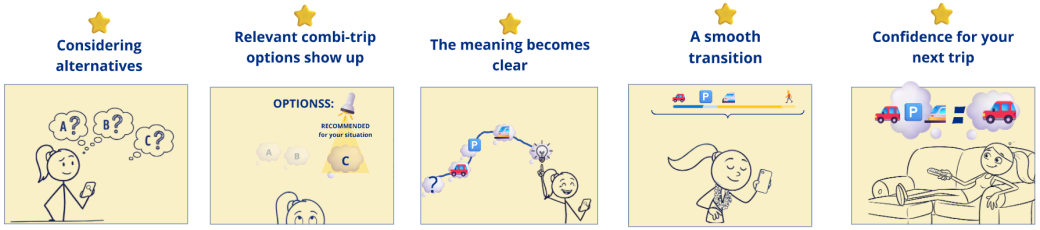


Figure 8.4. Moments that matter

Mayer et al. (1995) and Lee and See (2004) are used as theoretical lenses where questions of trust and reliance under uncertainty are relevant. Mayer et al. developed their model for organisational trust, while Lee and See focus on trust in automation. Neither model is used here as a direct explanation of traveller behaviour. The five mechanics themselves were developed within this project from the journey research and the Future Experience Vision.

The screens used in the short scenarios only make the desired experience easier to imagine. At this stage, they do not define the form of the final concept. The detailed development of the five moments is documented in Appendix D.1.

Considering alternatives

What options do I actually have?

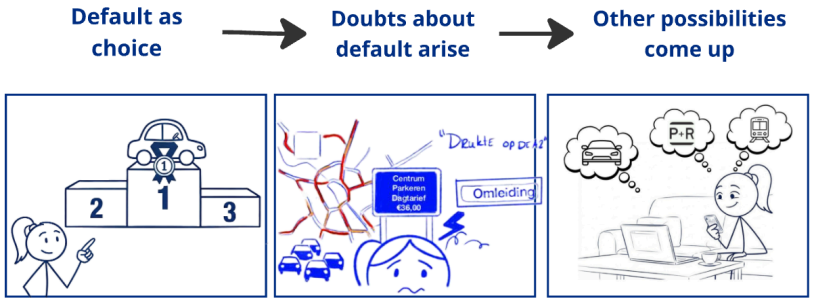


Figure 8.5. Desired experience Considering alternatives

Design mechanic: **REVEAL.** A relevant alternative needs to become visible early enough to enter the traveller's consideration.

Before Giorgia can compare travel options, the combined journey first has to enter her consideration. For her trip to Utrecht, this becomes relevant when the conditions of the trip give her a reason to look beyond the familiar car journey. High parking costs at the destination, expected congestion or a suitable train connection from a P+R location can all make the combined journey worth considering. REVEAL brings that possibility into view while the choice is still open.

The car stays visible as a legitimate option. The purpose of REVEAL is to make sure that Giorgia can also see an alternative that may otherwise be easy to overlook. This is supported by research on multimodal travel information. Chorus et al. (2007) found that information had its strongest effect on travel-choice quality when it

introduced alternatives that travellers had not previously considered. REVEAL therefore creates the possibility for comparison. Questions of trust only become relevant once the combined journey is part of the decision.

A relevant combined journey appears

Why is this relevant to my trip?

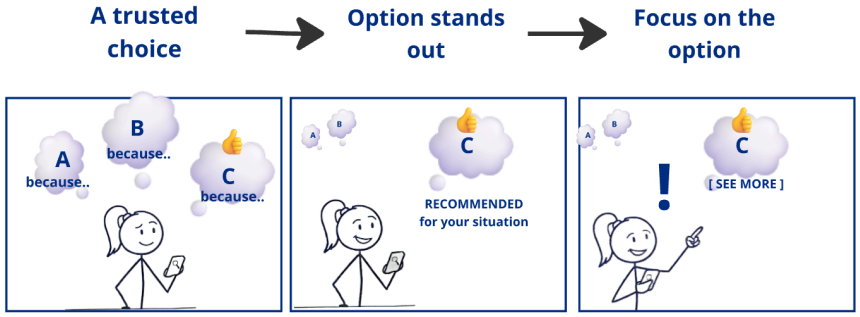


Figure 8.6. Desired experience Relevant combined journey appears

Design mechanic: **RELATE.** The traveller needs to understand why a particular option is relevant to the current trip.

Once the combined journey is visible, Giorgia still needs to understand why it deserves her attention. The same P+R option can be useful for one trip and irrelevant for another. Its relevance therefore depends on the situation in which the choice is made. For the Utrecht journey, this could mean showing that a particular P+R avoids city-centre parking while providing a direct train connection towards her destination.

RELATE makes the reason for presenting the option understandable. If destination parking is expensive, Giorgia can see how the combined journey changes that part of the trip. If congestion affects the direct car journey, she can see why changing to the train earlier may be useful. She therefore has less need to infer the relevance of the option from separate pieces of information. The desired experience is that she can recognise why the option might fit this trip before investing more effort in comparing it.

The meaning becomes clear

What does this choice mean for my day?

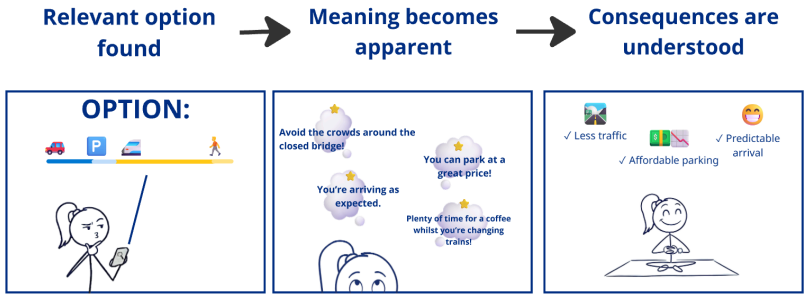


Figure 8.7. Desired experience meaning becomes clear

Design mechanic: **TRANSLATE.** Separate information needs to be translated into consequences and trade-offs that Giorgia can use in her decision.

A relevant option can still be difficult to judge when its information remains fragmented. The field research in Chapter 5 showed that travellers often had to combine parking conditions, costs, train information and transfer details themselves before they could

decide whether P+R made sense. TRANSLATE addresses this interpretive work. It brings the information together around the journey Giorgia is actually considering.

In the desired experience, Giorgia can understand what the option means before she commits to it. Travel time, parking conditions, cost and the transfer are shown in relation to the journey as a whole. This gives her a clearer basis for comparing the combined journey with the alternatives she already understands. TRANSLATE does not remove all uncertainty. It gives Giorgia enough understanding to judge whether she is willing to rely on the combined journey despite the uncertainty that remains. This is the point at which the definition of trust used in this thesis becomes relevant (Mayer et al., 1995).

A smooth transfer

Does the journey still work as expected?

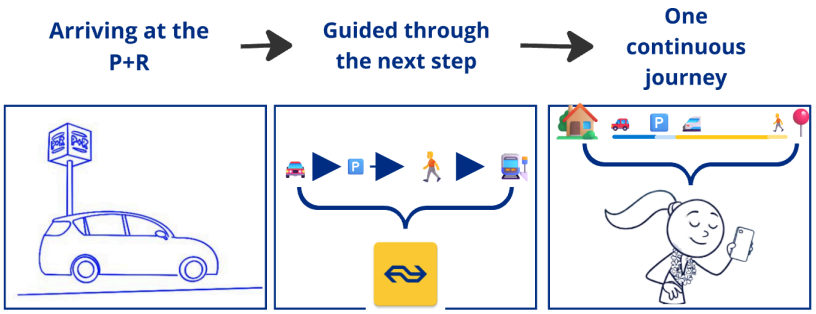


Figure 8.8. Desired experience smooth transfer

Design mechanic: **GUIDE**. Support should continue after commitment so that the chosen journey remains understandable as it unfolds.

After Giorgia commits to the combined journey, her task changes. She no longer needs to decide whether the option is worth choosing. She needs to understand whether the journey she selected is still developing as expected. The Current Experience Journey showed that this can become difficult around the transfer, where the parking location, walking route, station and train are experienced through different systems and touchpoints.

GUIDE keeps these parts understandable as one chosen journey. Giorgia can see what comes next, whether the conditions behind her choice still hold and what her options are when something changes. The support does not need to replace detailed navigation. Its role is to prevent Giorgia from having to reconstruct the journey each time responsibility moves between systems.

Lee and See (2004) describe appropriate reliance on automation as depending on trust that remains responsive to the capabilities and performance of the system. Applied here, the expectations Giorgia formed before choosing the journey should remain checkable once she starts travelling. GUIDE therefore supports continued reliance without assuming that the journey will always proceed exactly as planned.

Confidence for a future journey

Was this choice worth it?

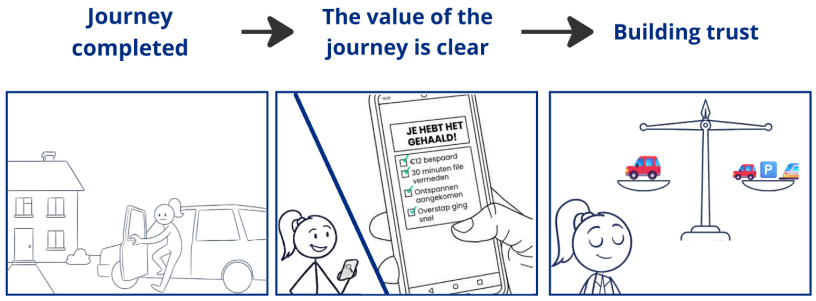


Figure 8.9. Desired experience Future journey

Design mechanic: **REINFORCE**. The completed journey should give the traveller a clear reference point for a similar decision in the future.

The experience can still matter after Giorgia has reached her destination. Chapter 6 showed that what happens after commitment can confirm or weaken the expectations formed before the journey. After the trip, Giorgia can compare what she expected with what actually happened. She can see whether parking was available, whether the transfer worked as expected, what she paid and whether the journey remained workable in practice.

Research on retrospective evaluation provides a reason to treat this final moment as part of the experience. Kahneman et al. (1993) showed that how an experience is evaluated afterwards can affect how it is remembered and which experience people prefer to repeat. This finding comes from a different context and does not show that one successful P+R journey will lead to repeated use. It does support making the outcome of the completed experience visible enough to be evaluated.

The MWM2 study on regulated P+R adds travel-specific context. Among travellers who did not currently use regulated P+R, future use depended on personal circumstances and practical conditions such as parking availability, access to the platform, safety, parking tariffs and ease of payment (Internal company document D9, 2024). The implication for REINFORCE is therefore modest: a completed journey can give Giorgia concrete experience with some of the conditions that may matter when she considers P+R again.

In the desired experience, Giorgia can relate the outcome of the journey back to the reasons behind her original choice. If avoiding parking stress, keeping costs low or making an easy transfer mattered beforehand, she can see how the actual journey performed against those expectations. The combined journey then becomes easier to judge when a similar travel situation occurs again. Whether this is enough to influence future behaviour remains a question for evaluation rather than an assumed effect of the design.

The five mechanics describe different forms of support throughout the journey. **REVEAL** brings a relevant alternative into consideration. **RELATE** explains why it may fit the current trip. **TRANSLATE** makes the consequences of that option understandable before commitment. **GUIDE** keeps the chosen journey understandable as it unfolds. **REINFORCE** connects the completed experience back to the basis of the original choice.

Together, the five mechanics form an experience arc across the journey, shown in Figure 8.10. The figure does not represent a measured increase in trust. It shows how the type of support changes from making an option visible before the choice to helping the traveller make sense of the completed journey afterwards. Section 8.4 shows how this experience arc is used for concept development.

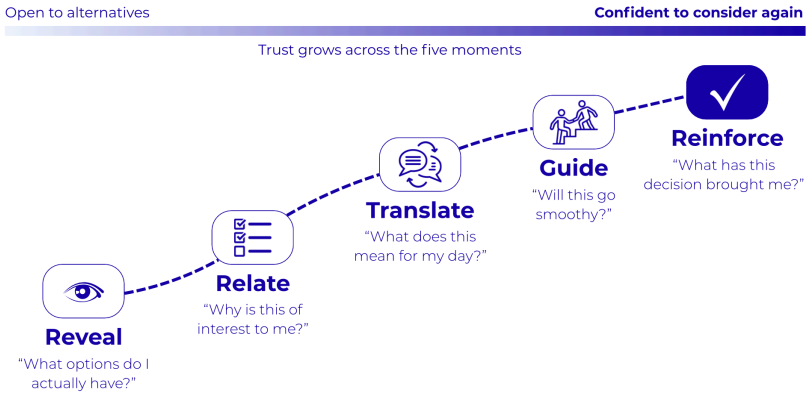


Figure 8.10. Experience arc from reveal to reinforce

8.4 From design mechanics to concept development

The five mechanics are used as the basis for concept development. They describe what a future solution should support at different moments of the journey without prescribing a specific interface, feature or service. This gives room to explore different concept directions while keeping them connected to the experience developed in this chapter. The framework was developed for this project to structure concept development and review. It is not intended as a general model of P+R behaviour.

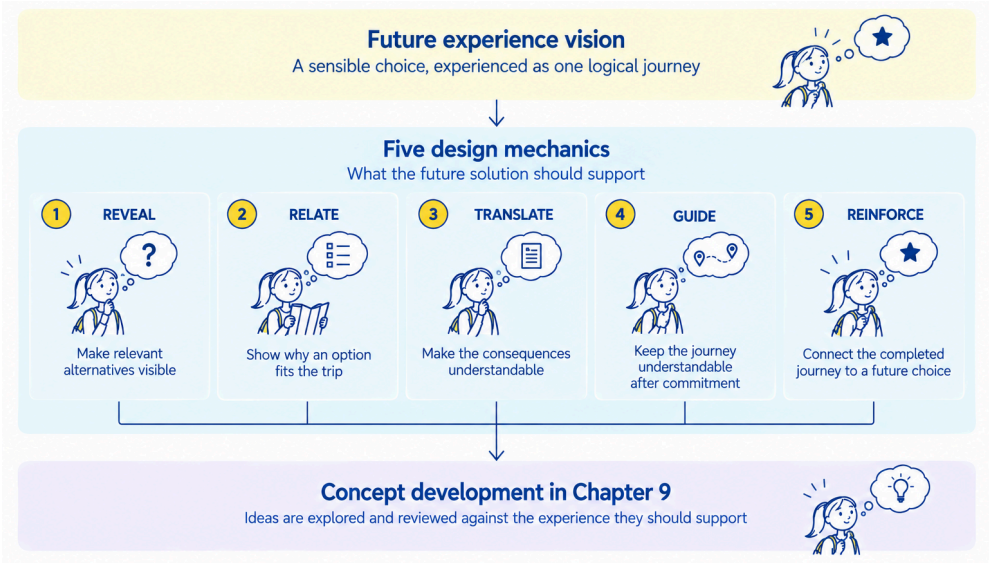


Figure 8.11. Design framework used for concept development.

In Chapter 9, the mechanics are used to organise and review the concept exploration. Ideas can be traced back to the moment in the journey they address and to the type of support they provide. This makes it possible to examine whether a concept contributes to the desired experience across the journey, instead of judging ideas only as individual features.

The framework also helps define what can be addressed through the NS app. Some conditions that influence the P+R experience, like parking capacity, on-site lighting and the reliability of physical facilities, are partly outside the scope of a digital concept. The app

can, however, support how travellers understand the combined journey, prepare for it and stay informed when different parts of the journey connect or conditions change. The mechanics therefore define a digital role within the wider door-to-door experience without treating the app as responsible for every problem identified in the research.

Chapter conclusion

This chapter translated the design direction from Chapter 7 into a Future Experience Vision for Giorgia's P+R journey. Five moments were selected where the current experience needs to change, and five design mechanics describe the support required at those moments. Together, they provide the basis for the concept development in Chapter 9, where different ways of delivering this experience are explored and compared.

9. Deliver: From Design Direction to Concept

Chapter 8 defined the experience the future solution should create through five design mechanics: ‘Reveal’, ‘Relate’, ‘Translate’, ‘Guide’ and ‘Reinforce’. This chapter explores how that experience could take form.

The design process started broadly, with ideas generated through several ideation sessions and individual exploration. From this work, three concept directions were developed further: an information and cost comparison tool, a P+R mode in the NS app and NS CarPlay. Comparing these directions against the design criteria from Chapter 7 clarified the strengths and limitations of each. These lessons, together with the broader ideation and the design mechanics from Chapter 8, informed the development of the Travel Confidence Companion.

This chapter answers RQ4: *What concept can strengthen the traveller's trust across the key moments of the P+R journey?*

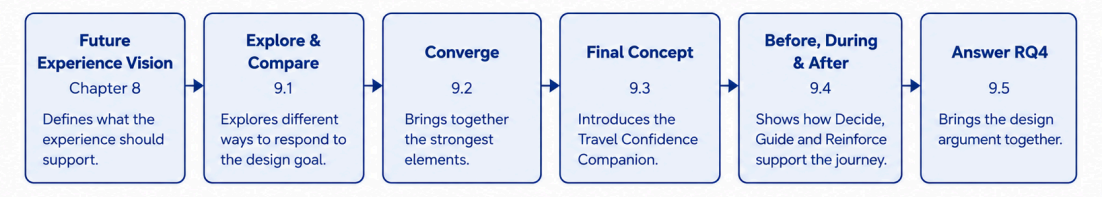


Figure 9.1. Chapter 9 flow

9.1 Exploring and comparing concept directions

Broad exploration

Ideation was used as a divergent step, with the aim of generating a broad set of possible responses before narrowing towards concept directions (Tassoul & Buijs, 2007). Ideas for possible solutions had already started to develop during earlier stages of the project. Concepts such as NS CarPlay and an integrated P+R travel mode were explored before the final design framework in Chapter 8 had taken shape. As the research direction became clearer, the solution space was revisited and deliberately broadened. The five design mechanics from Chapter 8 helped guide this exploration and reflect on new ideas, without prescribing what the final solution should look like.

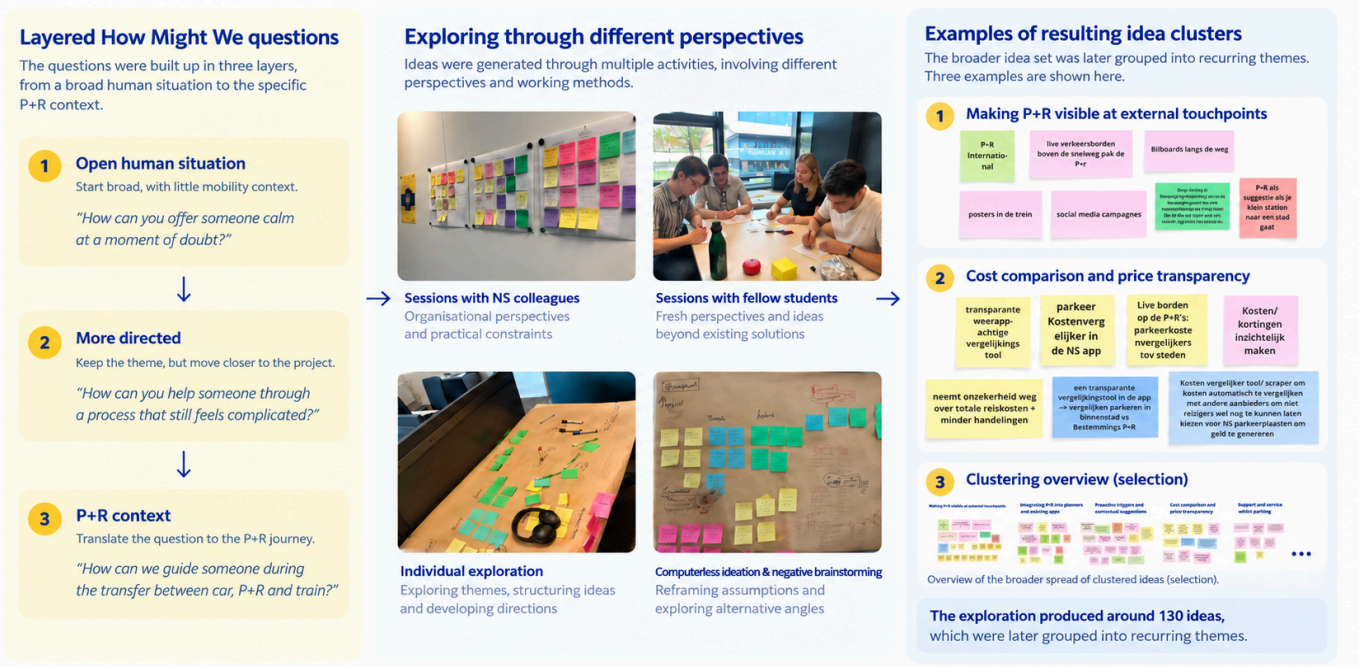
Ideas were developed through sessions with NS colleagues, fellow graduation students and individual exploration. These perspectives served different purposes. NS colleagues brought knowledge of current digital services, organisational possibilities and practical constraints, while fellow students approached the challenge with more distance from existing NS solutions. Individual exploration was used to question and extend ideas between these sessions.

To prevent participants from being limited by the context and boundaries of P+R during idea generation the ‘How Might We’ questions were built in three steps. For each topic, the first question was deliberately open and provided little mobility context. The second addressed the same underlying theme more directly, while

the third translated it into the P+R journey. For example, *How can you offer someone calm at a moment of doubt?* was followed by *How can you help someone through a process that still feels complicated?* and finally *How can we guide someone during the transfer between car, P+R and train?* This structure allowed participants to generate ideas from other situations before applying them to P+R.

The approach was repeated across several topics and produced a wide range of ideas. Additional exploration, including negative brainstorming and a computerless ideation week, was used to examine the challenge from different traveller perspectives. The resulting ideas ranged from cost comparison and P+R information to journey integration, contextual support and guidance during travel. The wider exploration and filtering process are documented in Appendix D.2–D.3.

Figure 9.2. Broad exploration of the solution space.



The broad exploration produced many individual ideas, but also showed different ways of approaching the design goal. Three directions were developed further during the project: an **Information and cost comparison tool**, a **P+R mode in the NS app**, and **NS CarPlay**.

Three concept explorations

The ideation process produced around 130 ideas. Some were developed further to explore a specific part of the P+R journey. Figure 9.2 shows three examples: an **Information and cost comparison tool**, a **P+R mode in the NS app**, and **NS CarPlay**. These were not developed as three competing final concepts. They came up at different moments in the project, and each focused on a different part of the P+R journey.

The three ideas came from different parts of the design process. The comparison tool came from a brainstorm session with fellow graduation students. The P+R mode developed from sessions with NS colleagues and personal experience with the Rejsekort app in Denmark. NS CarPlay came later, during the computerless ideation week. Appendix D.4 includes more detailed versions of these explorations.

Each idea focused on a different part of the P+R journey. The comparison tool explored how travellers could compare options before departure. The P+R mode focused on making car, parking and train feel like one connected journey. CarPlay

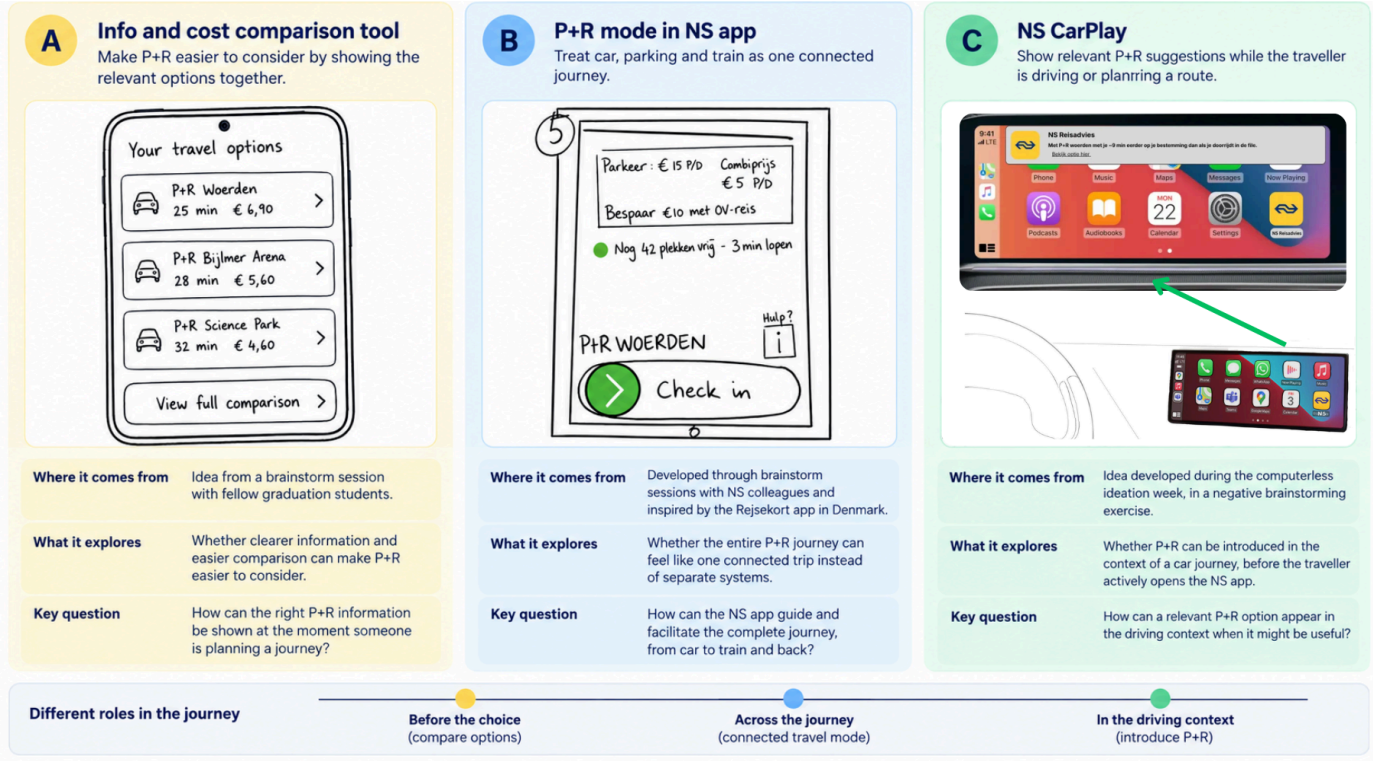
explored whether P+R could become relevant while someone was still planning or making a car journey.

None of these ideas became the final concept. As the research direction and the design criteria became clearer, each idea also showed a different limitation. One mainly addressed the planning moment, another focused on the journey after P+R had already been chosen, while the third covered only the part of the journey in the car. Once the design criteria from Chapter 7 were defined, the three explorations were revisited together to make these differences more explicit.

Comparing the explorations

The three concept explorations were developed at different moments during the project. Each idea was taken further through sketches, discussions and further detailing. This helped to understand what the idea could contribute, but also where it no longer matched the problem that was becoming clearer through the research. When an idea addressed only part of the problem or no longer matched the core tension, the exploration continued in another direction.

The **Information and cost comparison tool** mainly addressed the planning stage. It brought relevant information together and made alternatives easier to compare, but did little for the later stages of the journey. **The P+R mode in the NS app** explored how car, parking and train could become one connected journey. Its main limitation was that much of the support became useful only after users had already chosen P+R. **NS CarPlay** explored an earlier moment by bringing P+R into the car context, but the concept provided little support after the car leg had ended.



After defining the design criteria in Chapter 7, the three explorations were reviewed together again. This made the differences that had already become visible during development more explicit. Figure 9.4 compares the concepts using the same five criteria. The comparison is qualitative: *Strong, Partial* and *Weak* indicate how directly each exploration addresses a criterion. It was used to structure the reflection on the concepts, instead of to select a winning concept. Using the same

criteria for different concept directions makes the reasoning behind a comparison easier to trace (Pugh, 1991). Appendix D.4 provides the supporting rationale for these ratings.

Design criterion	A Info and cost comparison tool	B P+R mode in NS app	C NS CarPlay
Immediate understanding Can the traveller quickly understand what the travel option means?	Strong Makes relevant options and key facts visible in one place.	Partial The one check-in idea is simple, but requires understanding a new travel mode.	Partial The suggestion is easy to notice, but only explains the immediate option rather than the full journey.
Journey coherence Does the journey feel like one connected whole?	Weak Brings information together, but does not connect the journey itself.	Strong Connects driving, parking and train travel into one journey.	Weak Covers only the car part of the journey and does not support the full transfer.
Uncertainty reduction Does the concept reduce important doubts before the traveller makes a choice?	Partial Answers factual questions, but still leaves interpretation to the traveller.	Partial Makes the combined journey easier to understand, but mainly after P+R has already been chosen.	Partial Can reduce uncertainty when conditions change, but enters the journey after the initial travel choice.
Ease of comparison Does the concept make comparison and interpretation easier?	Strong Makes costs, availability and alternatives easier to compare.	Weak Focuses mainly on carrying out one selected journey.	Partial Can introduce another option, but does not provide a full comparison.
Clear expectations Does the concept help the traveller form a realistic picture of the journey?	Partial Provides facts, but not a clear picture of the whole journey.	Strong Makes the practical sequence and next steps clear.	Weak Helps with the immediate next decision, but not with forming a picture of the full journey.

Strong — Directly addresses the criterion
Partial — Addresses the criterion only partly or at a limited moment in the journey
Weak — Does not substantially address the criterion

Figure 9.4. Comparison of the three concept explorations against the design criteria from Chapter 7.

Taken together, the three explorations showed that no single direction covered both parts of the confidence problem identified in Chapter 6: helping the traveller judge whether P+R makes sense before commitment and maintaining that understanding as the journey develops. This became the starting point for the next round of concept development.

9.2 Converging towards the final concept

The comparison showed that each concept direction addressed a useful part of the problem, but none covered the full journey. The broader set of ideas was therefore revisited to identify which elements still fitted the design direction developed in Chapters 7 and 8.

The around 130 ideas generated during the different ideation activities were placed under the five design mechanics from Chapter 8: ‘Reveal’, ‘Relate’, ‘Translate’, ‘Guide’ and ‘Reinforce’. Doing this made it easier to see which ideas contributed to the desired experience and which ideas no longer fitted the direction of the project. About 32 ideas remained after this step. Ideas were kept when they addressed an important moment in the traveller journey, supported one or more of the design mechanics, and contributed to the aim of building trust around the P+R choice. This was a qualitative filtering step, not a formal scoring method.

The three earlier concept directions remained useful during this process. The Information and cost comparison tool explored how alternatives and costs could be made visible side by side. The P+R mode in the NS app had explored how driving, parking and train travel could be treated as one journey. NS CarPlay explored how support could appear at a moment when P+R might otherwise not be considered. These directions therefore continued to influence the development, but they were not used as fixed building blocks for the final concept. Some elements were taken further, some returned as possible future extensions, and others were left behind.

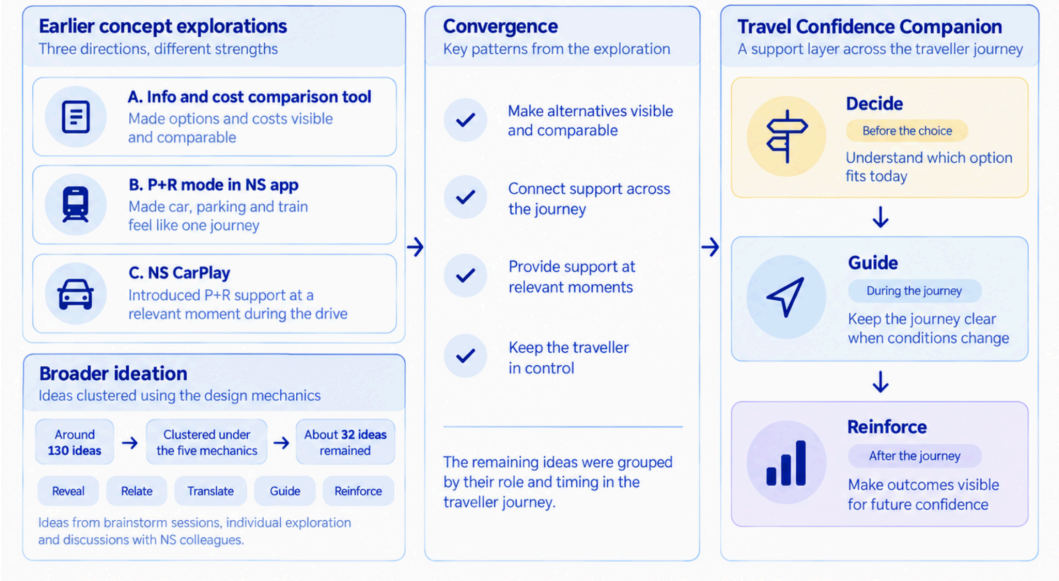


Figure 9.5. From exploration to the final concept structure.

Figure 9.5 shows how these earlier explorations and the broader ideation contributed to the convergence.

The remaining ideas were then considered in relation to the traveller task and the moment at which support was needed. Before commitment, ‘Reveal’, ‘Relate’ and ‘Translate’ all contribute to the same decision: noticing a relevant option, judging whether it fits the situation and understanding what it means in practice. Chapter 5 showed that travellers already had to connect separate pieces of information before they could judge whether P+R made sense. Treating ‘Reveal’, ‘Relate’ and ‘Translate’ as separate concept layers would have split one pre-trip decision into separate forms of support. They were therefore combined into ‘Decide’, one layer that supports the traveller until a choice can be made.

‘Guide’ starts after that choice, when the traveller's task shifts from comparison to keeping the chosen journey understandable as conditions change or the next step becomes unclear. ‘Reinforce’ addresses a later task: relating the completed journey back to the priorities behind the choice so that the experience can inform a future decision. Unlike ‘Decide’ and ‘Guide’, ‘Reinforce’ remained a more exploratory part of the concept.

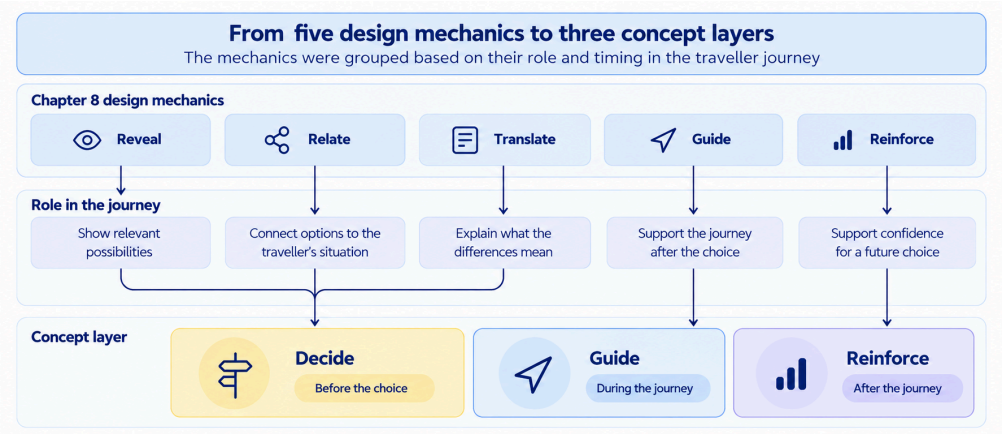


Figure 9.6. From five design mechanics to three concept layers.

This resulted in three connected parts: **‘Decide’ before the choice, ‘Guide’ during the journey, and ‘Reinforce’ after the journey**. The final concept combines the retained ideas across these three moments. The filtering process is documented in Appendix D.3. Appendix D.5 documents how the five design mechanics were combined into ‘Decide’, ‘Guide’ and ‘Reinforce’.

Together, these three parts formed the structure for the ‘Travel Confidence Companion’. The next section introduces the concept as one experience and shows how it sits around the existing NS Reisplanner.

9.3 The ‘Travel Confidence Companion’

The final concept is the ‘**Travel Confidence Companion’**, a decision- and journey guidance service within the NS travel experience. It helps travellers understand which travel option fits their situation before they commit to a journey, supports them once that choice has been made, and helps them make sense of the outcome afterwards.

The concept responds to a problem that became clear throughout the research. Travellers can already find much of the information needed for a combined journey, but it is spread across different sources and still needs interpretation. Field research in Chapter 5 showed that travellers had to piece together parking conditions, costs, train information, and transfers before P+R became a realistic option, especially for unfamiliar journeys (Section 5.3). Knowing the train departure time, parking cost or traffic situation does not automatically answer if P+R is a sensible option for a particular journey.

In the concept, recommendations are based on traveller-defined priorities and journey conditions. The traveller can indicate what matters most for the journey: low parking stress, reliable connections, low cost, an easy transfer, short travel time or comfortable travel. These priorities are considered together with information about the journey, such as train services and disruptions, P+R availability and tariffs where available, city-centre parking costs, road traffic and weather conditions.

The Companion selects the information that is relevant to the traveller's situation and translates the differences into practical meaning for that journey. Section 10.3 examines the availability, reliability and integration requirements of these inputs.

Figure 9.7 on the next page introduces the concept visually:

NS TRAVEL CONFIDENCE COMPANION

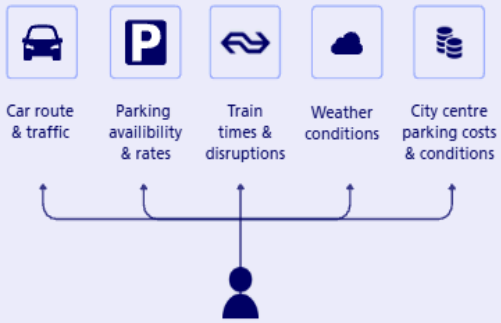
Find the journey that fits. Travel with confidence.



The Travel Confidence Companion is a support layer around the NS Reisplanner that helps travellers understand which option fits their situation, know what to expect, and stay in control when circumstances change.

Today

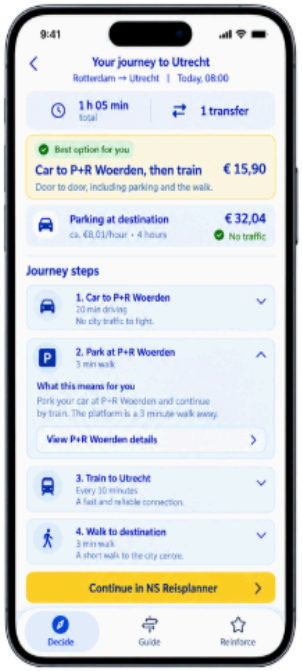
Travellers often have to connect information across different sources



Fragmented information.
More uncertainty.
A Higher threshold to choose P+R

1 DECIDE
Before the choice

" Which journey fits me best today?"



Reveal
See relevant alternatives

Relate
Based on your situation

Translate
Understand what it means

2 GUIDE
During the journey

"Will this still go well?"



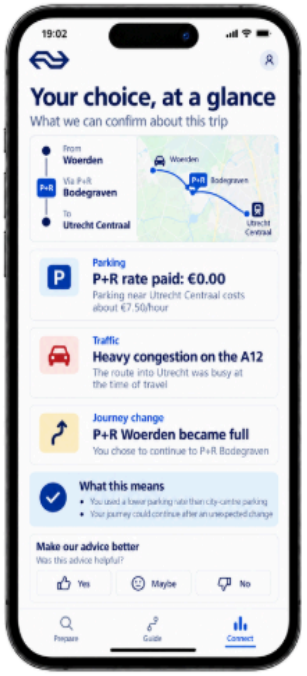
Real-time support
Clear next steps

Proactive support
When conditions change

Keep in control
You decide what to do

3 REINFORCE
After the journey

"Was this choice worth it?"



Make outcomes visible
See what your journey delivered

Build confidence
Learn from your experience

Encourage future use
Make it easier next time.

NS Reisplanner
Plans the journey.
Provides real-time travel information

\+

Travel Confidence Conpanion
Adds support around the door- to door journey.
Helps you understand, choose and stay confident

Two parts. One smooth experience

Value for the traveller
- ✓ More confidence in unfamiliar journeys
- ✓ Less effort comparing travel options
- ✓ Understand why an option fits your situation
- ✓ Support before, during and after the journey

Value for NS ComIT Reizigers
- ✓ Supports personalised travel recommendations
- ✓ Extends journey planning beyond A-to-B routing
- ✓ Turns information into meaningful guidance
- ✓ Connects choice support with the Reisplanner

Value for NS Stations
- ✓ Brings P+R into consideration at the right moment
- ✓ Makes P+R easier to find and understand
- ✓ Provides actionable alternatives when conditions change
- ✓ Strengthens P+R within the door-to-door journey

UNDERSTAND.
CHOOSE.
TRAVEL.
WITH CONFIDENCE

The concept consists of three connected layers: '**DECIDE**', '**GUIDE**' and '**REINFORCE**'. Each addresses a different moment in the traveller's decision and journey. Giorgia, introduced as the design lens in Section 6.2 and carried through Chapter 8, returns here to keep these three layers connected to the traveller experience.

DECIDE.

Before committing to her journey, Giorgia asks: Which journey fits me best today? 'Decide' makes relevant alternatives visible and helps her understand how they compare with what matters in her situation. This responds directly to the difficulties of making sense of P+R and fragmented journey support identified in the field research, where unfamiliar travellers had to connect the different parts themselves before they could judge whether P+R made sense (Section 5.3). Research on travel choice also suggests that making relevant alternatives visible can improve decision quality when travellers become aware of alternatives they had not previously considered (Chorus et al., 2007).

GUIDE.

Once Giorgia has made her choice, the question changes: Will this journey still work for me? 'Guide' stays with her during the journey. It can confirm when the journey is still developing as expected and provide relevant options when circumstances change. Field research showed that uncertainty becomes especially visible at points where car, parking, and train have to connect. At these system switches, travellers often need confirmation that the next part of the journey still works as expected (Section 5.3). Similar integration problems are recognised in research on multimodal mobility services (Alyavina et al., 2020). The Companion can advise, but the traveller remains responsible for the final choice.

REINFORCE.

After arriving, Giorgia can look back on the choice she made and ask: *Was this choice worth it?* 'Reinforce' relates what actually happened during the journey back to what mattered when she made that choice. It can show if the journey stayed within the expected travel time, if parking was available and what the traveller actually paid. 'Reinforce' uses the journey that actually took place as a reference for a future decision. Chapter 6 showed that the journey itself shapes expectations for a later choice. Kahneman et al. (1993) also show that an experience influences how it is remembered and evaluated afterwards, even though their study was **not** about P+R or travel behaviour.

The concept also builds on the organisational findings from Chapter 4. Stakeholder interviews and the internal document review showed that further integration of P+R into the NS app is already a recognised direction, while the traveller-facing experience is still being defined (Sections 4.4.1 and 4.4.2). The same research showed that increasing visibility alone is unlikely to solve the problem when travellers still struggle to understand how P+R works and if it applies to their journey. The Companion focuses on the still-undefined traveller-facing role of the app, without introducing a separate mobility product.

The ‘Travel Confidence Companion’ does not replace the NS ‘Reisplanner’. The ‘Reisplanner’ remains responsible for planning the executable journey, including routes, departure times, connections, and transport modes, and supports booking where available. The Companion works around this planning process. Before planning, it helps the traveller understand which type of journey may fit. During travel, it helps interpret changes in relation to the choice already made. Afterwards, it helps the traveller understand how that choice worked out. Support therefore starts before the route is planned and continues after the journey, while the final choice remains with the traveller.

The following section shows how Decide, Guide and Reinforce work in practice throughout the journey. Appendix D.6 documents the development of the three layers, including their information needs and selected interface iterations.

9.4 Supporting the journey before, during and after travel

Section 9.3 introduced ‘Decide’, ‘Guide’ and ‘Reinforce’ as the three layers of the ‘Travel Confidence Companion’. This section follows these layers through one journey with Giorgia, travelling from Nootdorp to Utrecht for a busy event. The screens show how the concept is intended to respond at different moments in the journey.

Earlier iterations were developed as a separate prototype to make the interaction and design intentions clear. The final version was then translated into the NS app context. The screens shown here focus on the information and guidance Giorgia receives, rather than defining a final NS app interface. The journey starts before a route has been planned, when Giorgia is still deciding how she wants to travel. Appendix D.6 includes the development of the three flows, including intermediate iterations and their underlying information needs.

Decide: understanding what fits before committing

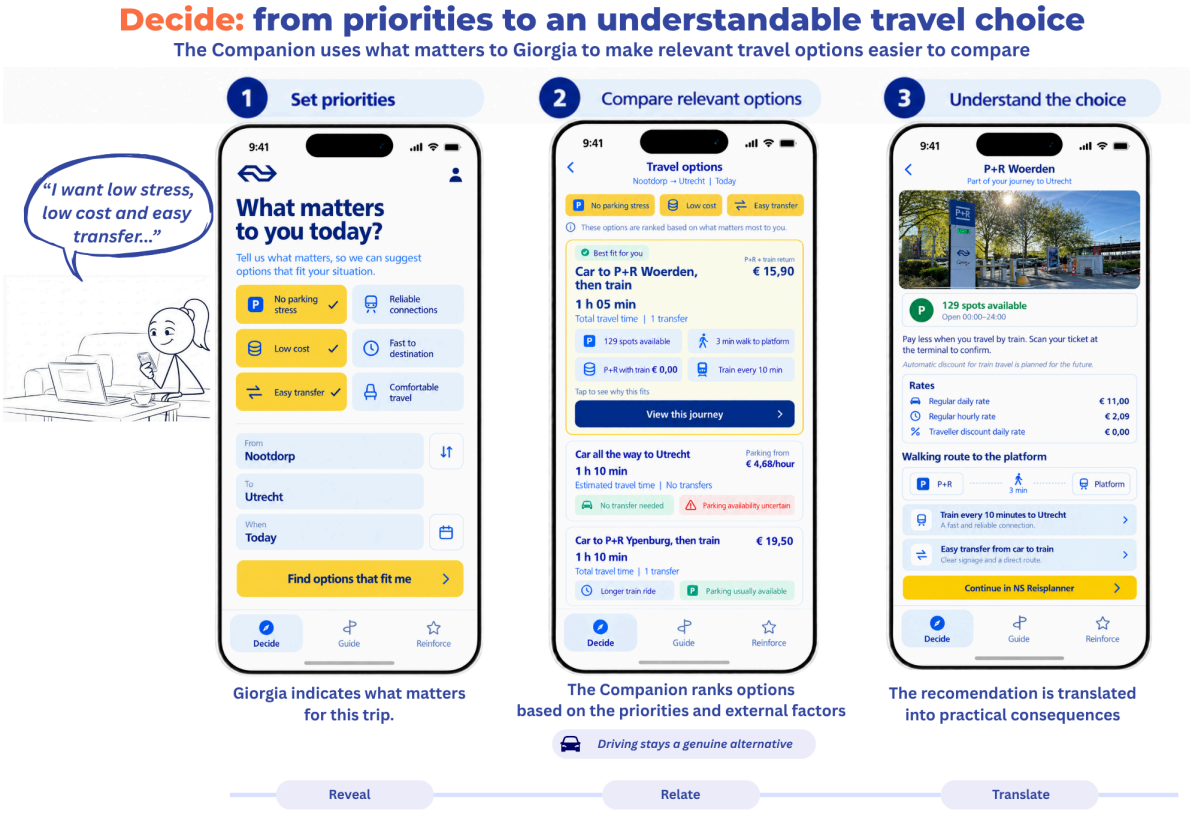
Before choosing a journey, Giorgia indicates what matters most for this trip. Because she expects parking pressure in Utrecht, she selects **No parking stress**, **Low cost** and **Easy transfer**. These priorities form the starting point for the recommendation. The Companion combines them with current travel conditions, such as P+R availability and tariffs, train frequency, traffic and parking conditions at the destination.

Figure 9.8 shows how this develops across three steps. First, Giorgia provides the journey context and selects the priorities that matter most to her. In this scenario, the Companion compares several ways of reaching Utrecht and ranks them according to these priorities. P+R Woerden appears as the strongest match because parking is available, the transfer to the platform is short and the P+R rate is low when combined with train travel. The final screen explains what this option means in practice before Giorgia commits. This includes the walking distance, parking conditions and frequency of the train connection. Giorgia can then continue to the NS Reisplanner, where the executable journey is planned.

For NS, the goal is therefore to build confidence in the advice, not to steer travellers toward P+R or the train. An important part of this comparison is that **driving all the way to Utrecht remains a visible, genuine option**. NS therefore does not present P+R or train travel as the automatic answer. The direct car journey is compared using the same situation, including travel time and parking conditions at the destination. This keeps the recommendation transparent and reduces the risk that the Companion is perceived as steering the traveller towards an NS product. If driving is a reasonable option for Giorgia's situation, it should remain part of the comparison. The role of the Companion is to explain how the available options fit what she values, while leaving the decision with her.

The sequence combines the three mechanics behind Decide. **Reveal** makes relevant alternatives visible, including options Giorgia may not have considered herself. **Relate** connects these alternatives to her own priorities and the current travel situation. **Translate** turns the differences into practical consequences that she can understand before choosing. The comparison therefore moves from separate pieces of information to an explanation of what the options mean for Giorgia's priorities.

Figure 9.8. Decide: from priorities to an informed travel choice.



Guide: staying supported after the choice

After Giorgia has chosen her journey, the role of the Companion changes. She no longer needs help comparing travel options. Instead, she needs to know whether the journey she selected still works as expected. Guide therefore follows the chosen journey and brings forward information when it becomes relevant.

The first Guide screen confirms that Giorgia's journey is still on track. P+R Woerden is available, the transfer remains short and the train connection is running as expected. This confirmation is intentional. ‘Guide’ also has a role when the journey is proceeding as planned. A simple confirmation reduces the need to repeatedly check different sources and gives Giorgia a clearer sense of what comes next.

The situation changes when P+R Woerden becomes full while Giorgia is still on the way. Because avoiding parking stress was one of her original priorities, the change directly affects the reason why Woerden was recommended. ‘Guide’ therefore brings forward another option that still fits that priority. P+R Gouda is shown together with the consequences of changing the plan, including the additional driving time, parking availability and the following train connection. Giorgia can continue towards Woerden, switch to Gouda or look at other alternatives. The recommendation therefore supports the decision without making it for her.

‘Guide’ can also respond when circumstances change in a positive way. After Giorgia reaches the station, an earlier direct train to Utrecht becomes available. The ‘Companion’ makes this opportunity visible and shows what it means for her arrival time. She can take the earlier train or keep the train she originally planned. ‘Guide’ therefore supports beneficial changes as well as disruptions. Its role is to keep the journey understandable as conditions develop.

Together, these moments show the role of the Guide mechanic from Chapter 8. The Companion keeps the separate parts of the journey connected and reduces the need for Giorgia to reconstruct the situation herself when something changes. The information shown is tied to the journey she has already chosen and to the priorities behind that choice. The guidance remains tied to the situation while Giorgia keeps control over what happens next.



Figure 9.9. Guide: supporting the journey as conditions change.

Reinforce: making sense of the outcome

After arriving in Utrecht, the completed journey can provide a reference for a future travel decision. ‘Reinforce’ looks back at what happened during Giorgia's journey and relates the outcome to the priorities she selected at the start.

Figure 9.10 shows the journey summary after Giorgia arrives. The Companion records that the original plan changed from Woerden to Gouda, but the final journey still matched what mattered to her. Parking was available when she arrived, the P+R rate was €0 with train travel and the transfer from car to platform remained short. These outcomes are shown next to the same priorities that shaped the recommendation in ‘Decide’: **No parking stress, Low cost and Easy transfer**.

‘Reinforce’ uses the journey that actually took place. By relating that outcome to Giorgia's original priorities, it gives her a concrete experience to draw on when she faces a similar choice again. The priorities that shaped the recommendation in ‘Decide’ therefore remain relevant during ‘Guide’ and return after the journey as a reference for a later decision.

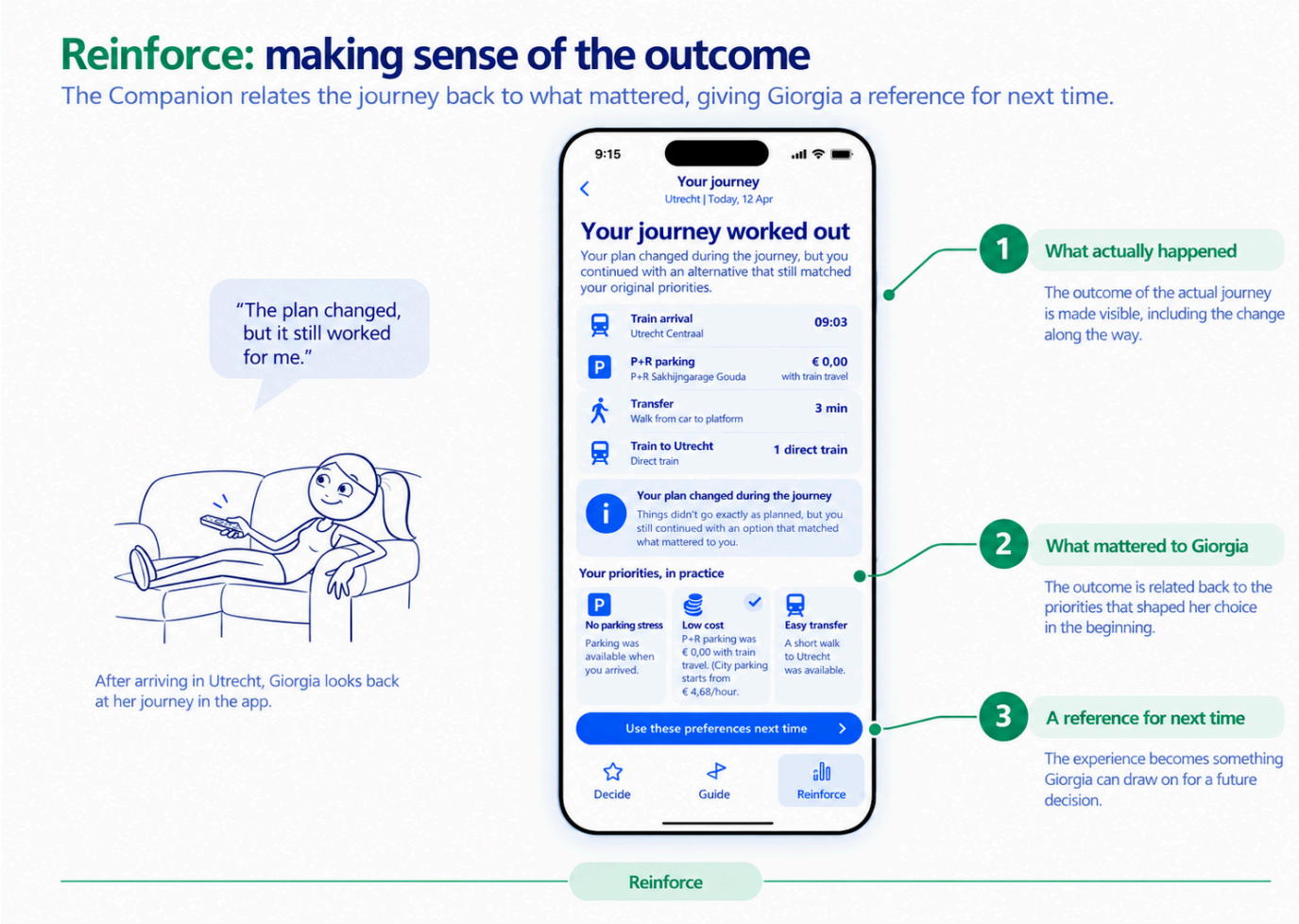


Figure 9.10. Reinforce: relating the journey outcome back to Giorgia's priorities.

Throughout the journey, the role of the ‘Companion’ changes with Giorgia's needs. Before departure, it helps her understand which option fits her situation. During travel, it keeps the chosen journey understandable when circumstances change. After arrival, it relates the outcome back to the priorities that shaped the original choice. The same principle runs through all three layers: the ‘Companion’ provides context and guidance, while Giorgia remains responsible for the final decision. The concept has now been translated from the design direction into a concrete journey and set of interactions. The next chapter evaluates whether these interactions are understood as intended, whether they support the traveller experience, and how realistic they are within the NS context.

9.5 Answer to RQ4

RQ4 asked: What concept can strengthen the traveller's trust across the key moments of the P+R journey?

The concept developed in this chapter is the **Travel Confidence Companion**, a decision and journey guidance layer around the NS Reisplanner. It translates the design direction from Chapters 7 and 8 into three connected layers. **DECIDE** helps travellers judge which option fits their situation before committing. **GUIDE** keeps the chosen journey understandable when circumstances change. **REINFORCE** relates the outcome back to what mattered when the choice was made.

The Companion is designed to strengthen trust by reducing the amount of interpretation travellers currently have to do themselves. Relevant information is selected and explained in relation to the traveller's priorities, while the final choice remains with the traveller. Alternatives, including driving the full journey by car, remain visible where relevant, and the NS Reisplanner remains responsible for planning the executable journey. Chapter 10 evaluates how travellers understand and respond to this support, and what would be required to make the concept workable within the NS context.

10. Deliver: *Evaluating the concept and the way forward*

Chapter 9 translated the design direction into the Travel Confidence Companion. This chapter evaluates how travellers respond to the concept and what NS would need to make this type of support work in practice.

The evaluation addresses four questions. *Does the concept help travellers understand and judge a P+R journey while keeping the final choice in their own hands? What would NS need to provide this support reliably? How does the concept relate to current developments within NS? What still needs to be tested before further development can be considered?*

Different evidence is used for these questions. Traveller sessions show how participants understood the concept, judged the recommendations and described their confidence and control during the test. Stakeholder input is used to identify organisational and technical conditions and to examine how the concept relates to current work within NS. These studies do not show repeated use during real journeys, full technical feasibility or financial value. These limits are taken into account throughout the chapter.

This chapter answers RQ5: *To what extent does the proposed concept address the identified traveller tension, and what conditions would NS need to implement it?*

10.1 Evaluation approach and evidence boundaries

This evaluation uses traveller feedback and stakeholder input to assess what can already be learned from the concept and which questions remain open. The evaluation protocol and supporting traveller evidence are documented in Appendix E. Supporting stakeholder material is included in Appendix F.

Traveller evaluation

Two traveller studies were conducted. Thirteen participants took part in semi-structured online sessions. The sample was purposively varied across travel behaviour, familiarity with P+R and attitudes towards travel-planning applications. The purpose was to include a range of traveller perspectives, not to create a statistically representative sample.

A second study consisted of sixteen short sessions around Utrecht Centraal. Participants were approached around the station instead of a P+R location. The station setting was chosen to avoid recruiting mainly travellers who had already decided to use P+R and to reach people with different levels of P+R experience.

The two studies served different purposes. The online sessions allowed more time to discuss how participants saw the concept and why they responded to it in a certain way. The shorter field sessions provided a second setting in which the main decision-support logic could be tested with limited explanation and with participants recruited in a travel context.

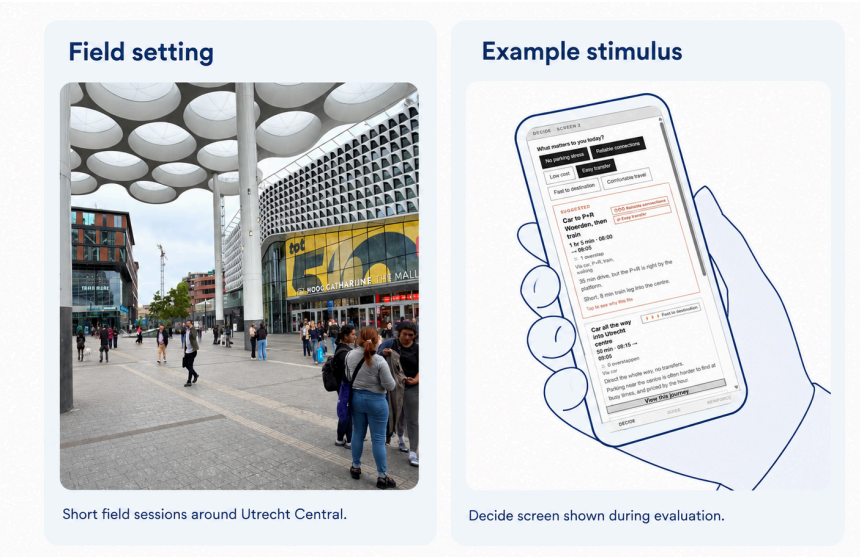


Figure 10.1. Field evaluation setting and example Decide.

Both studies followed the same basic sequence. Participants first discussed how they would normally approach the journey. The concept was then shown with limited explanation. Participants were asked what they understood, how they judged the advice and whether they still felt in control of the final choice. They were also shown a situation in which travelling entirely by car was recommended. This was included to see whether advice from NS would still be seen as credible when the recommendation did not favour train travel.

Tested Concepts

The three layers of the Travel Confidence Companion were not evaluated equally. **DECIDE** was the main focus of the concept evaluation. **GUIDE** and **REINFORCE** were discussed using scenarios and follow-up questions rather than experienced during an actual journey.

The evidence for each layer is therefore different. **DECIDE** has the strongest direct evidence from the traveller sessions. Guide gives an initial indication of how travellers respond to support when circumstances changed within the presented scenarios. **REINFORCE** was explored more briefly and provides only early evidence of how participants interpreted post-journey feedback. These differences are taken into account when discussing the three layers in the rest of this chapter.

Analysis and interpretation

Participants were asked to self-report how confident they felt about judging if P+R suited their journey before and after seeing the concept. The scores were treated as supporting evidence of perceived confidence within the test setting, not as evidence that the concept would change behaviour in practice. Participants' explanations were therefore also examined to understand what had become clearer, what still caused doubt and why their judgement changed or remained the same.

Responses were compared using the same evaluation dimensions: self-reported confidence and the reasons for changes in confidence, understanding of the recommendation, perceived control over the final choice and credibility of the advice. Points of confusion and contrasting responses were also kept in the analysis.

The analysis also separates observed behaviour from what participants said they might do. Hesitation, rereading and

interaction problems could be observed during the session. Confidence scores describe participants' self-reported perception in the test situation. Statements about future use or preference were treated as stated intentions and were not interpreted as observed behaviour. For example, saying that P+R would now be considered is evidence of stated consideration, but it does not show that the traveller would choose P+R in a real journey.

Stakeholder analysis

Stakeholder input from ComIT Reizigers, a separate governance discussion and NS Stations was used to examine what the concept would require in practice (see Appendix F). The material was reviewed for dependencies, organisational conditions and unresolved questions related to further development. Related points were grouped into recurring conditions and compared across the stakeholder discussions. This resulted in four conditions used in Section 10.3: planning capability, reliable information, recommendation governance and journey oversight.

The ComIT and governance discussions were documented through transcripts. Part of the NS Stations input is based on researcher notes and supporting internal material. The analysis can therefore identify conditions and dependencies raised by the stakeholders, but it does not establish technical feasibility, formal ownership, an approved roadmap or a business case.

Evidence limitations

There are also limitations to the traveller evaluation. Participants responded to concepts and scenarios instead of using a working service repeatedly during real journeys. Recruiting around Utrecht Central may have resulted in a sample that is relatively familiar with rail travel. The researcher also designed the concept and conducted the evaluation. To limit the influence of this role, participants discussed their existing behaviour before seeing the concept, the concept was first shown with limited explanation, and both positive and critical responses were included in the analysis.

The evaluation therefore supports a concept-level judgement of traveller response and an assessment of the conditions for further development. Real-world behaviour, sustained trust, full feasibility and financial viability remain open and require different evidence.

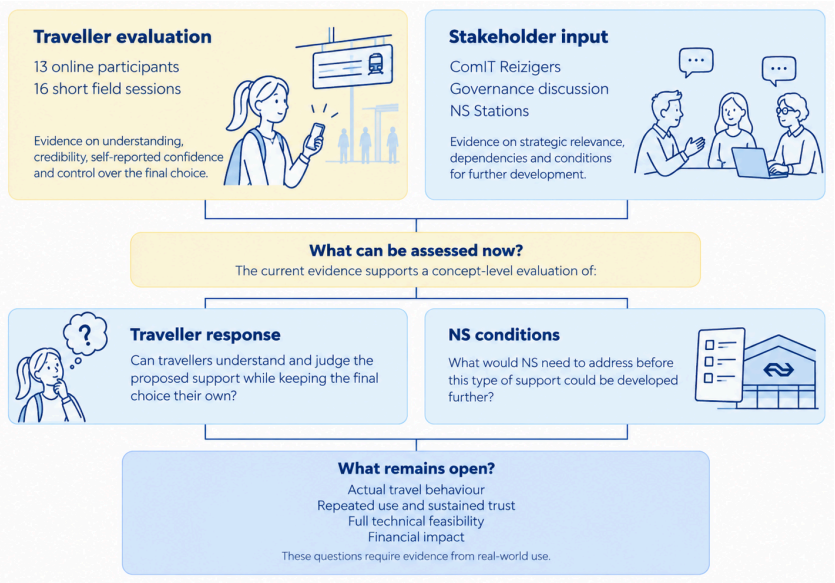


Figure 10.2. Evidence used to evaluate the Travel Confidence Companion and the questions that remain open.

10.2 Does the concept address the traveller tension?

The core tension identified in Chapter 6 is that travellers need enough confidence to judge a P+R journey, but currently have to understand, compare and connect its separate parts themselves before it feels like one coherent option. The evaluation suggests that the Travel Confidence Companion addresses this tension most clearly before the choice is made. Decide has the strongest direct traveller evidence. Participants generally understood the recommendation, found the P+R option easier to judge and still described the final decision as their own. Guide received positive responses when participants considered situations in which something changed during the journey, while responses to Reinforce were more mixed. Figure 10.3 summarises these differences in the current evidence. Supporting traveller evidence is included in Appendix E.



Figure 10.3. Summary of the traveller evidence for the three concept layers.

Decide: helping travellers make the choice

Across both traveller studies, participants generally understood what Decide was trying to do and described the recommendation as support for their own choice. Keeping alternatives visible also appeared to support this sense of control, because participants could still consider another option instead of treating the recommendation as a fixed decision. This relates directly to the tension identified in Chapter 6. Travellers need support to judge a combined P+R journey while remaining in control of the final choice.

All sixteen field-session participants reported a higher confidence score after seeing the concept. The available online scores showed the same pattern, but not every online session contained a complete before-and-after score. The online scores were therefore used as supporting evidence and were not combined with the field-session scores. Participants often linked their increased confidence to having the relevant comparison in one place and needing less additional research before deciding. Within the evaluation, 'Decide' reduced the amount of information participants said they would need to find and combine before making the choice.

Credibility still depended on how the recommendation was presented. Participants generally responded positively when travelling entirely by car could also be recommended, because this made the advice feel more credible and less one-sided. Some would still check the recommendation through another service such as Google Maps, and some questioned how the advice would be calculated and wanted to be able to check its assumptions. The evaluation also showed that adding more information is not always helpful. A busy first view could create new choice stress. This adds a condition to the Chapter 7 principle of reducing mental effort. The interface should not create new comparison work while trying to reduce the work involved in making the decision. 'Decide' therefore needs to remain selective and explain the reasoning behind the recommendation clearly enough for travellers to judge it.

Guide: support when the journey changes

When participants were shown situations in which something changed during the journey, they generally saw value in support from the app. Several expected 'Guide' to do more than signal that something had changed. They wanted a realistic alternative and enough information to judge what that alternative would mean, while leaving the final decision with them. This follows the same logic as 'Decide'. The app provides information and alternatives, while the traveller makes the final choice.

Participants also set limits on how proactive this support should be. Continuous guidance could become intrusive when nothing required attention. 'Guide' therefore seems most relevant when there is a clear reason to intervene, such as a disruption or an unclear next step. Because this layer was only discussed through scenarios, the evaluation cannot show how travellers would respond during an actual journey or whether the guidance would help them recover from a change in practice.

Reinforce: value after the journey is less certain

'Reinforce' received the most mixed response of the three layers. Some participants liked the idea of receiving concrete feedback after the journey, for example about time, cost or a disruption that had been avoided. Others mainly saw it as a useful extra once the trip was already finished. Its contribution is therefore less clear than that of 'Decide' and 'Guide'.

The credibility of this feedback also mattered. Participants were more positive when the comparison could be checked and clearly related to what had actually happened. Some participants were less positive about savings claims when it was unclear how those claims had been calculated. Because 'Reinforce' was only explored through scenarios, the evaluation cannot establish any effect on confidence or later travel choices.

Section conclusion

At concept level, ‘Decide’ provides the clearest evidence that the Travel Confidence Companion addresses the traveller tension identified in Chapter 6. ‘Guide’ appears to extend this support into moments when the chosen journey changes, but this still needs to be tested in use. ‘Reinforce’ remains the least established layer. The next question is what NS would need to make this type of support credible and workable in practice.

10.3 What would NS need to make the concept credible and workable?

The traveller evaluation showed that understanding the interface alone is not enough. The recommendation also needs to be based on information that travellers can rely on, and the support needs to stay credible when conditions change. The stakeholder discussions were therefore used to examine what NS would need to provide this type of support in practice. Analysis of the stakeholder evidence resulted in four conditions for further development: sufficient planning capability, reliable information, recommendation governance and oversight of the journey across organisational boundaries. Figure 10.4 brings these conditions together.

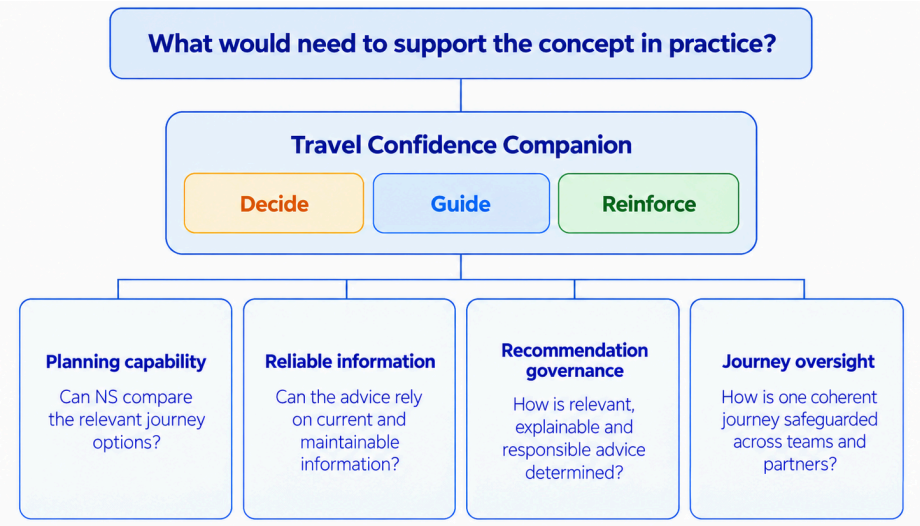


Figure 10.4. Conditions that would need to support the Travel Confidence Companion in practice.

Planning capability

‘Decide’ places the clearest demand on the underlying journey-planning foundation. The concept compares more than departure and arrival times. It brings together different journey legs and allows factors such as cost, parking, transfers and traveller priorities to influence how the options are presented. In the stakeholder discussions, the future journey-planning foundation was identified as an important dependency for ‘Decide’, and this layer was described as the most demanding to realise. Developing the full recommendation logic on the current foundation could also create rework as the new journey-planning foundation develops. The current evidence therefore supports the need for a richer planning

capability, but does not establish that ‘Decide’ is technically ready to implement.

Richer decision support should also leave ordinary journey planning simple. Stakeholders stressed that travellers who simply want an A-to-B journey should still be able to plan one without going through an additional comparison process. The Companion would therefore need to provide extra support when it is relevant while preserving a simple planning path when it is not. Stakeholders also considered integration into the existing NS digital environment more appropriate than developing a separate application, although the final form of that integration has not been determined.

Reliable information

The recommendation depends on several types of information that can change before or during a journey, including train services and disruptions, P+R availability and tariffs, road traffic, destination parking costs and, where relevant, weather conditions. For traveller-facing advice, the existence of data alone is not enough. The information also needs to be sufficiently current, reliable and maintainable for NS to use it as part of a recommendation. This connects directly to the credibility issue identified in the traveller evaluation. If availability, travel time or disruption information is incorrect, the recommendation can lose credibility even when the interface itself is clear.

Maintenance becomes especially relevant when information differs between P+R locations or depends on external partners. NS Stations raised the effort involved in keeping location-specific information and tariffs up to date, while automated data exchange was discussed as one possible way to reduce manual work. The current evidence does not establish which integrations are available or sufficiently mature for use. A reservation function could strengthen certainty about parking availability in future development, but the stakeholder evidence does not make it a prerequisite for testing the core service logic.

Recommendation governance

Reliable information does not by itself guarantee useful advice. The Companion interprets available information and recommends what may fit a traveller's situation. This means that choices have to be made about which factors influence the advice, how they are weighed and how the reasoning is explained. The governance discussion distinguished between data quality and recommendation quality. Correct source information can still result in advice that is poorly ordered, difficult to understand or inappropriate for a particular traveller.

Future development would therefore require explicit decisions about how recommendations are constructed, checked and governed. Recommendation governance concerns the responsibilities and decision rules that shape the advice, including which factors can influence it, how uncertainty is handled and who is accountable for recommendation quality. Where underlying information remains uncertain, the recommendation would need to communicate that uncertainty instead of presenting an estimate as a guarantee. Travellers should also be able to understand the basis of the advice and remain free to choose another option.

Personalisation adds another question. If preferences are stored or inferred, permissions and onboarding need to make clear what information is used and for what purpose. The current study identifies these governance questions, but does not define a final recommendation model or privacy implementation.

Concept boundaries

The Travel Confidence Companion can help travellers understand their options and adjust their plans when circumstances change. It provides information, explains what this means for their situation and suggests alternatives, but it cannot remove the practical limitations of the journey itself.

The Companion cannot create additional parking capacity, improve the physical quality of a P+R location or guarantee that parking spaces are available if the underlying service cannot provide that certainty. It also depends on the quality and coverage of the information it uses, such as train services and disruptions, P+R availability and tariffs, road traffic, destination parking costs and, where relevant, weather conditions.

If one of these data sources is missing or uncertain, the service needs to communicate that uncertainty or avoid giving a firm recommendation. These boundaries are important because the goal of the concept is to make a fragmented journey easier to judge. The Companion should help travellers make informed decisions, without creating a stronger sense of certainty than the underlying services can realistically offer.

Journey oversight

The concept also depends on coordination across organisational boundaries. The traveller experiences the drive, parking, transfer and train journey as one trip, while the information and services involved are distributed across different NS teams and external partners. The stakeholder discussions connected the concept to ComIT Reizigers and NS Stations, alongside external partners involved in parking and location-specific services. If these parts are developed separately, the coherence that the concept tries to create for the traveller could be lost again in the service itself.

The discussions did not establish one formal owner for the complete journey, nor does the current study support assigning that role. The discussions indicate that the journey would need to be coordinated across existing responsibilities. This includes coordinating the links between digital advice, parking information and what travellers encounter at the physical location. For this reason, end-to-end oversight is needed to keep the journey coherent across organisational boundaries, without implying a new department or ownership structure.

Implementation differences between layers

The conditions above do not affect all three concept layers in the same way. Decide has the clearest dependency on future planning capability and was described by stakeholders as the most demanding layer to realise. Parts of Guide may be explored through existing P+R information or services without first requiring full planner integration. Reinforce can also be explored in a limited form, but the stakeholder evidence is not detailed enough to rank its eventual technical difficulty. Its traveller value is also the least

established of the three layers. The three layers therefore have different implementation dependencies, but the stakeholder discussions did not establish an agreed priority order for Decide, Guide and Reinforce.

Section conclusion
The analysis identifies four conditions that would need to be addressed before broader implementation could be considered: planning capability, reliable information, recommendation governance and end-to-end journey oversight. The current evidence does not show that these capabilities are operationally ready or establish full technical or organisational feasibility. Section 10.4 therefore examines whether the direction has enough strategic relevance to justify further testing.

10.4 Is the direction strategically worth pursuing?

The conditions identified in Section 10.3 mean that further development of the Travel Confidence Companion would require effort from NS. This section considers if there is enough evidence to justify further testing of the direction. The judgement is based on the traveller evaluation, the response from ComIT Reizigers and NS Stations, and the scale of the existing P+R context. The study does not establish a financial business case or behavioural impact.

Potential value for NS
Both ComIT Reizigers and NS Stations identified relevance in the concept, but for different reasons.

Within **ComIT Reizigers**, Decide was considered highly relevant because it supports a type of planning that takes more into account than travel time alone. The concept was connected to the personal digital travel assistant and to capabilities being considered for future journey planning. The preferred outcome was that travellers should be able to recognise P+R as a serious option when it suits their journey. This fits the traveller evaluation in Section 10.2, where participants generally found the P+R option easier to understand and judge after seeing Decide.

The **NS Stations** discussion produced a similarly positive response from a different perspective. The concept was seen as closely related to ongoing work around digital findability, personal travel advice and the customer experience around P+R. Particular interest was shown in Guide when a chosen P+R location no longer works. Providing a usable alternative after a location becomes full was seen as more useful than leaving the traveller with the problem after notifying them of the change. Together, the discussions show that the concept touches both the digital journey and the P+R service. ComIT focused on the planning and digital support, while NS Stations focused on how this support connects to the parking service and the traveller experience at P+R locations.

The stakeholder discussions also identified two possible routes through which this could matter for NS. Existing P+R users may consider P+R for a wider range of suitable journeys, while travellers who currently leave P+R out of their decision may begin to consider it. These are still hypotheses. The current evaluation shows that the concept can make the option easier to understand and assess, but it did not observe changes in actual travel behaviour.

The Travel Confidence Companion is not part of an approved NS roadmap. Its underlying logic does, however, fit current work on

personalised travel support, P+R discoverability and the wider door-to-door journey. A real-world test would also allow NS to observe where travellers discover, consider, reject or abandon P+R, which is not visible from the current concept evaluation.

Indicative scale of the opportunity

The existing P+R network gives a useful sense of the scale involved. NS currently provides P+R at more than 270 station locations (Nederlandse Spoorwegen, n.d.). NS reported around 48,500 P+R parking spaces at stations in 2021 (Nederlandse Spoorwegen, 2021).

An indicative estimate used in this project places the existing group of travellers who drive to and park at the station at around 600,000 people. The estimate is based on approximately 10.2 million unique NS customers per year and an estimated 6% who drive to the station as the driver and park there (Nederlandse Spoorwegen, 2021). The estimate is intended to show the order of magnitude and should not be read as an exact count of unique P+R users.

Internal NS travel data provides a second indication of the size of this travel pattern. In the NS Rittenonderzoek 2023, 5.59% of weighted train journeys involved the traveller driving to the departure station. This figure is based on journeys, so it is used as supporting context and not as part of the 600,000 estimate.

The potential group may extend beyond travellers who already park at a station. The earlier traveller research showed that P+R sometimes remains outside the initial consideration even when it could be suitable for the journey. The size of this additional group cannot be established from the current data. Figure 10.4 therefore estimates the scale of the existing problem space, not expected adoption of the concept.

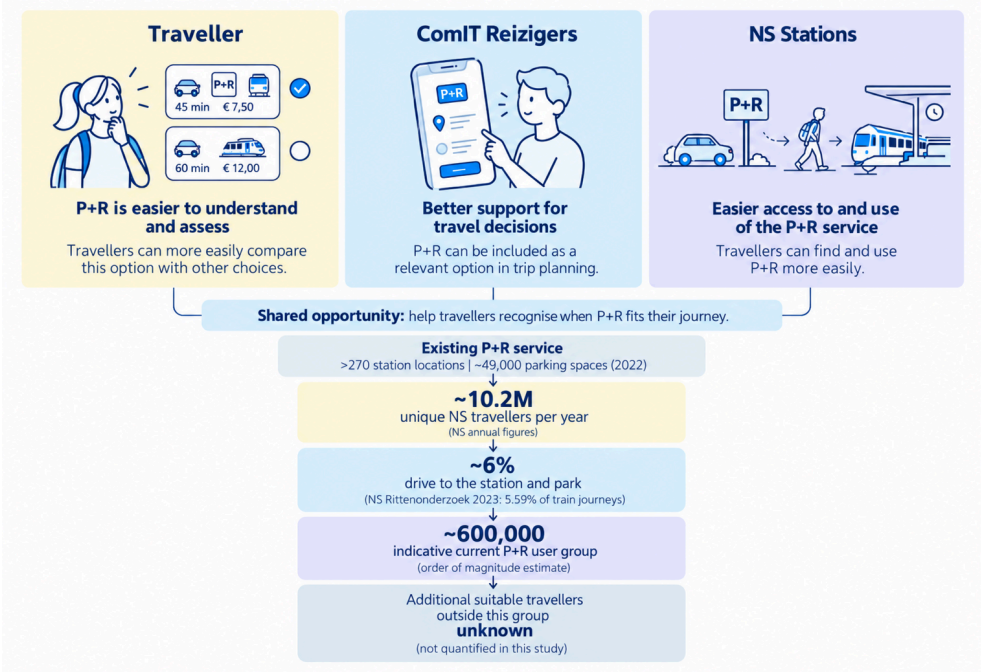


Figure 10.5. Indicative scale of the existing P+R problem space.

The evidence is sufficient to justify a next test. Travellers responded positively to the core decision-support logic, ComIT Reizigers and NS Stations both identified relevance from their respective perspectives, and the concept addresses a decision context that already exists at substantial scale. What remains to be established is how often this support changes a real travel decision and what value that creates for NS. Section 10.5 addresses how this can be tested.

10.5 What should NS learn next?

The current evaluation provides enough evidence to justify a next test, but the remaining questions concern actual use. The concept has so far been evaluated through interviews, scenarios and short field sessions. These studies show how travellers understand the proposed support and how they respond to its logic, but they do not show what happens when a real journey is at stake and the advice depends on current information and operational processes.

A next step should therefore test the concept in a bounded real-world setting. Before such a test is started, NS would need to decide that the proposition deserves further attention and appoint people who can support the test across the parts of the journey involved. The stakeholder discussions suggest that this requires both sponsorship and someone who can keep the complete traveller journey in view across organisational boundaries (see Appendix F). This does not require a permanent new team at this stage.

A bounded real-world test

A first pilot could be limited to one journey context, provided that travelling entirely by car and using P+R are both credible choices and that the required parking and public transport information is sufficiently reliable for the advice being tested. A limited setting also makes it easier to understand why the concept succeeds or fails without introducing unnecessary variation between routes and locations.

DECIDE should be the main focus. It has the strongest support from the current evaluation and addresses the point where the main traveller tension occurs. The test should examine if travellers notice the P+R option, how they compare it with the alternatives and why they eventually select or reject it. Choosing P+R is not the only relevant outcome. A traveller may understand the option and still decide to continue by car. In that case, the test should establish if the support helped the traveller make that choice with a clearer understanding of the alternatives.

GUIDE should be included in a more limited form. A small number of realistic changes, for example a parking location becoming unavailable or a change in the train journey, would make it possible to examine how travellers respond when the planned journey no longer works as expected. The test should look at if the traveller notices the change, understands the proposed alternative and can continue the journey without losing control over the next choice. This gives NS evidence about one part of Guide without requiring the full functionality of a personal digital travel assistant.

REINFORCE has a weaker evidence base and does not need to determine the scope of the first pilot. It can be examined in a separate small test if time and resources allow. This would make it possible to assess the value of post-journey feedback without adding complexity to the first real-world pilot. Figure 10.5 shows how the pilot can move from choosing what to test, to learning from the test and deciding what to do next.



Figure 10.6. What NS should learn next.

Deciding what follows

The purpose of the pilot is to support a decision about further development. P+R uptake on its own would give an incomplete picture. The concept is intended to help travellers understand and judge a combined journey while keeping the final choice in their hands. The test should therefore record what travellers notice, compare and eventually choose or reject, including where they stop considering P+R after initially taking it into account. It should also examine when they check the advice elsewhere and how they respond when the journey changes.

The pilot also needs to test the service behind the interface. Section 10.3 showed that the concept depends on reliable information, understandable recommendation logic and coordination across different parts of the journey. The test should therefore record information failures, situations in which advice cannot be explained or trusted, the effort needed to keep the service working, and problems around ownership or escalation. These observations matter because a concept that travellers understand can still be unsuitable for further development if it cannot be provided reliably.

The findings from the pilot can inform one of three proposed decisions: proceed, adapt or reconsider. These decision categories are used in this thesis to structure the next step; they are not approved NS thresholds. **Proceed** is appropriate if travellers can find

and understand the support, use it to make a reasoned choice and receive advice that NS can provide with sufficient reliability. The next test can then move to another journey context, since one successful setting is too limited to support wider implementation.

Adapt is appropriate when the direction appears useful but a specific part of the concept or service causes recurring problems. Travellers may, for example, understand the comparison but question the recommendation, or Guide may help after a change while depending on information that is difficult to keep current. The next test should then address the problem found.

Reconsider remains a possible outcome. Further development would need a stronger case if travellers make little use of the support in real decisions, if the recommendation repeatedly loses credibility, or if providing the service requires more effort than its observed traveller value can justify.

A first pilot should therefore answer a limited question: does the Travel Confidence Companion help travellers understand and judge an actual journey, and can NS provide the required support reliably enough to justify another test? Questions about repeated use, long-term trust, modal shift and financial value require later stages of research.

10.6 Answer to RQ5

To what extent does the proposed concept address the identified traveller tension, and what conditions would NS need to implement it?

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The current evidence suggests that the Travel Confidence Companion addresses the core traveller tension at concept level. This is clearest for **DECIDE**, where participants were generally able to understand the recommendation, compare the alternatives and still recognise the final choice as their own. **GUIDE** also received positive responses and fits a broader NS ambition for more proactive support during the journey, although its value has not yet been tested in live travel situations. **REINFORCE** stays the least established part of the concept and would need further exploration before a stronger claim can be made.

There is also a plausible path for the concept within NS, but several conditions still need to be resolved. The quality of the support depends on journey-planning capability, reliable information, clear rules for how recommendations are made, and coordination across the teams and partners involved in the journey. Stakeholder discussions showed that the direction is relevant to developments already taking place within NS, particularly around more personalised and proactive travel support. This supports its strategic relevance, but does not establish full technical feasibility or financial viability.

The evidence is sufficient to justify a bounded real-world test, but not wider implementation. That test should examine whether the traveller benefits found at concept level remain when people make actual choices and the service relies on live information and operational processes. Broader implementation would require stronger evidence on repeated use, service reliability, behavioural impact and financial value.

10.7 Answer to the main research question

How can the NS app support travellers at key moments to build the trust needed to consider and use P+R in combination with the train as an alternative to driving?

The answer I arrived at during this project is that supporting P+R is not mainly about giving travellers more information. It is about helping them understand what the different parts of the journey mean together, at the moment when they are trying to decide if P+R makes sense for their trip.

This became especially clear during the fieldwork. Information about parking, trains, costs and travel time often already existed, but travellers still had to bring these pieces together themselves. The difficulty was not simply finding the information, but judging the complete journey with enough confidence to make a choice.

The strongest opportunity therefore lies before commitment. At this moment, the NS app can help by showing realistic travel options together, explaining the differences in relation to what matters to the traveller and making clear what each choice means in practice, even if the car is the best option. The final decision should remain with the traveller.

The Travel Confidence Companion translates this idea into three moments. **DECIDE** supports the choice before the journey. **GUIDE** helps the traveller when something changes after that choice has been made. **REINFORCE** looks back at how the journey worked and connects this to what mattered when the traveller chose it. In this way, the concept does not treat P+R as a parking facility followed by a train journey, but as one travel decision that continues to develop after the traveller has chosen.

The evaluation gives the strongest support for **DECIDE**. Participants generally understood the recommendation, could compare the alternatives and still felt that the final choice was theirs. **GUIDE** was received positively in the scenarios that were tested, while **REINFORCE** remains the least established part of the concept. The project therefore provides a direction for how the NS app could support traveller trust, but it does not yet show how this support will work in repeated, live use.

Looking back at the question I started with, this is also the main lesson I take from the project. Building trust does not mean removing every uncertainty from a P+R journey. That is not possible. It means helping the traveller understand enough of the journey to make a choice with confidence, and continuing to support that choice when the journey develops differently than expected.

Reflection

Looking back, this project taught me a lot about the topic, but also about myself and the way I work.

One thing I recognised again is that I tend to fully immerse myself in a subject. When something interests me, I want to understand every detail, map every connection, and fill an entire Miro board with insights. This helps me build a deep understanding of a problem, but it can also become a pitfall. During this project, I learned that there comes a point where decisions need to be made. I often kept exploring because I was still looking for more certainty. Looking back, I would have benefited from committing to directions earlier.

I learned that a design decision does not require complete certainty. At some point, I need to judge what is supported well enough, accept what is still unknown, and use the next step to test it. I would try to make that distinction earlier in a future project.

I also learned how iterative a design process really is. Throughout the project, I restarted parts of the process multiple times because I felt I had not yet found the right angle or insight. While this sometimes feels frustrating, it is also one of my strengths. I care about doing things properly and want to understand the underlying problem before moving forward. At the same time, I learned that perfection can slow progress, and that moving forward with an imperfect idea is often better than waiting for the perfect one.

Another lesson came from working within a large organisation like NS. Before starting this graduation project, I did not realise how much impact one person could have. I noticed that colleagues became genuinely interested in the work I was doing and wanted to contribute. At several points, what started as my research became something shared, with colleagues joining field visits and standing together at P+R locations in researcher jackets. Seeing that level of involvement was motivating and something I am grateful for.

I also recognized again that I enjoy involving people in a problem. I liked talking to colleagues with different areas of expertise, connecting their views and turning those conversations into something concrete. During this project, design was often as much about creating these conversations as it was about developing the final concept. I was blessed with joining a team like this with the expertise in the digital working field.

Throughout the project, I relied heavily on Miro because it allowed me to quickly capture ideas, insights and connections. However, I eventually ended up with one very large and chaotic board. By the time I started writing the final story, I sometimes struggled to bring everything back together. Miro worked very well for exploration, but I learned that I need to connect it more closely to the reporting process so that insights do not become fragmented.

Finally, I spent a significant amount of time developing the concept in detail and improving my UI and UX design skills. Working alongside experienced designers motivated me to learn more and improve the concept. As a result, testing happened later than originally planned. I would have preferred to test the concept earlier, but the detailed design work helped me communicate it clearly and made the final proposal much more tangible.

Before starting this project, one of the things I liked most about Industrial Design Engineering was how broad the field is. I enjoy the tangible product focus of IPD, the human and product interaction side of DFI, and the strategic side of SPD. I thought that by the end of my graduation project I might finally know which of these I like most. I still do not.

I am still an all-rounder, and I actually like that. I enjoy understanding a problem, working with people, thinking about the bigger picture and then making something concrete out of it. I still have no clue which part of design I like most, but I do know that I am very happy to be a designer.

Limitations

Several limitations affect how the findings and the final concept should be read.

The traveller research included 37 P+R field cases: 13 in Rotterdam, 20 in Woerden and 4 in Amersfoort. The three locations were chosen to include different station and P+R settings, but they do not represent the full Dutch P+R network. Most participants were approached at or near a P+R location. This means that the research mainly reached people who already used P+R or were familiar with it. Travellers who had already decided against P+R before leaving home were harder to reach. This is important because the final concept focuses strongly on the choice made before travelling. The fieldwork can show recurring needs and problems, but it cannot show how common these are among all potential P+R travellers. The smaller number of cases in Amersfoort also gives this location a more limited basis for comparison.

The traveller profiles used later in the project have a similar boundary. Giorgia was built from recurring patterns in the research and was used to focus the design work. She is not an average P+R traveller or a measured traveller segment. The confidence curves were also created from the research findings and were used to show where confidence may change during the journey. Confidence was not measured at every stage. These tools helped translate the research into a design direction, but they should not be read as a measured model of how every traveller experiences P+R.

The concept evaluation also has clear limits. The concept was evaluated in 13 online sessions and 16 short field sessions at Utrecht Central. These sessions showed how participants understood the concept, how they responded to the recommendations and how confident they said they felt after seeing them. Participants did not use a working service during real P+R journeys. The evaluation therefore cannot show how people would respond when a real journey, current parking availability or an actual disruption is involved. It also cannot show if the concept would change travel behaviour over time. The evidence differs between the three parts of the concept. Decide received the most direct testing. Guide was mainly discussed through journey scenarios, while Reinforce received less direct evidence. I also designed the concept and conducted the evaluation myself. This may have influenced some responses. I tried to reduce this by first discussing existing travel behaviour, giving limited explanation before showing the concept and keeping critical responses in the analysis.

There are also limits to what the project can say about implementation. Most stakeholder research was carried out within NS, mainly with NS Stations and ComIT Reizigers. Municipalities, parking operators and other external parties were studied in less depth. Two stakeholder sessions were recorded, while the others were documented through notes, which gave less detail for later analysis. The stakeholder research helped identify what the concept would need in practice, but it does not prove that these conditions can already be met. Reliable parking information, journey-planning capability and coordination between the parties involved would still need to be tested in a working setting. The project therefore does not establish full technical or organisational feasibility.

Finally, the study cannot determine the actual value the concept would create for NS. The evaluation shows how participants responded to the proposed support, but it did not measure changes in real travel choices. The size of the group that currently does not consider P+R also cannot be established from the available data. In addition, I did not have access to the data needed to calculate a reliable financial effect. The thesis can therefore explain why the concept is worth testing further, but it cannot estimate future adoption or provide a financial business case.

AI statement

AI tools were used during different parts of this project in accordance with TU Delft guidelines. They were used to support specific research, writing and design tasks. The interpretation of the research, the design decisions and the final conclusions were made by me. AI-generated output was reviewed and adjusted before it was used in the project.

AI was used for the following purposes:

- **Transcription:** Copilot (connected to NS) was used to transcribe recorded interviews and meetings.
- **Transcript processing:** ChatNS was used to clean and organise transcripts. All transcripts were checked afterwards.
- **Coding support:** ChatNS was used to review an initial set of codes that I had created manually and to suggest possible groupings. It was also used for a first coding pass through the internal strategy documents. Suggested codes and groupings were checked against the original material and changed or removed where needed.
- **Writing support:** Copilot (connected to NS) and Claude were used to improve readability, restructure text, provide feedback on drafts, and support the writing process. The arguments, evidence and final wording are always reviewed by me before inclusion in the thesis.
- **Clustering and sense-making:** Miro AI was used to cluster large research boards. The results were reviewed together with fellow thesis students.
- **Visualisation:** Gemini was used to translate some hand-drawn sketches into clearer visual representations. ChatGPT was used to help create a more consistent visual style between figures.
- **Concept prototyping:** Claude Design was used to quickly translate ideas into interactive concept prototypes and support iterative design.
- **Brainstorming:** Copilot, ChatNS were used at different moments to organise thoughts, explore possible directions and reflect on design choices. Claude Design was used to quickly translate ideas into interactive prototypes. The selection and development of the final concept were based on the research and my own design decisions.
- **Literature search:** Perplexity was used to help find potentially relevant academic literature. The original sources were reviewed before they were used or cited in the thesis.

References

9292. (n.d.). Over 9292. Retrieved August 4, 2026, from https://9292.nl/

Alyavina, E., Nikitas, A., & Tchouamou Njoya, E. (2020). Mobility as a service and sustainable travel behaviour: A thematic analysis study. *Transportation Research Part F: Traffic Psychology and Behaviour, 73*, 362–381. https://doi.org/10.1016/j.trf.2020.07.004

ANWB. (n.d.). ANWB Parkeren: parkeer voordelig met de Onderweg app. https://www.anwb.nl/verkeer/anwbparkeren

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Braun, V., & Clarke, V. (2021). Thematic analysis: A practical guide. SAGE Publications.

Capurso, M., Hess, S., & Dekker, T. (2021). Stated consideration and attribute thresholds in mode choice models: A hierarchical ICLV approach. *European Journal of Transport and Infrastructure Research, 21*(3), 106–123. https://doi.org/10.18757/ejtir.2021.21.3.3982

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum, 41*(5), 545–547. https://doi.org/10.1188/14.ONF.545-547

Chorus, C. G., Arentze, T. A., & Timmermans, H. J. P. (2007). Information impact on quality of multimodal travel choices: Conceptualizations and empirical analyses. *Transportation, 34*(6), 625–645. https://doi.org/10.1007/s11116-007-9120-1

Chorus, C. G., Arentze, T. A., & Timmermans, H. J. P. (2008). A random regret-minimization model of travel choice. *Transportation Research Part B: Methodological, 42*(1), 1–18. https://doi.org/10.1016/j.trb.2007.05.004

Design Council. (n.d.). The Double Diamond. https://www.designcouncil.org.uk/resources/the-double-diamond

EasyPark. (n.d.). *De parkeerapp die tijd vrijmaakt om te leven*. Retrieved August 4, 2026, from https://www.easypark.com/nl

Fu, X., van Lierop, D., & Ettema, D. (2024). Is multimodality advantageous? Assessing the relationship between multimodality and perceived transport adequacy and accessibility in different travel contexts. *Transportation Research Part A: Policy and Practice, 179*, Article 103893. https://doi.org/10.1016/j.tra.2023.103893

Gemeente Amsterdam. (n.d.). Parkeergarages — actuele beschikbaarheid. Retrieved August 4, 2026, from https://maps.amsterdam.nl/parkeergarages_bezetting/

Gemeente Rotterdam. (n.d.). P+R Kralingse Zoom. https://www.rotterdam.nl/pr-kralingse-zoom

Gemeente Woerden. (n.d.). Reactienota parkeerregulering. https://www.woerden.nl/Verkeer/Parkeren/Uitbreiding_parkeerregulering_Woerden/Reactienota_parkeerregulering

Hamersma, M., & de Haas, M. (2020). *Kenmerken van 'veelbelovende' ketens: Inzichten voor het stimuleren van ketenmobiliteit in Nederland*. Kennisinstituut voor Mobiliteitsbeleid. https://www.kimnet.nl/documenten/2020/07/03/kenmerken-van-veelbelovende-ketens

Hamersma, M., & Roeleven, I. (2024). *Acceptabele bereikbaarheid: Een reizigersperspectief. Achtergrondrapport*. Kennisinstituut voor Mobiliteitsbeleid. https://www.kimnet.nl/documenten/2024/09/26/acceptabele-bereikbaarheid-een-reizigersperspectief

Hekkert, P., & van Dijk, M. (2011). Vision in design: A guidebook for innovators. BIS Publishers.

Hosseini Shoabjareh, A., Ghasri, M., Roberts, T., Lapworth, A., Dobos, N., & Boshuijzen-van Burken, C. (2024). The role of trust and distrust in technology usage: An in-depth investigation of traffic information apps usage for mandatory and non-mandatory trips. Travel Behaviour and Society, 37, Article 100816. https://doi.org/10.1016/j.tbs.2024.100816

IDEO.org. (2015). *The field guide to human-centered design*. https://www.designkit.org/resources/1.html

International Organization for Standardization. (2019). *Ergonomics of human-system interaction—Part 210: Human-centred design for interactive systems* (ISO Standard No. 9241-210:2019). https://www.iso.org/standard/77520.html

Kallio, H., Pietilä, A.-M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing, 72*(12), 2954–2965. https://doi.org/10.1111/jan.13031

Kahneman, D., Fredrickson, B. L., Schreiber, C. A., & Redelmeier, D. A. (1993). When more pain is preferred to less: Adding a better end. *Psychological Science, 4*(6), 401–405. https://doi.org/10.1111/j.1467-9280.1993.tb00589.x

Kennisinstituut voor Mobiliteitsbeleid. (2025). *Mobiliteitsbeeld 2025*. Ministerie van Infrastructuur en Waterstaat. https://www.kimnet.nl/documenten/2025/11/25/mobiliteitsbeeld-2025

Lee, J. D., & See, K. A. (2004). Trust in automation: Designing for appropriate reliance. *Human Factors, 46*(1), 50–80. https://doi.org/10.1518/hfes.46.1.50_30392

Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. Journal of Marketing, 80(6) 69-96. https://doi.org/10.1509/jm.15.0420

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. Academy of Management Review, 20(3), 709–734. https://doi.org/10.5465/amr.1995.9508080335

Mingardo, G. (2013). Transport and environmental effects of rail-based Park and Ride: Evidence from the Netherlands. *Journal of Transport Geography, 30*, 7–16. https://doi.org/10.1016/j.jtrangeo.2013.02.004

Ministerie van Infrastructuur en Waterstaat. (2023). Concessie voor het Hoofdrailnet 2025–2033. https://www.rijksoverheid.nl/documenten/rapporten/2023/12/21/bijlage-2-concessie-voor-het-hoofdrailnet-2025-2033

Nederlandse Spoorwegen. (2021, April 30). *NS-app toont of P+R plek heeft*. https://nieuws.ns.nl/ns-app-toont-of-pr-plek-heeft/

Nederlandse Spoorwegen. (2024). Vervoerplan NS 2025. https://ocp.ns.nl/caas/v1/media/stable/89336/data/vervoerplan-ns-2025.pdf

Nederlandse Spoorwegen. (2026). *Jaarverslag 2025 (inclusief jaarrekening).*

https://www.nsjaarverslag.nl/external/asset/download/project/f9822a0a-03f4-0000-e6ae-dd5deb051167/name/NS%20Jaarverslag%202025.pdf

Nederlandse Spoorwegen. (n.d.). *P+R parkeren*. Retrieved August 4, 2026, from https://www.ns.nl/deur-tot-deur/parkeren/parkeer-en-reis.html

P1. (n.d.). P+R Amersfoort. Retrieved August 4, 2026, from https://www.p1.nl/parkeerplaats/parking-eemplein/

ParkeerService gemeente Amersfoort. (n.d.). *Park and Ride (P+R).* Retrieved May 11 2026 , from https://amersfoort.parkeerservice.nl/parkeren-op-straat/park-and-ride-p-r/

ParkeerService gemeente Woerden. (n.d.). *Betaald parkeren*. Retrieved May 11, 2026, from https://woerden.parkeerservice.nl/straatparkeren/betaald-parkeren-/

Pruitt, J., & Adlin, T. (2006). *The persona lifecycle: Keeping people in mind throughout product design*. Morgan Kaufmann. https://doi.org/10.1016/B978-0-12-566251-2.X5000-X

Pugh, S. (1991). *Total design: Integrated methods for successful product engineering*. Addison-Wesley.

Q-Park. (n.d.). NS en Q-Park: in- en uitrijden op kenteken bij 53 P+R locaties. Retrieved August 11, 2026, from https://www.q-park.nl/nl-nl/over/nieuws/ns/

Rekenkamer Amsterdam-Zaanstad. (2025). Parkeren + Reizen (P+R). https://www.rekenkamer.amsterdam.nl/onderzoek/parkeren-reizen-pr/

Saldaña, J. (2021). *The coding manual for qualitative researchers* (4th ed.). SAGE Publications.

Sanders, E. B.-N., & Stappers, P. J. (2012). Convivial toolbox: Generative research for the front end of design. BIS Publishers.

SKIDATA. (n.d.). NS / Q-Park – P+R. Retrieved August 4, 2026, from https://www.skidata.com/nl-nl/references/ns-pr-nederland-0

Sleeswijk Visser, F., Stappers, P. J., van der Lugt, R., & Sanders, E. B. N. (2005). Contextmapping: Experiences from practice. *CoDesign, 1*(2), 119–149. https://doi.org/10.1080/15710880500135987

Sochor, J., Arby, H., Karlsson, I. C. M., & Sarasini, S. (2018). A topological approach to Mobility as a Service: A proposed tool for understanding requirements and effects, and for aiding the integration of societal goals. *Research in Transportation Business & Management, 27*, 3–14. https://doi.org/10.1016/j.rtbm.2018.12.003

Stappers, P. J., & Giaccardi, E. (2017). Research through design. In M. Soegaard & R. Friis-Dam (Eds.), *The encyclopedia of human-computer interaction* (2nd ed., pp. 1–94). The Interaction Design Foundation. https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/research-through-design

Stations.nl. (n.d.). *Stationsklasse*. Retrieved August 4, 2026, from https://stations.nl/over-stations/stationsklasse/

Tassoul, M., & Buijs, J. (2007). Clustering: An essential step from diverging to converging. *Creativity and Innovation Management, 16*(1), 16–26. https://doi.org/10.1111/j.1467-8691.2007.00413.x

van Boeijen, A. G. C., Daalhuizen, J. J., & Zijlstra, J. (2020). *Delft design guide: Perspectives, models, approaches, methods* (2nd ed.). BIS Publishers.

Van der Hoek, V. (2026). *Parkeren bij stations*. Rover. https://www.rover.nl/images/PDFs/Parkeren%20bij%20stations%201.pdf

Yellowbrick. (2025). Yellowbrick — De beste parkeer app voor mobiel parkeren. Retrieved August 4, 2026, from https://yellowbrick.nl/

Zijlstra, T., Vanoutrive, T., & Verhetsel, A. (2015). A meta-analysis of the effectiveness of park-and-ride facilities. *European Journal of Transport and Infrastructure Research, 15*(4), 597–612. https://doi.org/10.18757/ejtir.2015.15.4.3099