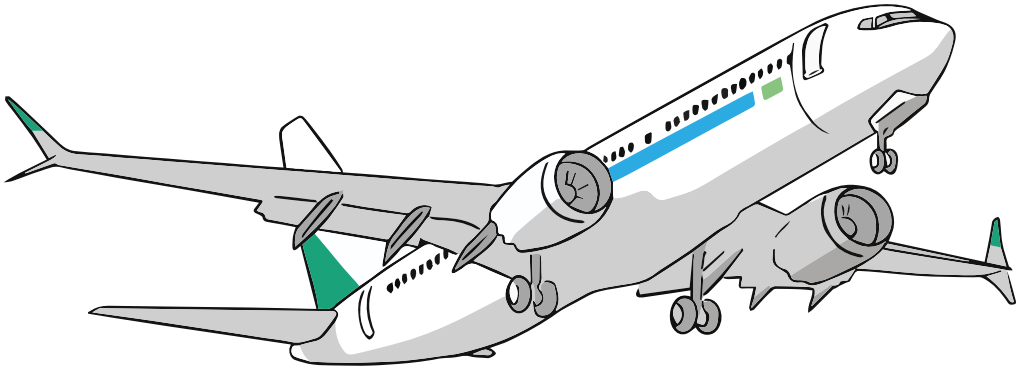
A service design vision for air-rail journeys

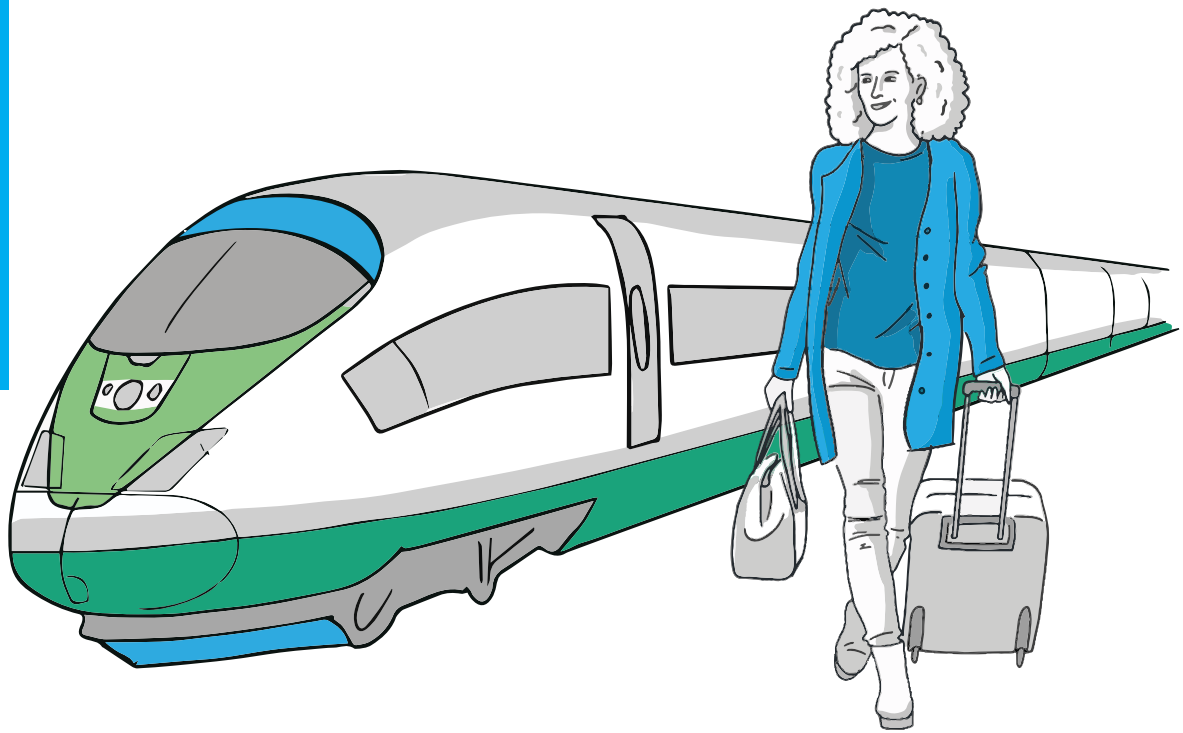
Stimulating travellers to make a more sustainable choice by integrating international trains and flights.

Graduation report, January 2021

Seamless Personal Mobility Lab

Rosa Hendrikx





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RET
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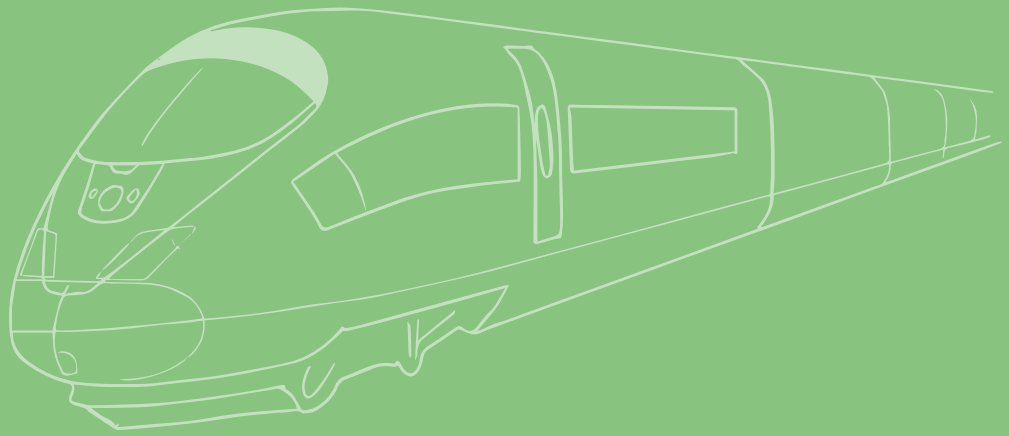
‘Passengers travel by plane, travellers travel by train.’



Preface

In front of you is the report ‘a service design vision for air-rail journeys’. I wrote this report as final deliverable of my masters Design for Interaction at the TU Delft. I started this project in September 2020 and I finished it in January 2021. During these 5 months, I dived in the complex world of trains and planes and tried to build a bridge between them. It was an interesting learning experience but moreover a great challenge to take on.

I was highly motivated to work on this project, since I believe innovating in mobility is essential to reduce the impact it currently has. Today, we are facing some big challenges. A climate crisis, but also a pandemic. Although this period is tough for the sector, I hope it can be a time in which we can make a start to reconsider the way we were used to do things and ultimately, make sustainability a priority.

I could not have completed this project without the help and support of the people surrounding me. I want to thank Suzanne and Jasper, who supervised me during the entire project. Thank you both for your feedback, advice and keeping me on track. Thank you for offering a listening ear, the good discussions and the to the point advice which helped me a lot to steer the project in the right direction. It was a pleasure to work with you!

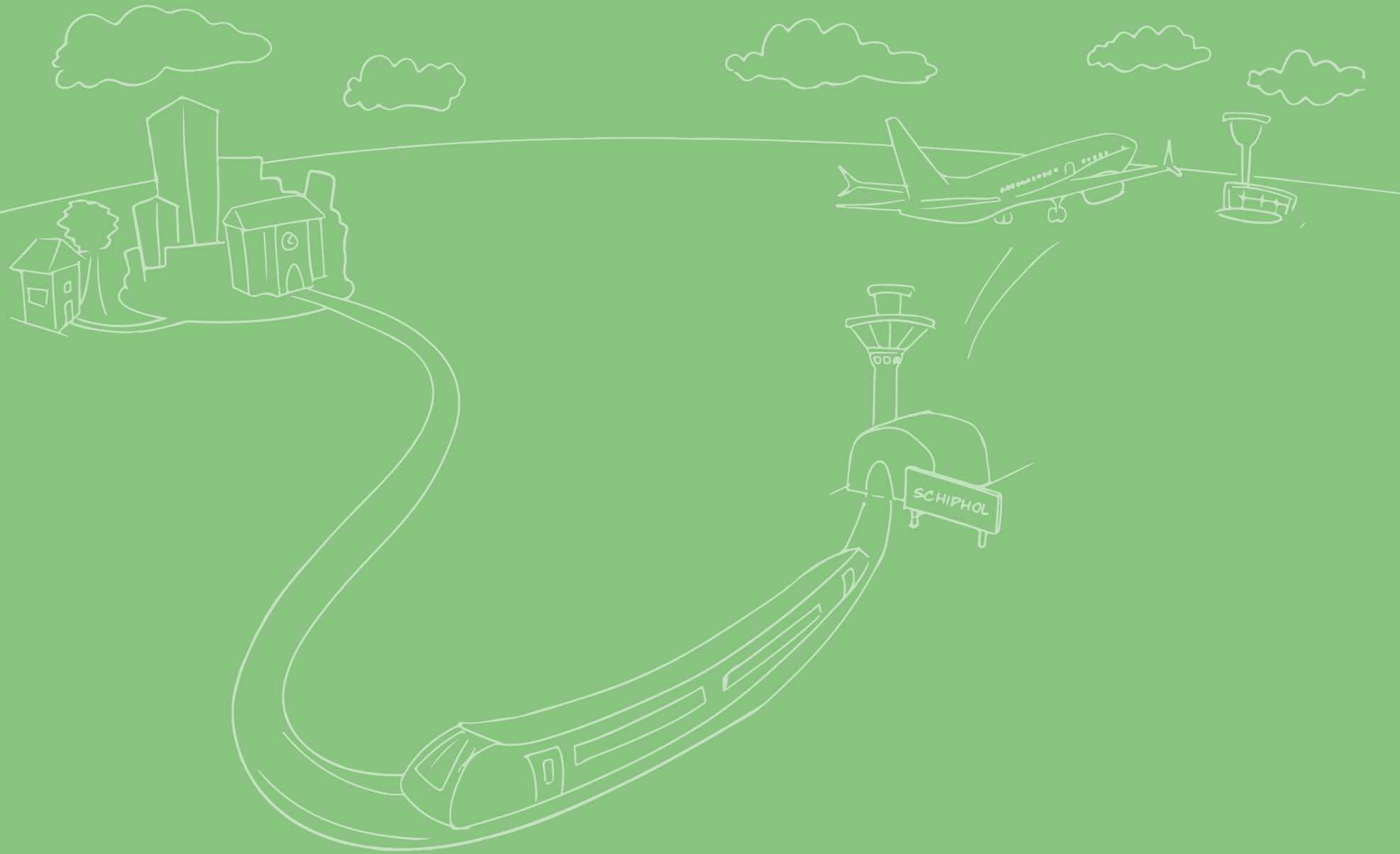
Additionally, I would like to thank the partners of the project. Carien, Jet, Klaas, Marij, Olivier, Ozgür Rinze and Wilco, thank you for your support, insights, and expert advice during the entire project. It was great to work with you and I am very grateful that you provided me with the opportunity to have a look behind the scenes!

I want to offer special thanks for all the people who participated in the research. Without you, I could not have executed this project. Addtionally, I would like to thank my friends and family for supporting me each in their own way during this project. For your listening ear, support and advice. But also by providing me with the necessary distraction!

Enjoy reading!

Rosa

19 January, 2021


SCHIPHOL

Executive summary

Concerns regarding the environmental impact of the aviation sector are increasing. Especially short distance flights within Europe are criticized, since these itineraries could be replaced by more sustainable alternatives, namely international trains. More specifically, international trains combined with long distance flights, the air-rail journey, could be a sustainable alternative for the multi-leg flight. This graduation project explores what is needed to make a shift from multi-leg flights to air-rail journeys within Europe in 2030.

The project is executed within the Seamless Personal Mobility Lab. Partners of the project are NS International, Schiphol Group, KLM Royal Dutch Airlines and the Ministry of Infrastructure and Water management. The stakeholders are involved during the entire project. Above all, the project took an use-centered approach, which means that the user's perspective is leading. The project explores how the future air-rail journey could truly address the needs and wishes of the international air-rail traveller.

The goal of the project is to create a design vision for air-rail journeys, that facilitates in creating a seamless travel experience between planes and international trains within Europe. To create this design vision, research regarding the rationale, steps & patterns, users and stakeholders is conducted. This creates understanding of the needs, wishes and current problems surrounding air-rail journeys.

Based upon the user research, the needs of international air-rail travellers can be defined with the use of six need-based personas: The determined survivor, the vulnerable rookie, the self-sufficient manager, the peaceful collaborator, the spontaneous adventurer and the certainty seeker. he analysis shows that international trains and flights are not well integrated, which makes the system hard to access, results in an incoherent service and creates an uncertain travel experience. This negatively influences the choice for a more sustainable alternative than the air-air journey.
Based upon the gathered insights, a design vision for future air-rail journey is designed. First a concept vision is created, which is evaluated with users and stakeholders. After that, the final service design vision of the AirRail Alliance is developed, based upon the gathered insights.

The AirRail Alliance aims to unify air and rail, stimulates travellers to choose for air-rail and assures them about and throughout the journey. By creating a fair choice and providing a comfortable transfer and coherent services, the service aims to stimulate international air-rail travellers to choose for air-rail journeys instead of multi-leg flights. The AirRail alliance integrates services, provides continuous guidance and manages disruptions over the entire journey. The traveller should experience this collaboration between train operators and airlines, in the feeling of one coherent and unified journey. Ultimately, continuous guidance, support and integrated disruption management should result in a feeling that nothing can go wrong, the feeling of assurance.

By implementing the service according to the strategic roadmap, an ambitious scenario of substitution from air to rail can become reality in 2030. This scenario will mean that around 12.000 air-rail travellers a day will travel with the AirRail Alliance, which could lead to the substitution of 63.000 flights on a yearly basis.

To be able to implement the service it is recommended to detail, develop and test the service. The development of the service should be kept user-centered and should be in synergy with the needs of origin destination international train travellers. Additionally, the focus of the development of air-rail should be on the whole journey, not only on the transfer. Existing infrastructure and services can be used to implement the service.

Collaboration between stakeholders is essential to be able to integrate the rail and aviation sector. Additionally, ticket pricing is key to make air-rail a success. Ultimately, to make air-rail a sustainable success, the substitution paradox should be addressed. This can be done by regulating on impact instead of number of flights and regulating on an international level.

List of abbreviations

DOVA	Decentrale OV-autoriteiten
EU	European Union
GVB	Gemeentelijk Vervoerbedrijf
ICE	ICE International
MIenW	Ministry of Infrastructure and Water Management
KLM	Koninklijke Luchtvaart Maatschappij
MRDH	Metropoolregio Rotterdam Den Haag
NS	Nederlandse Spoorwegen
OD	Origin Destination
RET	Rotterdamse Elektrische Tram

List of definitions

Air-rail
A trip in which a train ride and a flight are combined.

Customer journey
A visual representation of the experience of a user over time, which visualizes the steps that are taken accompanied by the main pains and gains experienced by users (Rosenbaum, 2017).

Hub
An airport that connects multiple modalities and act as a main airport or station, other smaller destinations fly to this airport and connect there to other destinations (Elledge, 2014).

Gain
An aspect of a product or service that is experienced as positive by a person.(Rosenbaum, 2017).

Journey
A piece of travelling between two different locations.

Modality
Means of transport, like the train, bus or plane.

Need
A need, goal or requirement for a user of a service of product. A need determines what the user needs from the product or service.

OD traveller
Origin destination traveller, a traveller that is traveller from one place to another in a single journey, so without transferring.

Pain
An aspect of a product or service that is experienced as negative by a person.(Rosenbaum, 2017).

Passenger
A person who is traveling in a certain modality.

Stakeholder
An organisation or person that has interest or concern in something.

Touchpoint
A point of contact or interaction between a service or business and the user.

Transfer
Changing between modalities of travellers. This can be the same modalities or two different modalities.

Travel
Go from one place to another.

Traveller
A persona that goes from one place to another.

Trip
A journey from one place to another (and back).

User-centered
An approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements. (ISO, 2019)

User Experience
A person’s perceptions and responses that result from the use and/or anticipated use of a system, product or service (ISO, 2019)

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1

In this chapter

Introduction

This chapter introduces the topic, the problem statement and scope of the project. Subsequently an introduction to the project background is given. This includes the stakeholders surrounding air-rail journeys, such as airlines, rail operators and governments.

Additionally, the project approach is discussed. Finally, the reading guide provides an explanation to the structure of the report.

1.1 Topic background

Concerns regarding the environmental impact of the aviation sector increase. Especially short distance flights within Europe are criticized, since these itineraries could be replaced by more sustainable modes of transport. One of the suggested modalities to replace short distance flights, are international trains. Consequently, in the near future international train travel may become an increasingly popular transport modality, for short and medium range international journeys.

Within Europe, a substantial number of short distance flights is part of a multi-leg flight. In most cases, this is a combination between a short distance flight and a long distance flight. If international train travel will replace these short distance flights, other combinations will arise. Namely, the combination of international trains with long distance flights.

To realize this shift, it should become an attractive option to go on a combined plane and train journey, the so called air-rail journey, illustrated in figure 1.1. Ideally, this should become more attractive than going on a multi-leg flight. In the hope that, the air-air dominated aviation sector might transform towards a more air-rail oriented sector.

However, currently air-air journeys are smoother and better designed than air-rail or rail-air journeys. Therefore, the majority of the travellers makes the choice for the multi-leg flight. By truly addressing the needs and wishes of travellers, the air-rail journey could become a more attractive option. Consequently, the willingness of travellers to make a choice for a more sustainable alternative to the multi-leg flight might increase.

This project explores what is needed to make a shift towards more international train travel within Europe. More specifically, to stimulate the choice for a sustainable alternative for the multi-leg flight, namely the air-rail journey. Above all, within this project the perspective of the user is leading and therefore the project explores how the future air-rail journey could truly address the needs and wishes of the international air-rail traveller.

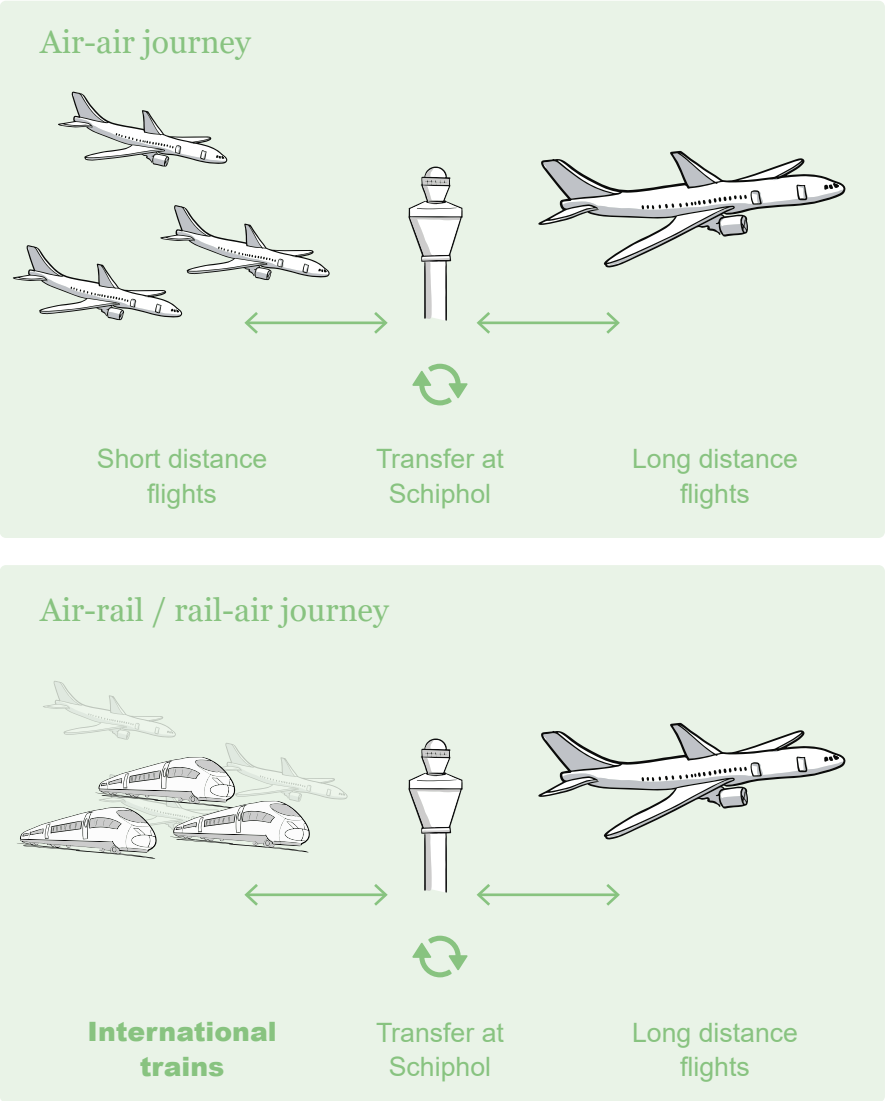


Figure 1.1 Air-air journey versus the air-rail journey.

1.2 Problem statement, goal and scope

1.2.1 Problem statement

Within this project the following problem statement is addressed:

Current plane-plane journeys are better designed than plane-train or train-plane journeys. This negatively affects the experience of combining a (long distance) flight with an international train, which makes it a less attractive option compared to a multi-leg flight.

1.2.2 Project goal

The project focuses on the following assignment:

Create a design vision for plane-train journeys, that facilitates in creating a seamless travel experience between planes and international trains within Europe.

For the project brief, see appendix A. The aimed project outcome is a holistic service concept, that is suitable for, or in connection with, Schiphol airport.

1.2.3 Scope

The project focuses on the total air-rail and rail-air journey. This means that the project focuses on the whole journey, from beginning to end. Starting with orientating on a trip and ending with arriving at the final destination.

The scope of the project is international train travel within Europe. More specifically, the focus is on air-rail (and rail-air) journeys that transfer at Schiphol airport in Amsterdam. The horizon of the project is around 2030. This is considered as short term, since infrastructural project mostly take time to be realized.

1.3 Project context

1.3.1 The stakeholders

The project focuses on the perspective of the traveller. However, there are some critical stakeholders that are part of the wider scope of the challenge. Governments, airports, airlines and international train operators are eventually in charge to facilitate the shift in air and rail travel, thus make air-rail and rail-air journeys happen. Because of this critical role within the challenge, not only the travellers' point of view, but also the stakeholders' perspective will be taken into account. To finally develop a user-centered and feasible design vision for air-rail and rail-air journeys. Therefore the graduation project is in cooperation with stakeholders surrounding the air-rail journey: NS International, Schiphol Group, KLM Royal Dutch Airlines and the Ministry of Infrastructure and Water management (see figure 1.2). The stakeholders are involved during the entire project. The project is enriched with insights and expertise of the different stakeholders regarding topics such as technological possibilities, business processes, social frameworks and ambitions. Furthermore, input and feedback provides guidance in the development of the design vision.

1.3.2 The Seamless Personal Mobility Lab (SPM-Lab)

The graduation project is part of the Seamless Personal Mobility Lab (SPM-Lab), part of the Delft Design Labs. In the SPM-Lab , the TU Delft explores new concepts for future personal mobility, in collaboration with public and private partners. The lab is also involved in a long-term collaboration between Schiphol and TU Delft 'Accelerating innovation', for which one of the focus areas is seamless international travel hubs. Other partners of the lab are also involved in the project, including 9292, GVB, Ministry of Infrastructure and Water Management, OV-Campus (CROW-KpVV and samenwerkingsverband DOVA), RET, Rover and TransLink Systems.

Figure 1.2 Overview of key stakeholders of the project.

1.4 Project approach

1.4.1 User-centered & multi-stakeholder approach

In order to create a design vision for air-rail and rail-air journeys that truly fits the needs and wishes of the user, a user-centered approach is taken. The project puts the user, the international air-rail traveller, at the centre of the process. This means the users form the most important source of information in the research phase and guide the design phase with their needs and feedback.

Besides the user-centered approach, multiple stakeholders are involved during the project. Similar to the users, the stakeholders act as an important source of information and provide feedback throughout the entire project. In this way, both the needs and wishes of the users and stakeholders can be taken into account. Additionally, the expertise of these stakeholders can contribute to develop a design vision that is not only user-centered but also feasible.

1.4.2 Process description

Based on the double diamond process, the project is divided into two main phases, the research and the design phase (Design Council, 2005). The research phase is focussing on revealing the problem, this means discovering and defining the problem of air-rail journeys. The design phase consists of a develop and deliver phase and is focussing on solving the problem right, thus develop and deliver the right solution to the problem.

1.5 Reading guide

The structure of the report is related to the approach of the project. An overview of the project approach and report structure is visualized in figure 1.3. The report is divided into two main parts: the research and design part. These parts are divided by chapters, in the research part this are the research themes. In the design part this are the phases of the design process. Throughout the report air-rail is used interchangeable with rail-air, unless it is made explicit that the air-rail or rail-air journey is discussed.

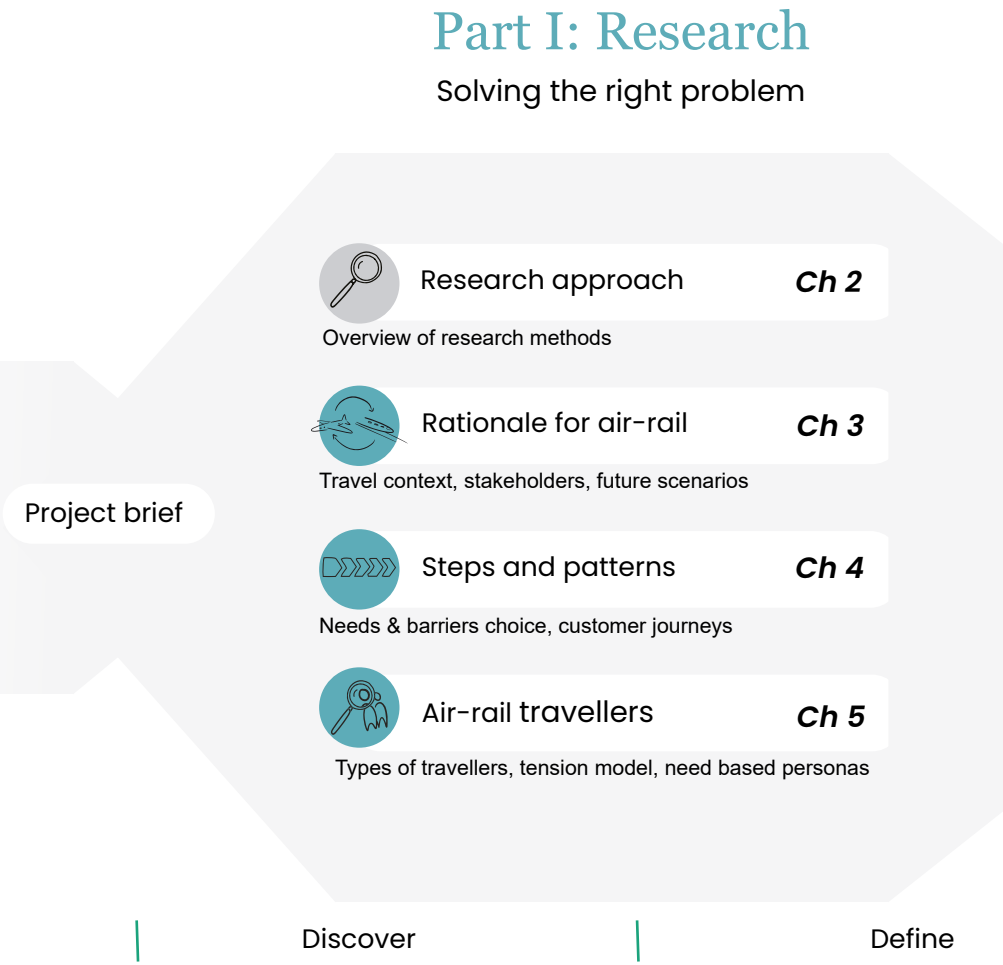


Figure 1.3 Overview of the project approach and report structure.

Part II: Design

Solving the problem right

Design brief ***Ch 6***

Vision & mission, problem statement
Design goal

Design approach ***Ch 7***

Overview of design activities

Ideation ***Ch 8***

Creative sessions, ideas, storytelling

Concept air-rail journey ***Ch 9***

Concept vision, user scenario and customer journey

Evaluation of the concept ***Ch 10***

User & Stakeholder evaluation of concept

Final design ***Ch 11***

Design vision, journey, scenario, implementation

Conclusion ***Ch 12***

Recommendations, discussion

Design | Deliver

Research

Analysis of the rationale,
steps, patters, user experience and users
of air-rail

In this part

The research phase is about revealing the problem surrounding air-rail journeys, in order to define and address the right problem. Within the research phase, the current situation surrounding air-rail journeys is discussed.

The current situation is explored in terms of its' rationale, defining why air-rail journeys should exist. The steps & patters of the journey explores what the current air-rail experience entails. Additionally, the people who are experiencing those journeys are defined, within the international air-rail travellers. The research part is concluded with a design brief, which serves as the assignment for the second phase of the project, the design phase.

2

Research approach

Within this chapter, the research approach is discussed in more detail. The research approach and corresponding methods are explained to create understanding of the origin of the results presented in the subsequent chapters.

In this chapter

2.1 Research process

The research process consists of three themes: the rationale, steps & patterns and the users. Within these themes various research methods are used and the results are analysed. These outcomes contribute to the design brief, in which the problem and the goal for the design phase are defined. The research process is visualized in figure 2.1.

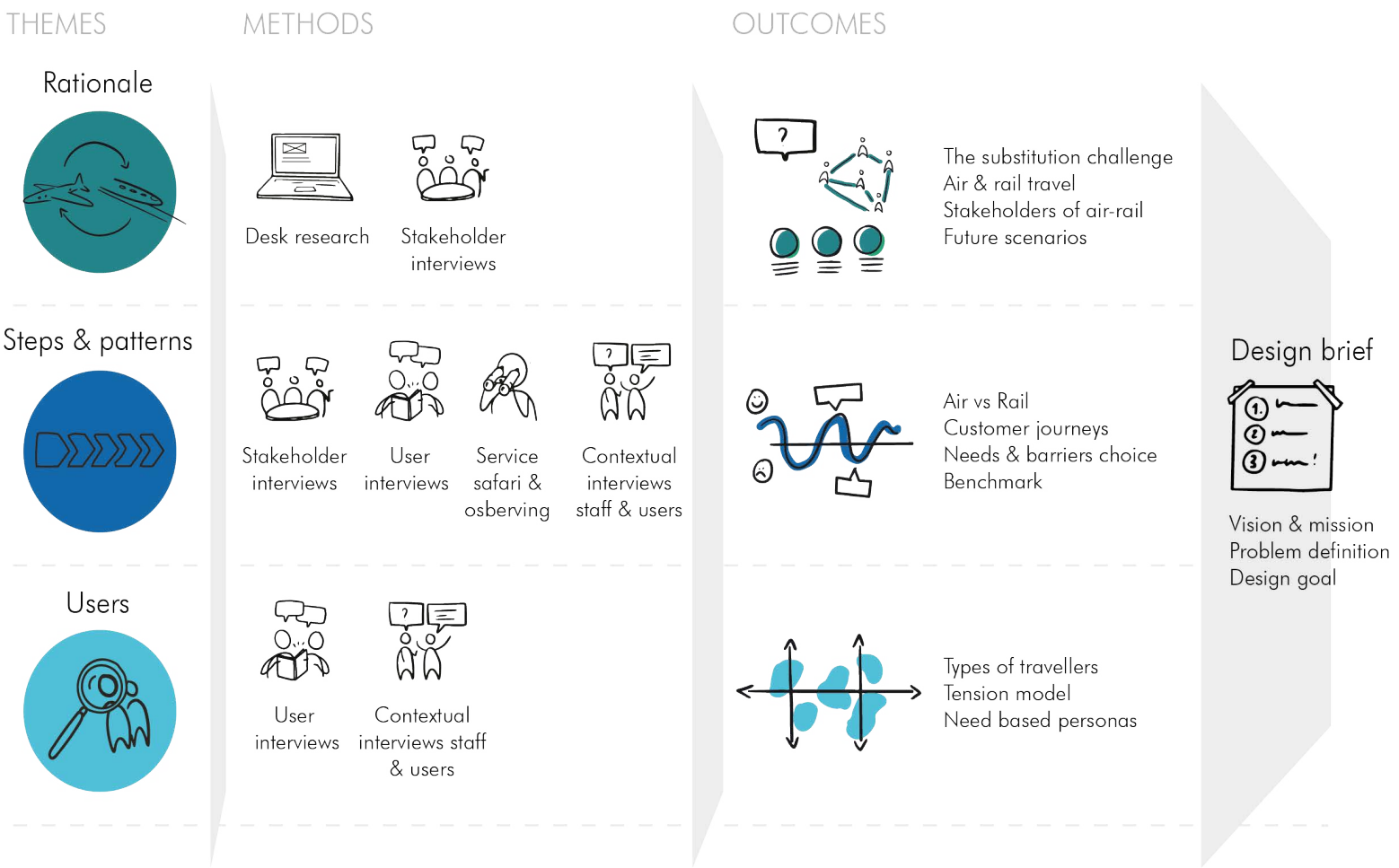


Figure 2.1 Overview of the research process and research methods.

2.2 Research methods

The following section discusses the different research activities of the research phase. In the subsequent chapters, the icons of the methods indicate which method is used for the outcomes of that chapter.

Desk research

To gain insight in the existing research and literature regarding the air-rail topic, desk research was executed. Literature and recent reports regarding the topic are reviewed.

Stakeholder interviews

To gain insight in the stakeholders perspectives, in-depth semi-structured interviews were held. Interviews were held with representatives of the airline KLM, the airport of Amsterdam Royal Schiphol Group, international train operator NS International, the Ministry of Infrastructure and Water Management department air and department rail. Finally, an interview was held with an mobility expert from Royal Haskoning DHV. The stakeholders were recruited via the network of the Personal Seamless Mobility lab. During these interviews, the goal of air-rail, the role and goal of the different stakeholders, their concerns and beliefs and their future vision were discussed.

Interviews Customer Experience

Additional interviews with representatives of the customer experience of KLM and NS international were held. Within these interviews, the current customer experience of the international air-rail traveller was discussed.

User interviews & sensitizing booklets

To gain insight in the perspective of the users, in-depth semi-structured interviews were held. The interviews were guided by sensitizing booklets, which the participants received a week before the interview. This type of booklet helps the interviewees to prepare and express their needs, by gradually building the interview from past to future experiences (Sanders & Stappers, 2012). An impression of the session and the sensitizing booklet is illustrated in figure 2.2 and 2.3. For the sensitizing booklet, see appendix B.

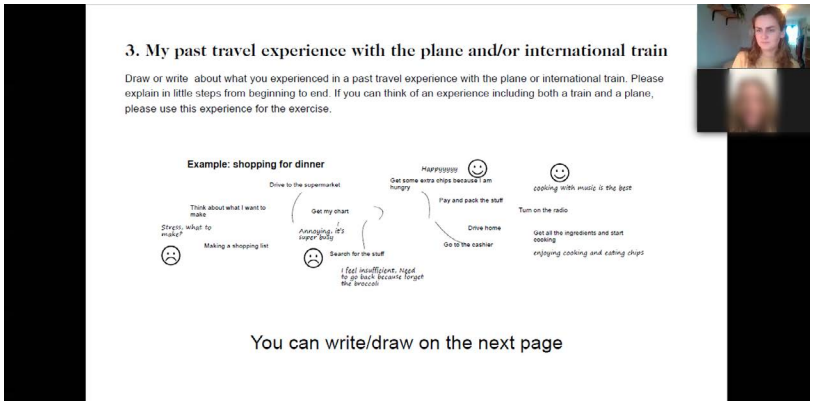


Figure 2.2 Impression of the interview session with the sensitizing booklet.

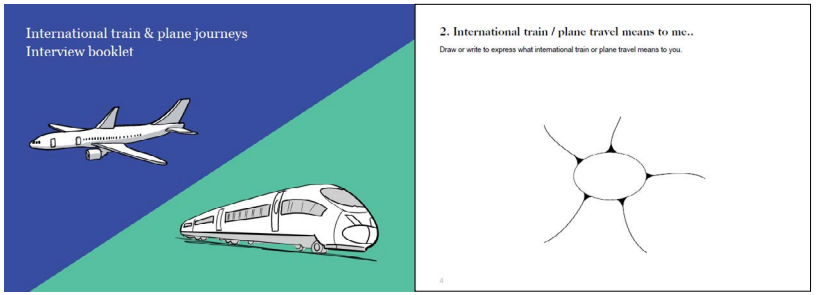


Figure 2.3 Impression of the sensitizing booklet.

Interviews were held with ten international travellers originating from Germany, Belgium, England, France and Australia, see table 2.1. Almost all interviewees experienced air-rail domestically and some internationally. The interviewees were recruited via the personal network of the researcher. To decrease personal biases, all interviewees are indirect contacts of the researcher.

Table 2.1. Overview of interviewees and their characteristics.

Nationality	Residential city	Sex	Age	Reason to travel	Modality choice
German	Cologne	V	29	Leisure, business	Plane / train
German	Munich	M	28	Leisure, relatives	Plane / train
German	Kleve	M	61	Business	Plane
Belgium	Gent	V	26	Relatives	Plane / train
Belgium	Gent	V	26	Relatives	Plane
English	London	V	34	Business, relatives	Plane
English	London	M	37	Business, leisure	Train
English / Portugees	Lisbon	V	29	Leisure, relatives	Plane / train
French	Paris	M	32	Business, leisure	Plane
Australian	Melbourne	M	42	Business, relatives	Plane

During this interviews, the reasons to choose the train or plane, the important aspects if travelling and past and future experiences of an air-rail, plane or train experience were discussed.

Contextual interviews users & staff

To gain insight in the perspectives of the users and their behaviour in context, contextual interviews were held at Schiphol airport (Stickdorn et al., 2018). Eight Travellers originated from Greece, Spain, Italy, Mexico, England, Argentina, Portugal and Austria are interviewed. The interviews were short since the travellers are on the move. Questions were asked about their reason of travelling and their motivations for choosing the plane, train or air-rail. Additionally, to gain insight in the needs of the users, contextual interviews with staff of NS International and KLM were held. Staff is in contact with the users every day and therefor have insight in the problems and needs of the travellers. The staff was interviewed at the service desks, at Schiphol Plaza, the platforms and transfer desks.

Service safari & observation

To be able to empathize with the user and understand all the steps of the current service, the context was visited and a service safari was conducted. A service safari is an activity in which the researcher experiences the service by her or himself (Davies & Wilson, 2015). Additionally, several visits to the context were done, to observe the surroundings and behaviour of the users. These visits were guided by staff of Schiphol and KLM. The transfer process from train to a flight and between flights was experienced and observed.

3

In this chapter

Rationale for air-rail journeys

To be able to understand the need for air-rail journeys, understanding of the rationale is essential. This means the motivation and reasoning behind combining international trains with flights. The rationale can be explained by addressing four main aspects.

Firstly, understanding of the motivation to substitute short distance flights for international trains is essential to understand why combinations of international trains with flights should exist. This is explained in the first section of this chapter.

Secondly, the rationale behind the combination of international trains with flights is inseparable from the hub function of Schiphol, which is carried by multi-leg flights. Due this hub function, the air-rail journey is actually a substitute for the multi-leg flight. To understand this better, the international travel context surrounding Schiphol will be introduced, the hub function will be explained and the fit of the air-rail journey within this context is discussed.

Thirdly, the stakeholders that are involved in the air-rail journey are introduced and their roles are discussed. The incentives of stakeholders are inseparable of the rationale and therefore their interests in substitution are identified. Although the motivation for substitution seems sustainability, there exists a paradox that implies that substitution could lead to greater environmental impact. The stakeholders interests do a play a role within this paradox, the relations between these interests and the paradox are discussed.

Finally, to understand to what extent air-rail journeys can be beneficial for users, societies and stakeholders, it is important to understand the potential of air-rail journeys. This potential can be illustrated by the use of possible future scenarios. These are discussed in the final section of this chapter.

Stakeholder interviews

Desk research

3.1 The challenge of substituting trains for planes

There exists an interest in the substitution of planes for trains in society and in the travel sector. To understand the urge and reasoning behind this interest, the challenge of substitution of short distance flights for international trains is discussed in the following section. The main reason for substitution, the impact of aviation, will be introduced and alternatives to flying are discussed.

3.1

3.1.1 The challenge of the aviation impact

The aviation sector is growing each year, resulting in increasing emissions, contributing to the current climate crisis (Kröger, 2019). Although the current COVID pandemic did drastically halted the aviation sector, stakeholders believe the sector will keep on growing. The upcoming economical markets like China and India are waiting for their turn to start discovering the world by plane, so the urge to fly will only increase the coming years. Resulting in more flights, more emissions and more impact on the environment.

"Those people all really want to fly. People can live further away from their family, et cetera. The reasons why we move a lot also applies to them. That is just going to explode enormously in the next 10 to 15 years."

– Representative of Schiphol airport

Flights contributed for around 6% to the total CO2 emissions in the Netherlands in 2018 (CBS, 2020). According to research from Remkes flights contribute for 1,1% to the total nitrogen emissions (Remkes, 2020). This report recommends that the nitrogen emissions should decease. It seems that the aviation sector does play a significant role in the current emissions of the Netherlands. Examining the emissions of the aviation sector, 38% of the emissions are caused by flights that are shorter than 750km, which can be categorized as short distance flights (Donners, Kantelaar, 2019). Therefor, decreasing short distance flights, could make a significant difference in the emitted emissions.

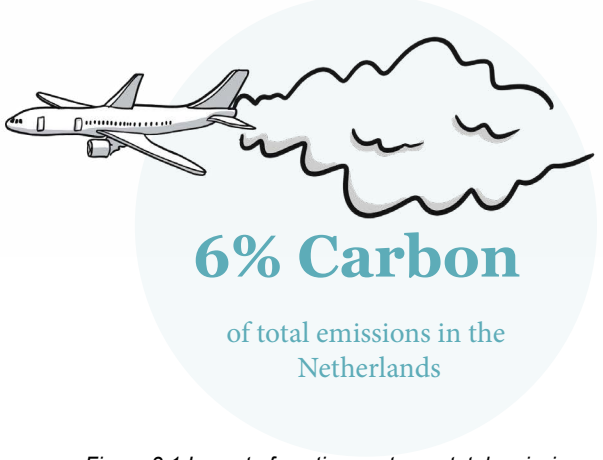


Figure 3.1 Impact of avation sector on total emissions of the Netherlands. (CBS, 2020)

In 2011, the European Commission argued that more travellers should choose the train over the car or plane. Additionally, according to the European Green Deal (European commission, 2019) emissions caused by transport should be decreased by 90% at the time of 2050. On top of that, the Aviation memorandum of 2020 – 2050 argues that CO2 emissions should be climate neutral in 2070 (House of representatives, 2020). That the impact of aviation is an important item on the European agenda, is also shown by the nomination of 2021 as 'year of the rail', imitated by the European Commission (European Commission, 2020). From a political perspective, the problem is acknowledged. However, if the aviation sector will continue to operate as it currently does, the climate goals will not be achieved.

Short distance flights are under attack in the media. Organizations like Greenpeace call for a stop of short distance flights (Stil, 2019) see figure 3.2. These organizations argue that the flights should be replaced by international trains.

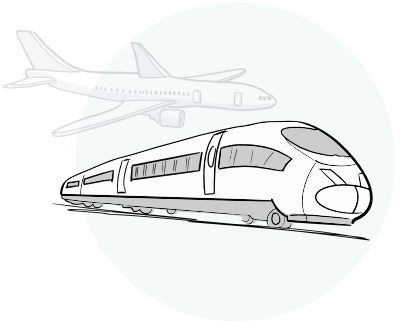
Greenpeace: stop met vluchten korter dan 750 km

Het aantal vluchten op Schiphol kan met ruim 200.000 dalen door niet meer te vliegen naar bestemmingen binnen 750 kilometer, meent Greenpeace. Die afstanden kunnen milieuvriendelijker per trein worden afgelegd. Dat zou 23 miljoen vliegreizigers per jaar schelen.

Herman Stil 27 november 2019, 6:01

Figure 3.2 Greenpeace calls for a stop of flights below 750km (Stil, 2019)

3.1.2. The train as alternative to flying



The train is put forward as an alternative to flying. According the research of Huibregtse et al. (2019), if planes, trains and cars are evaluated based upon their impact on society and the environment, the train emerges as the most sustainable option, provided the rails are already there. Consequently, to reduce the impact of aviation and reach the climate goals that are set on national and international level, substitution of short distance flights for international trains is proposed as one of the measures.

Less flying at short distances. That is the most important. The train. The HSL, absolutely. Bring him every hour from London to me. Then we can and we don't need to fly as much at short distances anymore. Then we do what is really necessary for Schiphol as a Hub, the connection with the wider world. - Dick Benschop CEO Schiphol (Matroos, 2020)

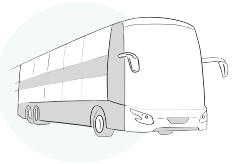
Nuancing the impact of the train

However, the train is not completely climate neutral and is therefore criticized. In the media discussions about the impact of the train arise, such as in the article "TGV really does not burn less than a Boeing" (Knip, 2018). It is important to acknowledge that the train is not climate neutral. However, it seems that the train is a more sustainable mode of transport compared to flying (Huibregtse et al., 2019).

"And at the same time I also think that trains are seen as great, while they also emit a lot of noise nuisance and polluted soil and CO2." – Representative Schiphol airport

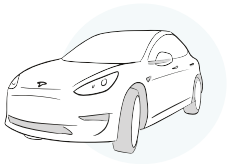
Other modalities to substitute planes

Besides trains, other sustainable alternatives for modality could be explored



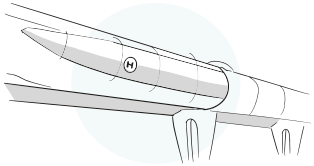
Electrical busses

International busses, electric cars, or even more innovative solutions such as the hyperloop could serve as alternatives to flying.
Long-distance buses are a flexible and inexpensive alternative to the train and can increasingly drive electrically. Therefore, international busses could be an interesting option for substitution. However busses cannot compete with high speed trains in terms of speed and therefor are less competitive over longer distances (Kröger, 2020).



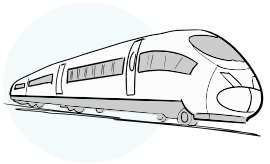
Electrical cars

Substitution could also be achieved by cars, especially electrical cars. However, electrical cars are expensive and therefore not yet a very accessible option for many (Kröger, 2020). Addtionally, cars have little capacity and therefor take relatively a lot of space within cities. Again, in the current system cars cannot compete on speed with a high speed trains.



Hyperloop

Finally, the hyperloop could be an interesting option for substitution. Unfortunately, the technology is not ready yet. First technical and safety issues have to be solved. Additionally, new infrastructure is necessary to be able to start operating the hyperloop (Heijden, 2020). This seems a very interesting option for the future, but will still take time and is therefore not a solution on the short term.



Train

In comparison to busses, cars and the hyperloop, the international train could be an interesting option for substitution. First of all, trains can serve a great amount of travellers. One international train from Paris to Amsterdam can hold up to 500 passengers (Railteam, 2020).Additionally, the existing infrastructure could already transport these international trains throughout Europe and these trains could even arrive directly at Schiphol airport in Amsterdam (Schiphol, 2020c). Most importantly, the train could compete with the travel times of short distance flights within Europe (Donners, 2018).

3.1.3. Conclusion

Due the impact of aviation, there is an increasing interests in decreasing short distance flights within Europe. Substitution of short distance flights by international trains seems to be an interesting measure to address this challenge. International trains could be a more sustainable alternative that could compete with short distance flights. Therefore this project explores the possibilities of the international train as alternative for short distance flights within Europe.

3.2 The air-rail journey as sustainable alternative to the multi-leg flight.

Within the previous section, the challenge of substituting planes for international trains is discussed. The international train could be a more sustainable alternative for the short distance flight. Eventually, by substituting short distance flights, multi-leg flights will become a combination with international trains and flights. However, to truly understand how the air-rail journey can act as a substitute for the multi-leg flight, understanding of the current travel context surrounding Schiphol airport is needed. First the context of international rail and air travel will be introduced. Secondly, the international hub function of Schiphol will be explained. Finally, the air-rail journey as alternative to the multi-leg flight will be introduced.

3.2

3.2.1 Context of international rail and air travel around Schiphol

In the following section, international plane and train travel surrounding Schiphol airport is introduced, to create understanding of the international travel context of the air-rail journey.

Plane travel around Schiphol

Every year half a million flights depart and arrive at Schiphol airport. From these flights, 40% is a short distance flight, this means a flight to a destination that is shorter than 750km. Additionally even 60% of the flights is shorter than 1250km (Donners, 2020). This implies that short distance flights do take a significant part in the total flights at Schiphol.

The short distance top destinations are London, Paris and Copenhagen. London is by far the most popular destination, with almost 5 million travellers in 2018. For Paris and Copenhagen this was 1,4 and 1,1 million travellers in 2018 (Donners, 2020). At Schiphol airport, 78 different airlines operate (Schiphol, 2020). Of these airlines, 19 are part of the alliance Skyteam. The dutch airline KLM is also part of this alliance. The alliance works together to offer a strong international network (Skyteam, 2020).

Transfer passengers at Schiphol

For air-rail journeys, the amounts of transfer passengers are interesting. Since transfer passengers could be the potential air-rail passengers. From the 71,1 passengers at Schiphol in 2018, 36,6% were transferring. This means 26 million transfer passengers (Donners, Kantelaar, 2019). Passengers that transfer at Schiphol are coming from various destinations. Some of these destinations have relatively large amounts of transfer passengers coming to Amsterdam. Brussels, Hannover and Düsseldorf are the destinations that cause by far the most transfer passengers. Namely over 80% of the passengers coming of these destinations is transferring at Schiphol. Figure 3.3 shows the destinations with a substantial amount of passengers that transfer at Schiphol. The three cities with over 80% of transfer passengers are indicated in green (Savelberg & Lange, 2018).These numbers imply that there could be a quite high demand for air-rail journeys, since the share of transfer passengers for several short distance destinations seems substantial. This also shows that on these tracks there are already sufficient alternatives for OD travellers, indicating that if air-rail becomes more attractive for transfer passengers, these will also choose for the train.

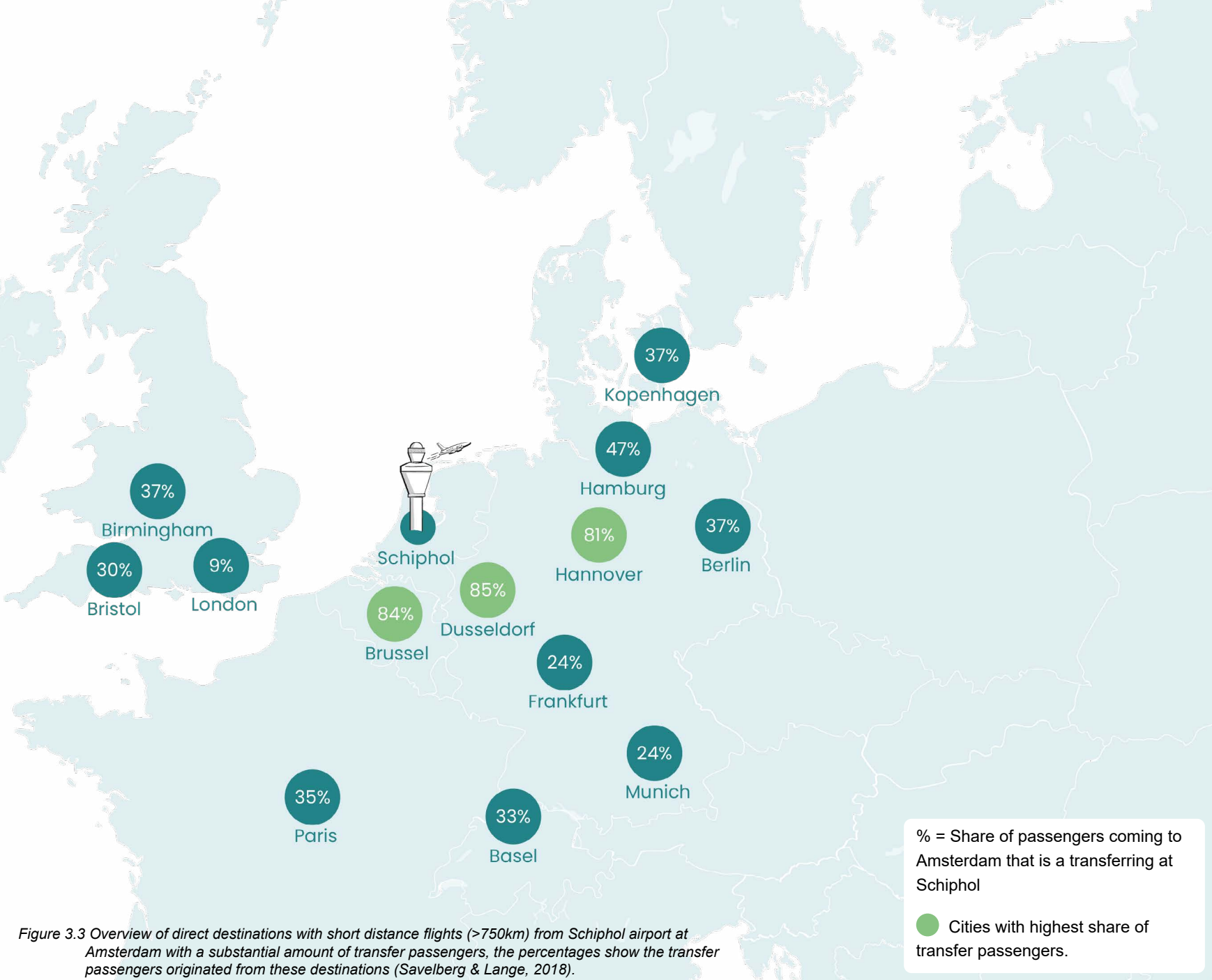


Figure 3.3 Overview of direct destinations with short distance flights (>750km) from Schiphol airport at Amsterdam with a substantial amount of transfer passengers, the percentages show the transfer passengers originated from these destinations (Savelberg & Lange, 2018).

International train travel around Schiphol

From and around Schiphol airport, there are several destinations that can be directly reached by international train. These direct destinations are Paris, Brussels, London, Berlin, Frankfurt and Basel. Also destinations that are on the route of these destinations can be reached directly by train. Besides these direct destinations, almost all European cities can be reached by train, only for these destinations transferring between trains is necessary.

Several international train operators offer international trains around Schiphol. These are the ICE, Thalys, Eurostar and IC Berlin and IC Brussels (NS International, 2020). The operators serve different destinations and are owned by different countries. NS International is working together with these operators to offer the network from and around Schiphol airport. An overview of the international train network surrounding Schiphol, including train operators and travel times, is illustrated in figure 3.4, Currently, the Thalys and intercity Brussels are operating from Schiphol airport. The Eurostar, ICE and IC Berlin are operating from Amsterdam Central.

Train travellers at Schiphol

The train station at Schiphol served around 90.000 travellers every day in 2018, this is around 33 million a year. This includes both international and domestic travellers. Around 1% of these travellers is transferring between a train and flight at Schiphol airport. This were around 380.000 travellers in 2018 (Donners, 2020). This shows that the part of current air-rail travellers is relatively small compared to the amount of total train travellers at Schiphol airport, this is mainly because the station at Schiphol airport also serves many domestic travellers.

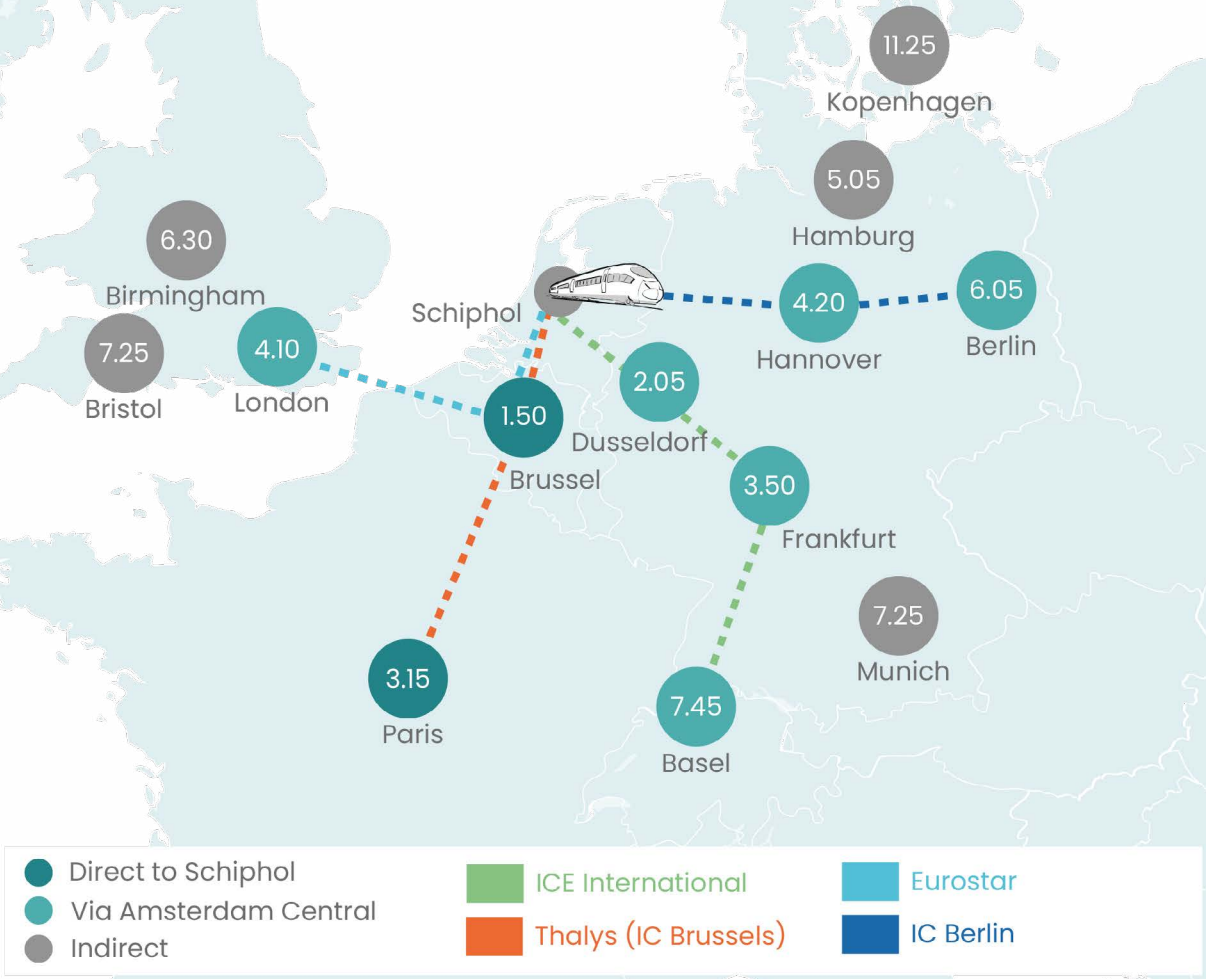


Figure 3.4 Overview of international trains and operators with corresponding travel times connected to Schiphol airport (Savelberg & Lange, 2018).

3.2.2. The international travel hub

This section discusses the international hub Schiphol airport Amsterdam. The air-rail journey is inseparable from the hub function of the airport. The air-rail journey will serve the hub function by connecting a variety of destinations. To understand how the air-rail journey fits into this hub function, it is valuable to understand what an international hub entails. Schiphol airport can be seen as an extremely connected airport, it serves over 300 direct destinations. Additionally, with over 70 million passengers in 2019, it is considered to be the third biggest airport of Europe (Schiphol, 2020a). Only London Heathrow and Paris Charles de Gaulle are bigger (Kröger, 2019). These relatively large airports are also called airport hubs. Hubs serve relatively generous destinations compared to surrounding airports.

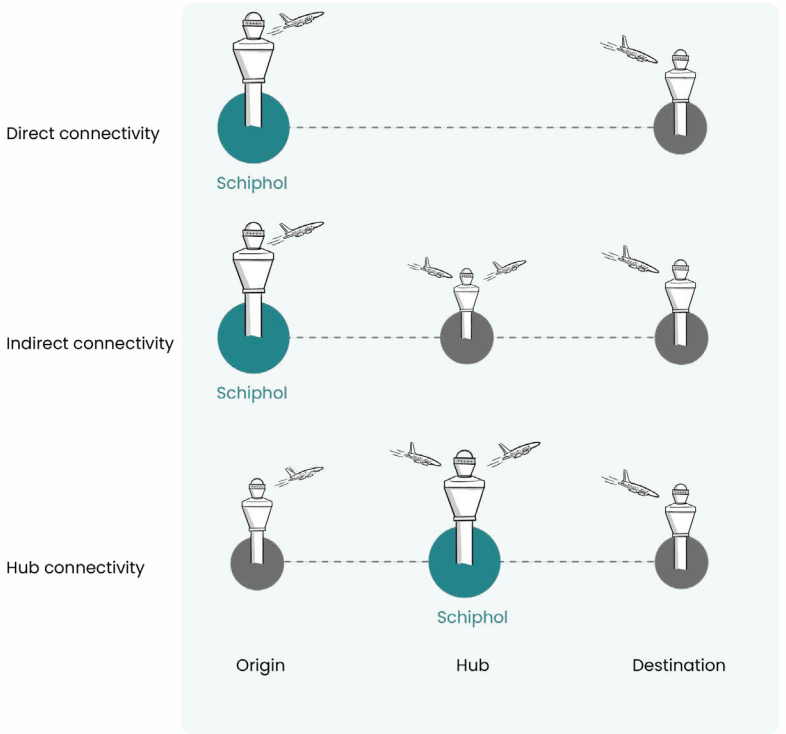


Figure 3.5 Overview of transport segments at Schiphol airport (Savelberg & Lange, 2018).

3 transport segments

At airports there are three transport segments that can be distinguished (Savelberg & Lange, 2018). Firstly, direct connectivity which is also called origin to destination (OD). These are flights that consist of only one leg to or from Schiphol. For example a flight from London to Amsterdam. Secondly there is indirect connectivity. These are flights that depart from Schiphol, transfer at the next airport to continue with a second leg towards the final destination. For example a flight from Amsterdam to London, that transfers at London to a flight to New York. Finally, there is hub connectivity. These are flights that arrive at Schiphol, transfer at Schiphol and continue to the final destination. For example a flight from Brussels to Amsterdam, that transfers at Schiphol to a flight to New York. The different transport segments at the airport are visualized in figure 3.5.

The hub & spoke model

Flights in the category hub connectivity are crucial for Schiphol's hub function. This can be explained by the so-called hub and spoke model. The reason why Schiphol is such a big airport is best explained by its' hub function. The hub is part of a model, called the Hub and spoke model. This means that the hub acts as a main airport, other smaller destinations fly to this airport and connect there to other destinations. These smaller destinations are also called spokes. The spoke destinations have a little number of flights, the hubs have a large number of flights (Elledge, 2014). The hub, collects passengers with small planes from relative smaller airports that are close to the hub airport. This short distance flights serve as 'feeders' for the long distance flights. This is useful because the local market of Schiphol is not big enough to fill the large planes that are needed for the long distance, mostly intercontinental, flights. The model creates a lot of combinations between short distance flights and long distance flights, this results in numerous transfers between those flights. The hub and spoke model is visualized in figure 3.6.

This model is executed at airport, but is created by the airlines. The airport is mainly facilitating in infrastructure, while the airlines are creating the network by operating flights. The infrastructure at the airport clearly reflects the hub function, it is designed to create convenient transfers for passengers between flights.

In this way you make a lot of long flights available. Because someone from Sweden can fly with someone from Italy via Amsterdam to New York. – Representative of Schiphol airport.

Strategic advantage of being an international hub

The motivation of airports to strive to become international hubs is mainly caused by the strategic advantage of being such a hub. It is argued that the extensive international network, it the main strategic advantage of the hub. This network of direct destinations at Schiphol creates an important aspect for international business to settle itself around the airport. Additionally the airport provides direct possibilities to work in the area (West, van der et al., 2019).

KLM argues that the international connection not only benefit on an economic level, but also benefit education and cultural institutions. Such as universities, that can easily connect with other universities and cultural institutions such as museums, that can easily exchange items. However other side of the coin is that the large amounts of flights have negative impact on the hubs' direct environment. Air pollution, noise and traffic congestion are negatively influencing the living environment of the hub (Elledge, 2014).

But by using this model, and therefore also having flights with little local transport, you create an enormous network that you can offer. You cannot offer this if you only focus on local transport. […] It's on an economic, educational, and cultural level that you benefit from those connections.. – Representative of KLM

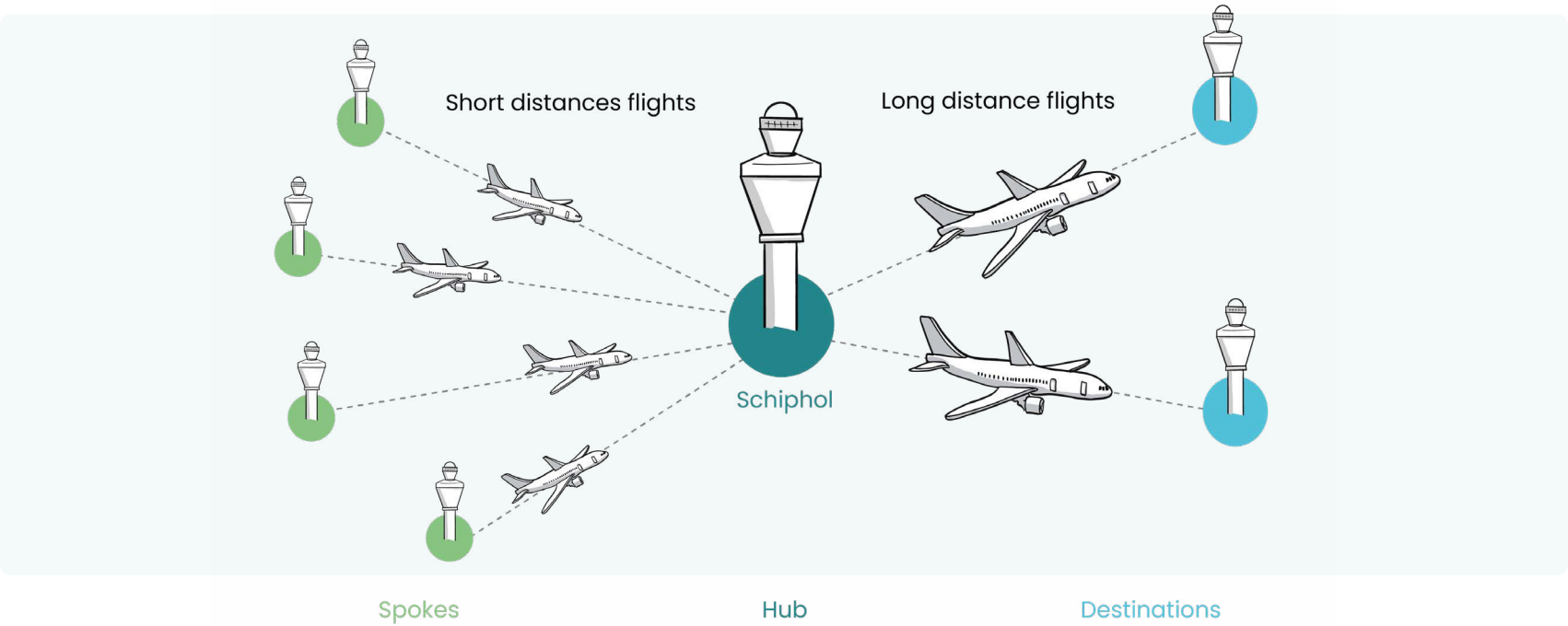


Figure 3.6 The hub & spoke model at Schiphol airport (Elledge, 2014).

3.2.3 Air-rail journeys as alternative to multi-leg flights

The short distance flights that serve the routes from the ‘spokes’, could be replaced by international trains. This results in a change of multi-leg flights to air-rail journeys. This is a journey which combines an international train and a flight. The international trains will now function as feeders for the long-distance flights. In this way, the hub and spoke model can maintain, without having to execute short distance flights. This could be a more sustainable alternative to operate as an international hub airport.

3.2.4 Conclusion

The international hub function of Schiphol is created by the hub spoke model, operated by the airlines. The extensive international network the hub provides is seen as a strategic advantage, the downside of this is the impact the hub has on its’ environment. The air-rail journey can fit in this model by serving as a spoke, a feeder for larger planes. In this way, the air-rail journey could serve as an more sustainable alternative to the multi-leg flight.

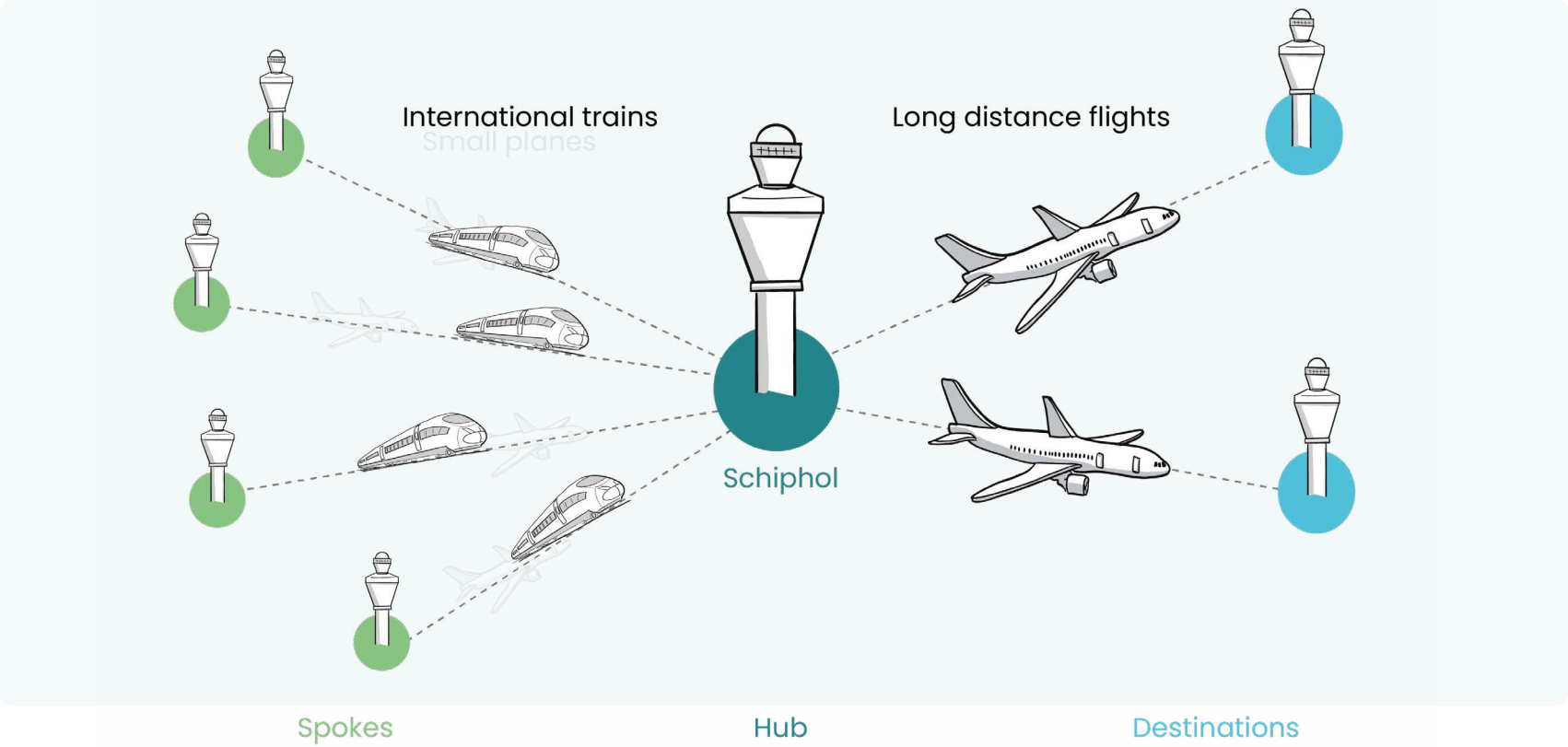


Figure 3.7 Integration of international trains at the hub & spoke model at Schiphol airport.

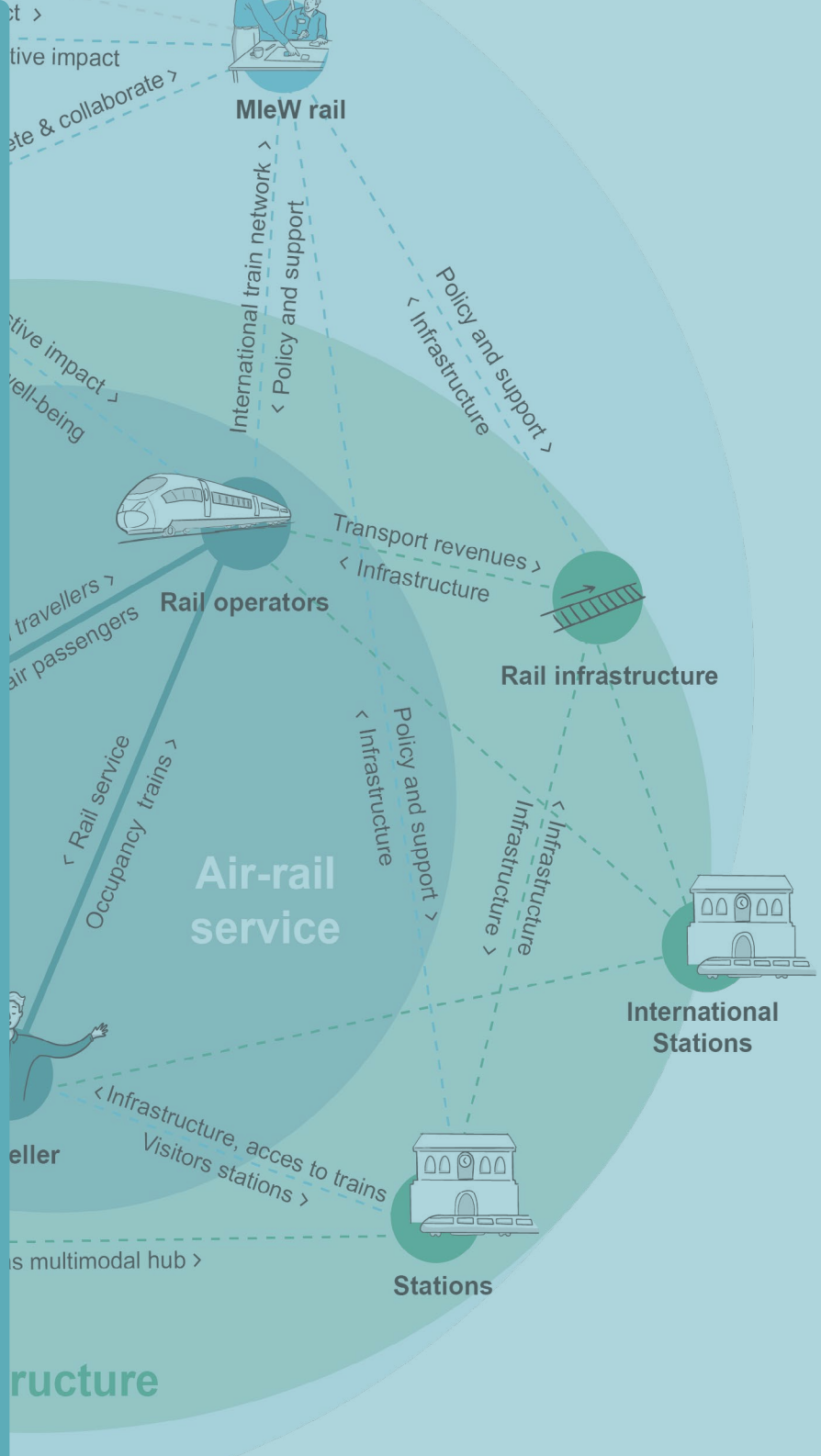
3.3 stakeholders of air-rail

The air-rail challenge evolves around the experience of the traveller. However, there are critical stakeholders that are part of the wider scope of the challenge. Governments, airports, airlines and international train operators are eventually in charge to facilitate the shift in air and train travel. Therefore, the understanding of their roles is essential. Additionally, the interests of the stakeholders in air-rail are inseparable of the rationale for air-rail journeys.

This chapter discusses the roles of the different stakeholders. Additionally, an overview of the relations between stakeholders is presented in a stakeholder map. Furthermore the interests in air-rail journeys of the different stakeholders is discussed.

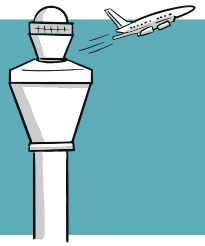
Finally the substitution paradox and the tension between the interests in air-rail is discussed. While the main reason seems to be sustainability, other interests seem to conflict with this goal. The substitution paradox illustrates this tension.

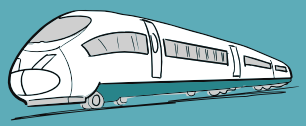
3.3

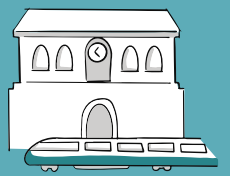


3.3.1 Overview of the stakeholders

Air-rail is surrounded by a quite complex multi-stakeholder environment. An overview of the involved stakeholders is created, to make clear what stakeholders are involved in this challenge and what their specific role within air-rail journeys entails. Both the role in general and the role regarding the air-rail service are evaluated. Figure 3.8 shows an overview of the stakeholders roles. For a detailed analysis and discussion of the roles and interests in air-rail of the stakeholders, see appendix C.

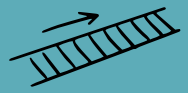






	Airlines	Airport	Train operators	Stations
Role	*Provide an international network*	*Provide infrastructure to create international connections*	*Provide the international train network from the Netherlands*	Station infrastructure
Role in air-rail	Managing as product owner for existing AirRail, network and service provider air	Facilitate in the shift and show leadership	Collaborate with airline for existing AirRail, network and service provider rail	Facilitate access to trains and facilitate transfer

Figure 3.8 Stakeholder overview concerning the current air-rail journey.



Rail infrastructure	Travellers	Government	Society
Rail infrastructure & accessibility	*Users of the product and service*	*Policy regarding mobility and infrastructure, quality of network, sustainability*	*Representative of positive impact, sustainability and well-being*
Deliver and manage rail infrastructure	End user	Nuancing and connector, providing information and creating awareness in society	Guide and put pressure on positive impact

3.3.2 Stakeholder map

A stakeholder map of the air-rail stakeholders is created, see figure 3.9. A stakeholder map helps to create an overview of the different stakeholders and provides insight in how the stakeholders relate in terms of value exchange regarding air-rail (Giordano et al. 2018).

Layers in the map

Within the map three layers can be distinguished.

Service

The first layer is the service layer. This layer consists of the traveller, airlines and rail operators. The airlines and rail operators are in direct contact with the traveller and are the service providers within the current air-rail journey.

Infrastructure

The layer surrounding the service layer is the infrastructure. This layer represents the stakeholders that facilitate the air-rail journey with rail or air infrastructure, including the airport, the national and international stations and the rail infrastructure.

Policy

The most outer layer is the policy surrounding air-rail. The government is responsible for this policy. More specifically, the departments that are directly involved are the Ministry of Infrastructure and Water management department rail and air. These are mapped as separate stakeholders, since both have different interests and focus on different stakeholders. Additionally, society is an important stakeholder since this stakeholder is guiding the policy. Finally, international policy is essential, since the air-rail journey is orientated internationally.

Main challenges in the stakeholder environment

The main challenges in the stakeholder environment are mainly based upon the differences between the sectors of international trains and aviation. Within the challenges, mainly the rail operators and airlines play a key role.

Colleagues versus competitors

An important aspect that creates a challenging in collaboration, is that the train operators and airlines are both colleagues and competitors. They are competitors on all the origin-destination journeys (OD), because on these trajectories it is either a plane or a train, so either a ticket for the airline or the train operator. However regarding the air-rail challenge, they are more complementary. Since both stakeholders can benefit from the air-rail journey due to feeding their modes of transport. However the competing nature on the OD trajectory can influencese the decisions regarding air-rail, since both parties want to create the best conditions for both air-rail and the OD journey.

Bringing two different worlds together

Rail operators and airlines are both transport providers, and have things in common. However, the sectors also differ on important aspects from one another. From different booking and ticket systems, to different security procedures and luggage handling standards. Additionally, the focus of both differs in terms of a national orientation for the train and international orientation for the plane. Ultimately, these different worlds make it complex to bring the aviation and rail sector together.

Conflicting interests

Another important challenge within the stakeholder environment, are the conflicting interests. The influence that air-rail could have on the current market and handled hub and spoke model, seems to obstruct the motivation for air-rail. The possibility exists that due to implementing air-rail, flights decrease, international connections get lost and ultimately the international network weakens. It seems that the aviation sector hesitates due the risk of a weaker network. Moreover the possible effect of less flights is the best for the environment, but probably not for the international network. There seems to be conflicting interests with the sustainable goal in the first place. Due to the conflicting interests, the motivation for air-rail seems moderate.

Limited influence on international level

A final challenge within the stakeholder environment is influence that stakeholders have on an international level. While the main challenges within air-rail ask for international measures and interventions, the influence stakeholders can have on this level are limited. For example the Ministry of Infrastructure and Water Management could intervene to create more attractive ticket prices, but to really make such measures work, international measures are needed. In the end, this limited influence on an international level makes implementation of air-rail harder.

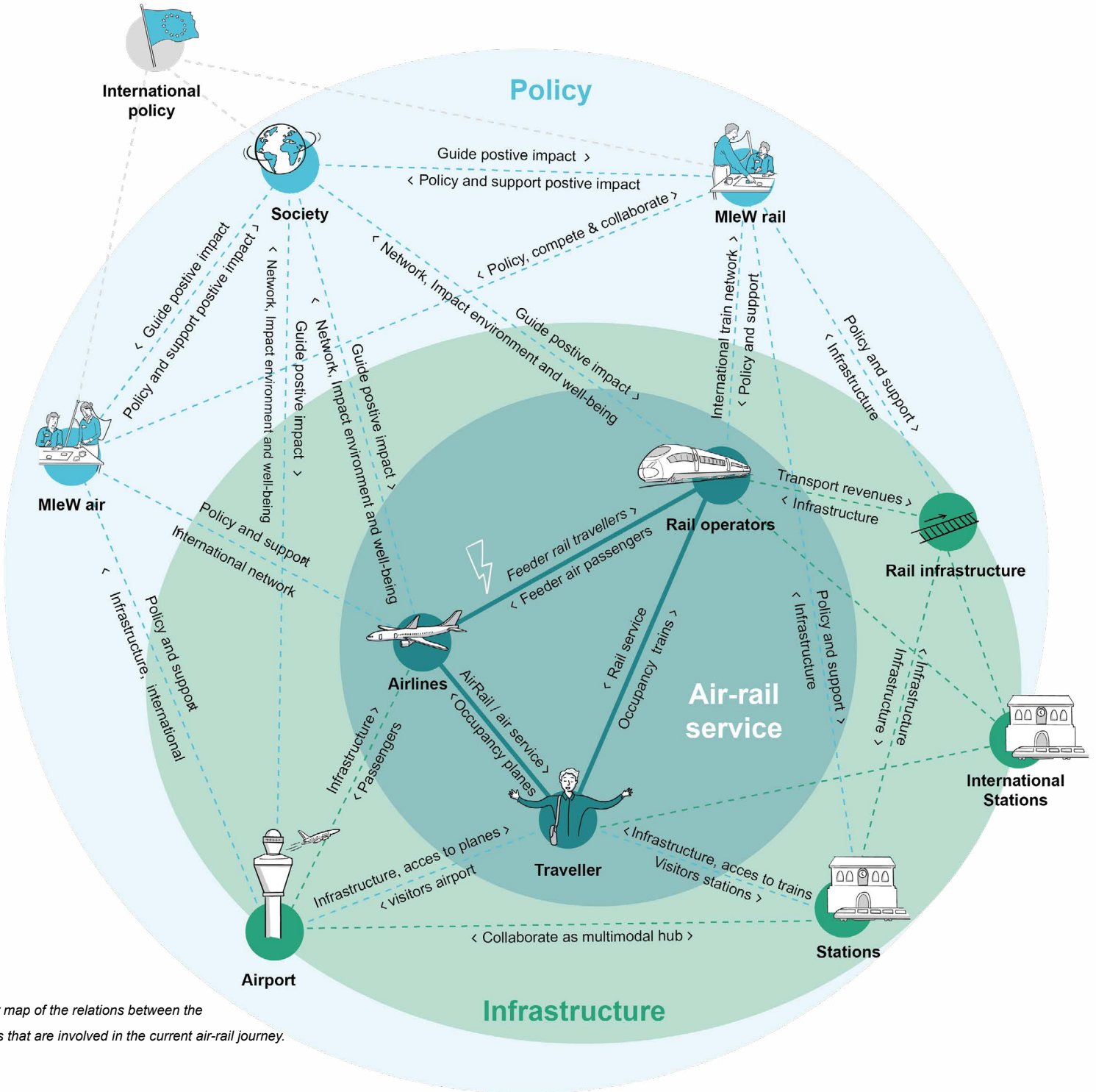


Figure 3.9 Stakeholder map of the relations between the stakeholders that are involved in the current air-rail journey.

3.3.3 The substitution paradox & the stakeholders' interests in air-rail

The aviation sector presented an action plan to reduce the impact of aviation with 35% by 2030. The plan introduces 7 themes to reduce CO2 emissions (Aviation Netherlands, 2020). One of these themes is arguing to reduce short distance flights, by replacing these flights by trains or other sustainable modalities. The aviation sector seems in favour of this modal shift. A shift from one modality to the other, from plane travel to train travel. This raises the question, why the sector is motivated to realize this shift.

The substitution paradox

The main motivation for air-rail journeys, seems to reduce the impact of the aviation sector, as discussed in chapter 3.1. However, the question that arises is, does substitution of short distance flights mean less impact on the environment. It seems that it is more sustainable to use the train compared to flying. However, does this result in a decline of emissions and environmental impact on a wider scope.

The effect substitution has on airports should be examined, to create understanding what the impact of substitution and thus air-rail journeys could be. The effect depends on the behaviour and policy of the airlines and airports. When the amount of short distance flights will decrease, the airport slots of these flights will become available. Subsequently, these empty slots could be used to operate other and even longer flights. Currently, capacity of the airport is tight, which means that the demand for operating flights is higher than the available slots. Stakeholders argue that even though the current pandemic did decrease the demand in the aviation sector, the upcoming markets in especially Asia, will increase travel demand in the coming years.

Additionally, research shows that the aviation sector will keep on growing. More important, it shows that the demand for flights will be higher than the capacity in 2030. This could indicate, that all released capacity at the airport will be used for other flights (Council for the Environment and Infrastructure, 2020).

The existing airport slots, which were occupied by short distance flights, could be used for other flights. If airlines decide to use these airport slots for long distance flights, this could mean that short distance flights are replaced by trains, but at the same time at the airport they are substituted by flights over longer distances (Berveling, 2020), see figure 3.10. Eventually, this could result that the overall impact of aviation at that airport will increase.

This is the so called 'substitution paradox'. Substituting short distance flights, intended to reduce the impact on the environment, could result in an increase of long distance flights. These long distance flights create higher emissions and more impact on the environment. The amount of the flights will not grow, but the impact will grow. Eventually, the results seems that substitution negatively influences sustainability.

Every short flight is likely to be replaced by a long flight. So that is just a lot worse for the planet. So you never actually get there. - Representative of NS International

If masses of people choose the train instead of the plane, then it is more sustainable. But not necessarily if more people start to travel as a result. Or if the released capacity is used for other types of air travel, there is no climate gain at all. – Ministry of Infrastructure and Water management, department rail

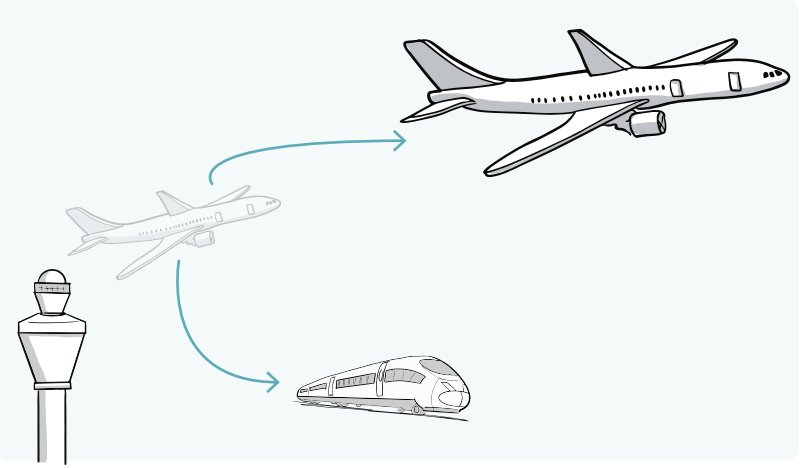


Figure 3.10 Swapping short distance flights for long distance flights.

The interests of stakeholders in air-rail

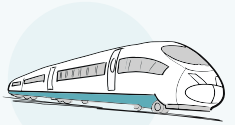
The different interests of the stakeholders towards substitution play a critical role within this paradox. Airlines, airports and the government are eventually in charge of what happens at the airport. Therefore, to understand this paradox better, understanding of these interests is essential. An overview of these interests is given in figure 3.11. The interests of the key stakeholders related to the paradox, is discussed on the next page.

Airlines

Sustainability, maintain and enhance connectivity

Airport

Sustainability, capacity, connectivity, position as airport



Train operators

Sustainability, improve and increase international train travel

Stations

Connectivity, transfers at station

Rail infrastructure

Reliable and safe rail network with sufficient capacity

Travellers

Costs &Time,travel options, comfort, experience, sustainability

Government

Sustainability, improve the quality of the international network

Society

Positive impact on the environment and well-being, connectivity

Figure 3.11 Overview of stakeholders' interests in air-rail.

The airport

The airport wants to take responsibility for reducing the impact of aviation and beliefs substitution could contribute to that. However, another goal for the airport could be that in this way, capacity can increase. Since the market is expected to grow and the airport is already operating on its limit, substitution could make room for other flights. This could enable the airport to keep on facilitating the demand for travel. Additionally, good international rail connections to the airport, can strengthen the strategic position of the airport compared to other hubs, since it could become more attractive to visit Schiphol.

We strive to find the right balance between the contribution we make by optimally connecting the Netherlands with the rest of the world on the one hand, and the negative effects of aviation on the quality of life of local residents and the wider environmental impact of aviation on the other (Schiphol, 2020b).

The airlines

The airline describes that their most important goal for substitution is to provide more sustainable travel options. However another important goal is the ability to grow as an airline. As the capacity of Schiphol is reaching its' limits, substitution could open up possibilities to grow without increasing the actual amount of flights. For the airline itself the connections they provide are key to their business model. Therefore, losing connections due to substitution is not preferred. Therefor an important goal of the airline is to make sure the connections and network are maintained. In the end, the airline would like to get rid of the short distance flights, but want to keep their market share.

I think you should look more at a traveller level. I think KLM is all about whether you can offer travellers a sustainable journey. That is still a bit difficult to Santiago de Chile, but if you can offer them a sustainable alternative for the short flights. Then that is only a step forward. - Representative of KLM

The Government

For the government, sustainability seems an important reason for the commitment to substitution. However, both departments doubt the actual positive impact of air-rail due the substitution paradox. More specifically for air-rail, another important goal is made clear, improving the quality of the international network. Air-rail could strengthen this international network by creating high quality connections to the airport of the Netherlands.

Sustainability is our primary motivation. – Representative of the Ministry of infrastructure and water management department air

The whole purpose of AirRail is not so clear. The political discussion is a bit around CO2. According to the minister, it is an excellent measure for the network, but not a climate measure. - Representative of the Ministry of infrastructure and water management department rail

The tension between growth, network and sustainability

There seems to be a tension between on the one hand becoming more sustainable and reduce the impact of aviation, and on the other hand being able to grow, increase capacity and maintain or expand the international network. The question that arises is, to what extend the air-rail journey is promising as a sustainable measure, if these interests are conflicting. However looking at the growth of the demand of travelling, a nuance on the paradox can be made. Since the demand for transport will grow the coming years, the need for mobility will be facilitated the ways that are on hand (personal communication, Donners, 2020). This means that due this growth, this increasement would happen anyway and would soften the paradox.

Additionally, the airline argues that looking at it from the level of the journey instead of the overall sector of the aviation, substitution does provides a more sustainable alternative for short distance flights.
However, from the perspective of the stakeholders, it seems that this tension also creates a barrier to fully commit to substitution. Because if substitution would lead to a reduced network and even shrinks the capacity, the aviation sector will not benefit on a business level. However, it seems that substitution could be beneficial on a sustainable and business level, if short distance flights can be reduced, but the network will be maintained.

Our right to exist is the connections we provide. If you lose the connections then you have a problem, what is the tipping point? […] It is successful when we no longer need short distance flights but do have sufficient market share. – Representative of KLM

3.3.4 Conclusion

Within the stakeholder environment, there are three key stakeholders, that directly influence the service: The traveller, the airlines and the train operators. Other stakeholders operate on the infrastructure and policy level.

The collaboration between the airlines and rail operators is crucial.
The main challenges regarding this collaboration are caused by the complementary and competitive nature of the collaboration, the differences between the sectors and the conflicting interests in air-rail. Finally, the limited influence stakeholders have on an international level is a barrier to implement air-rail.

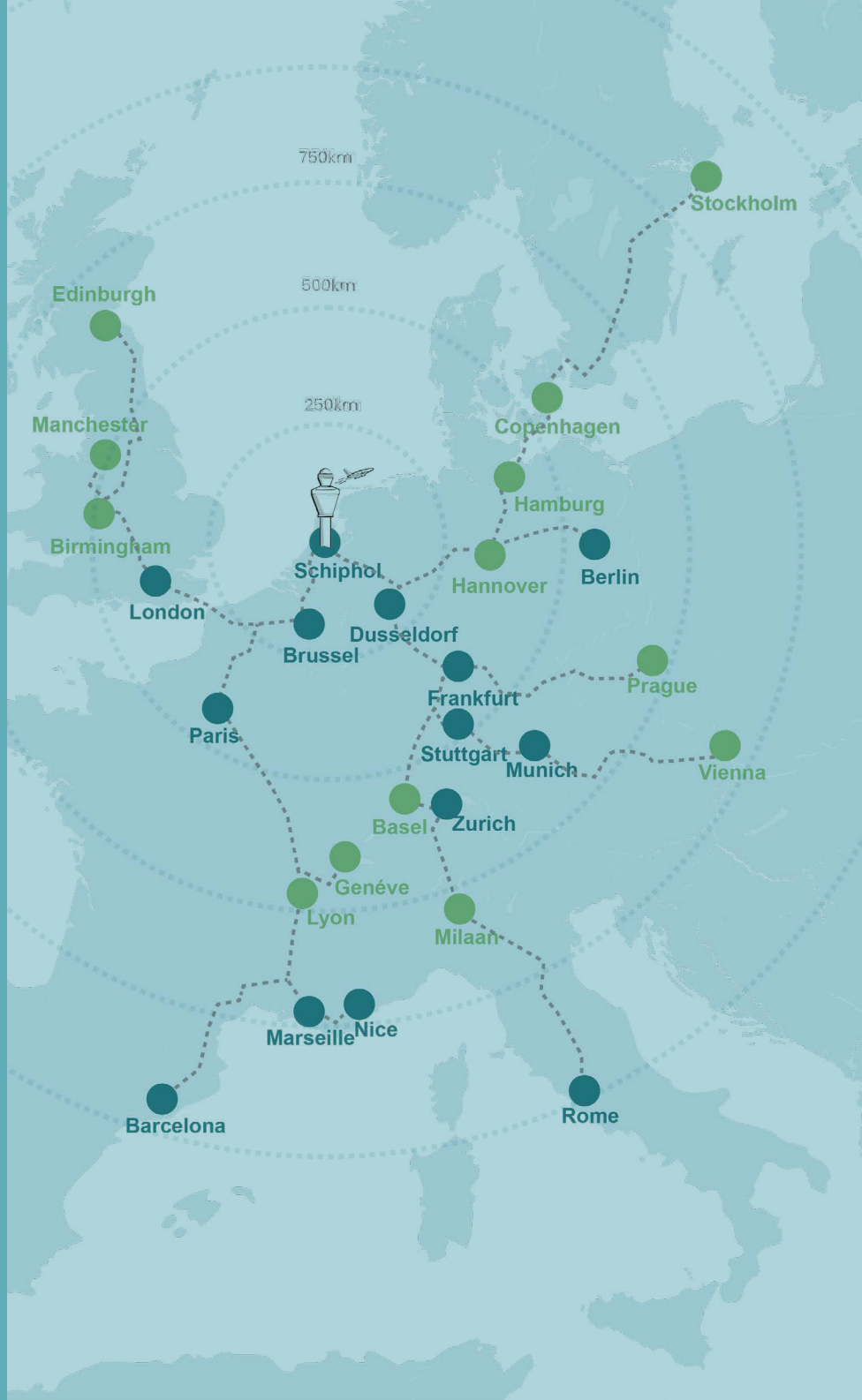
Due conflicting interests and moderate motivation, it seems that the stakeholder environment is missing orchestration. It seems that motivation should increase to make air-rail to a success and get other stakeholders along.

Finally research and the stakeholders indicate that the paradox seems true and that the conflicting interests of stakeholders make it hard to present air-rail as a completely sustainable measure. It does provide a more sustainable travel option, but overall it doesn't seem to reduce the overall impact of aviation. This does not mean substitution is a step backward, the paradox should be adressed to make it a truly sustainable step forward.

3.4 The air-rail potential: different scenarios

Within the previous section, the air-rail journey as a substitute of the multi-leg flight is discussed. However, to understand to what extent this substitution is possible, understanding of the air-rail potential is essential. Within this section, this potential will be discussed and illustrated by possible future scenarios. To be able to create such scenarios, first the process of making a modality choice is discussed. Followed by the factors that influence the choice for air-rail. Additionally, the steps that can be made regarding the factors that influence the choice for air-rail are introduced. The variations in steps are used to create 3 future scenarios, the low, realistic and ambitious scenario. Finally, the potential destinations for air-rail are introduced.

3.4



3.4.1 The choice for air-rail & the factors of influence

Making a modality choice

To be able to create future scenarios, it is important to understand how travellers make a choice for a certain modality. Ultimately, the choice of the traveller for an air-rail journey over an air-air journey, determines the number of air-rail travellers. Making a modality choice is part of an wider decision making process. To create understanding of this process, the decision making process of travelling is illustrated, see figure 3.12. Based upon the decision making model of Ortúzar & Willumsen (2011) five main choices are identified. These steps are rarely taken in this exact order, since they are interrelated and influence each other. Additionally, it differs a lot per situation, type of traveller and occasion what the order will be.

The choices that have to be made:

- Move: Am I going to travel?
- Destination: To where am I going to travel?
- Modality: How am I going to travel?
- Route: What will be my route?
- Timing: When am I going to travel?

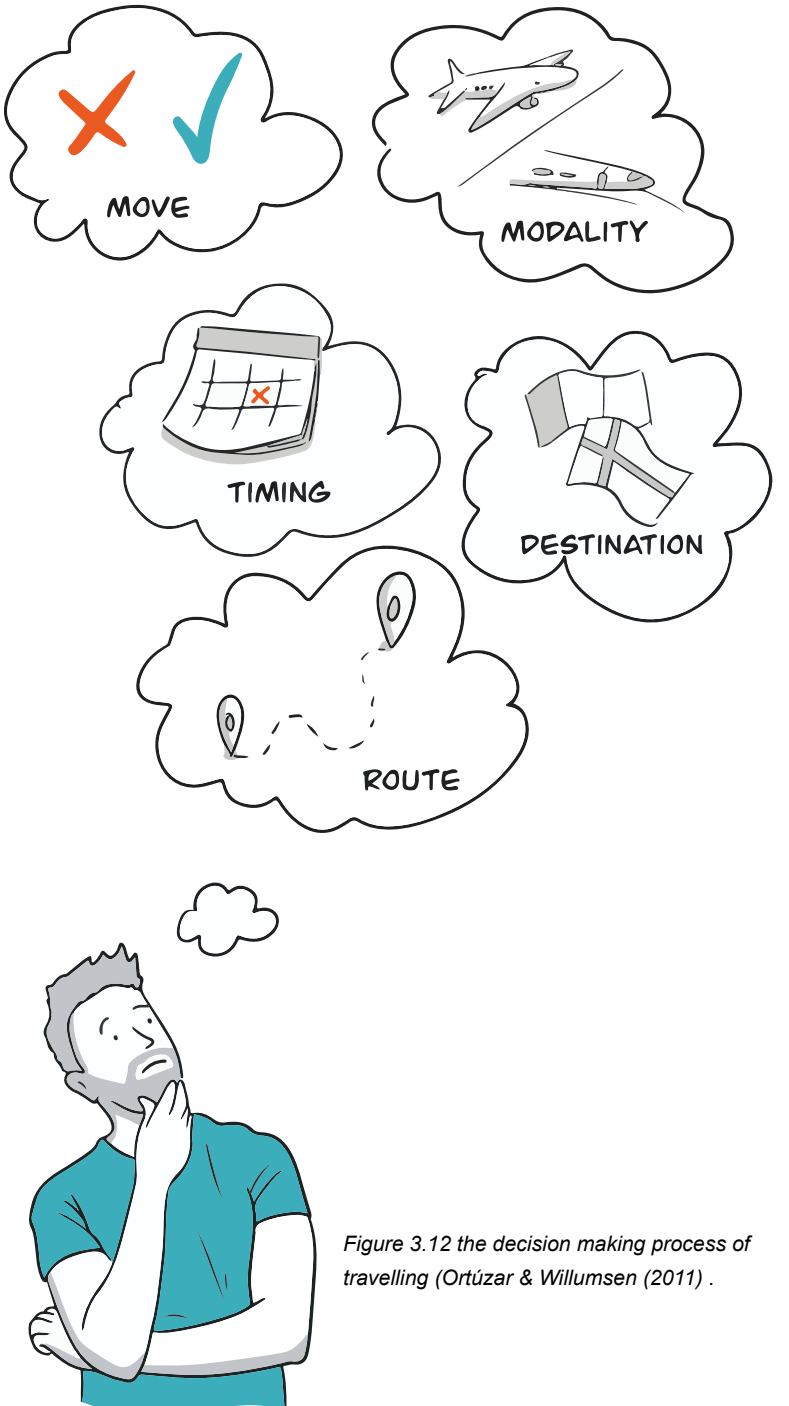


Figure 3.12 the decision making process of travelling (Ortúzar & Willumsen (2011) .

Factors that influence the air-rail choice & potential future steps

The factors that influence the choice of travellers can be divided in two main groups. The access to the system, which involves factors that enable travellers to become aware, find and book the choice. Additionally, the appreciation for the system, which are factors that influence making the actual choice, figure 3.13 shows an overview of the factors (Council for the Environment and Infrastructure, 2020).

Within the different factors that influence the choice for air-rail journeys, future steps can be made to make those factors more attractive and thus increase the willingness for travellers the make the choice for air-rail. How these factors are dealt with in the future, can influence how many travellers make the choice of the train over the plane. Within this section, the possible steps that can be taken regarding the factors are discussed. The steps are based upon the research of the potential of AirRail substitution of Donners et al (2020). These steps form the basis for the possible future scenarios, that will be discussed in the subsequent section.

Access to the system

Awareness, findability and book ability.

Access to the system is crucial to realize substitution. If travellers are not aware of the options, not able to find them or not able to book them, substitution will be rare. Therefor this factor is of great importance is set as a boundary condition for all the scenarios. Steps that can be taken are marketing, improvement of ticketing platforms and integrated ticketing.

Appreciation for the system

Travel time

According to Donners et al, travel time has the biggest influence. The model to determine the substitution is therefor built around travel time. Also the other factors do influence the travel time, such as the stops at Schiphol or integrated luggage. However, specifically for travel time the steps that are taken into account are infrastructural improvements and optimization of the EU network. Important to note is that the scenarios are based on that the traveller will assess the different options based on door-to-door travel time and not in-vehicle time.

Costs

Regarding costs, the main aspect that is taken into account is the balance between air and rail tickets. Since the average ticket price is similar, effect of the ratio is taken into account. Additionally the possibility of flight tax is taken into account.

Travel options

For travel options the main step that can be made is increasing the frequency of trains and thus the balance between the frequency of trains and planes. In this way, more AirRail travel options can be created. Additionally the reintroduction of the night train is taken into account. However this will not have influence on the transfer traveller, it is assumed the travel time is too long for the transfer traveller and another airport will be preferred. But this will influence the total substitution of air to rail.

Comfort

Regarding comfort two main aspects are taken into account. The location where the trains stop and luggage handling. The possible locations of the trains are Schiphol, Amsterdam Zuid and Amsterdam Central. Amsterdam Zuid is only 6 minutes from Schiphol and therefor an interesting location for passengers that should go to Schiphol. Also Luggage handling is taken into account as an aspect for comfort. The main step that can be made here is the integration of luggage comparable with the aviation sector. Finally, the transfer could be facilitated by easier access to airside of AirRail travellers.

Certainty

For certainty there are two aspects that are included in the scenarios are ticket integration and traveller rights. Both are important for creating certainty for travellers.

Sustainability

Sustainability is not taken into account in the scenarios, since there is little know about the effect of this on the choice travellers made. However more awareness and motivation to travel greener could increase the potential for substitution.

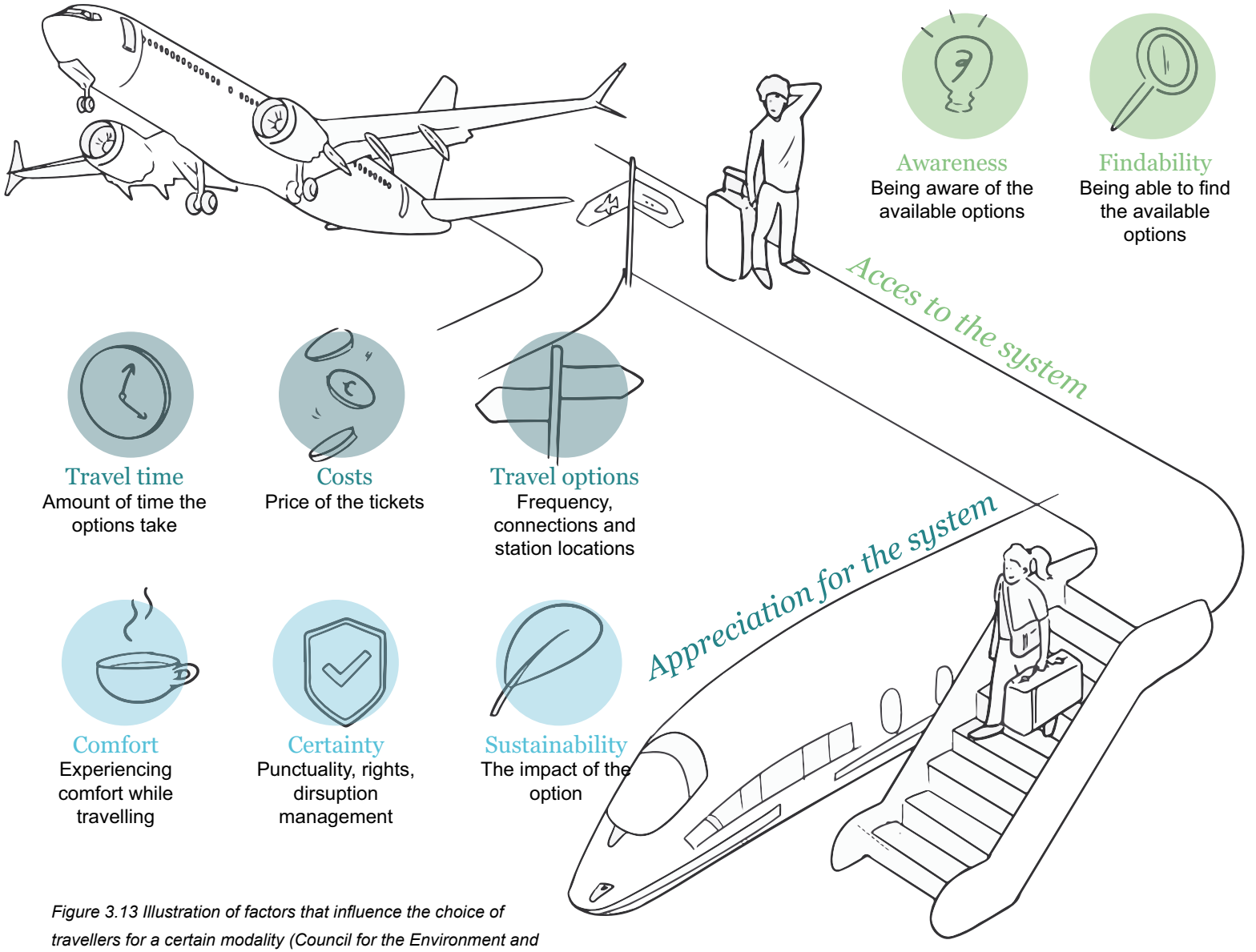


Figure 3.13 Illustration of factors that influence the choice of travellers for a certain modality (Council for the Environment and Infrastructure, 2020)

3.4.2 Future scenarios for air-rail and their impact

With the use of the steps per factor determined in the previous section, future scenarios are created. These scenarios show a set of steps that can be taken to make air-rail journeys a more attractive option. In this way, insight is gained in what possible futures could be and what is needed to make such a future reality. The scenarios are based upon the research of the potential of AirRail substitution of Donners et al (2020), the results are based upon expectations of 2040.

A low, realistic and ambitious scenario are created, see figure 3.14. The low scenario is really the minimum that could be expected. The medium scenario is labelled as medium since this scenario is not too radical when it comes to big infrastructure investments. It is more focused on institutional measures. The ambitious or maximum scenario is more radical and asks for more measures as well for OD travellers as transfer travellers. In the ambitious scenario some infrastructure will be improved and the EU network will be optimized.

The ‘low’ scenario

Within this scenario, some minimal improvements will be done to stimulate substitution. Mainly the focus will be on making people aware of the option. Also make the option findable and bookable. This means accessibility of the system will increase. However no ticket integration will be realized.

In this scenario planned improvements on the infrastructure will be done which will influence the travel time. Costs will not change, prices stay equal. Travel options will increase by the reintroduction of the night train.

The trains will stop at Schiphol, except for the Eurostar, this train will stop at Amsterdam Zuid. There will be no luggage integration and no facilitated transfer. The traveller will still arrange the transfer, luggage and ticketing by her or himself. There will also be no certainty due no integrated ticketing or traveller rights.

The ‘medium’ scenario

Within the realistic scenario, several extra measures will be done to stimulate substitution. Within this some more measures will be done compared to the low scenario, but radical measures will not happen. As well as in the low scenario, accessibility of the system will be improved.

Similar to the low scenario, planned improvements on the infrastructure will be done which will influence the travel time. Costs will not change, prices stay equal. Travel options will increase by the reintroduction of the night train.
All trains will stop at Schiphol and Amsterdam Zuid. There will be luggage integration but no facilitated transfer. The traveller will still arrange the transfer, luggage and ticketing by her or himself. Again no certainty is provided due to no integrated ticketing or traveller rights.

The ‘ambitious’ scenario

Within the ambitious scenario, measures will be maximized. More radical steps will be taken. Firstly ticket integration will happen, which means that the accessibility of the system can be optimized.

Planned improvements on the infrastructure will be done which will influence the travel time. On top of that the HSL network will be improved further and the EU network will be optimized. Costs will change, the prices of the train will become half of the flight tickets. Travel options will increase by the reintroduction of the night train and increasing the frequency of trains.
All trains will stop at Schiphol and Amsterdam Zuid. There will be luggage integration and the transfer from train station to airside will be facilitated. In this scenario there is certainty provided due to integrated ticketing and traveller rights.

	Low scenario	Medium scenario	Ambitious scenario
Scenarios	*Minimal improvements to stimulate substitution*	*Some extra measures to stimulate substitution.*	*Maximise measuers and more radical steps.*
Measures	Improved access, creating awareness, findability and bookability	+ Luggage integration and stop at Schiphol.	+ Cheaper train tickets, more trains, ticket integration and travel inssurance.
Modal split Rail / air transfer	7 / 93%	17 / 83%	57 / 43%
Modal split focus cities	14 / 86%	34 / 66 %	75 / 25%
Total travellers substitution (a year)	21 mln	24 mln	38 mln
Transfer travellers substitution a day	505.000	1.291.000	4.546.000
a day	1040	3.540	12.450
Substitution of flights a year	0	0	63.000

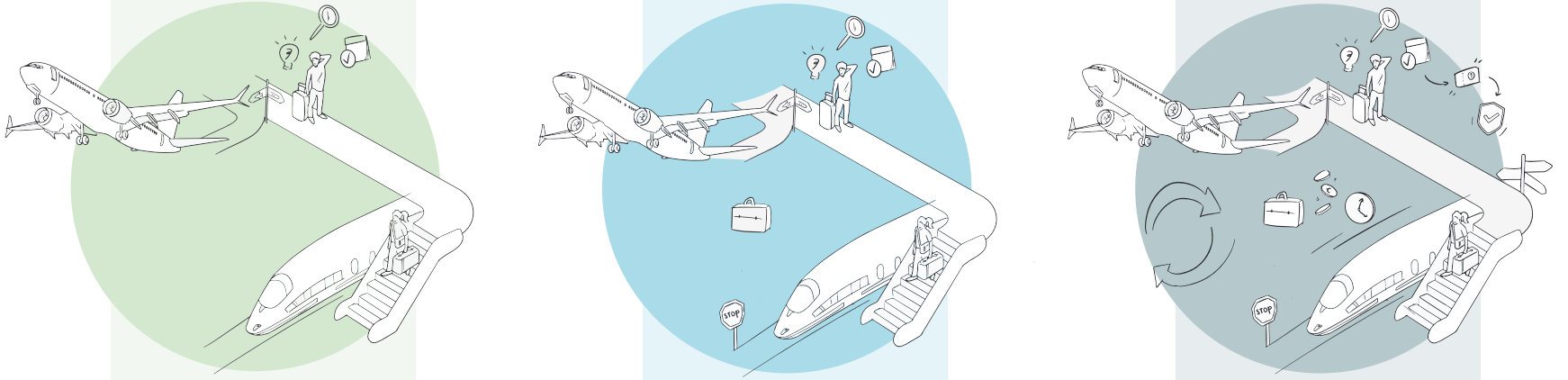
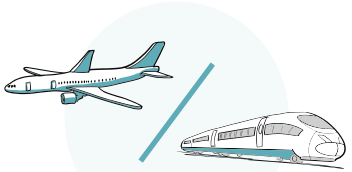


Figure 3.14 Overview of the possible future scenarios concerning air-rail (Donners et al. 2020).

Impact of the scenarios

In the following section the possible impact of the different scenarios is discussed. Impact on the modal split, amount of travellers and the amount of substituted flights is discussed. The impact is based upon the model of Donners et al (2020).



25 / 75%

Modal split

The modal split means how the amount of travellers between modalities are distributed. Compared to the current modal split, there can be big steps. In the ambitious scenario this can lead that 57% of the transfer passengers will choose an rail transfer over an air transfer. For the focus cities explained in the next sections, this is even more, it could even reach 75%.

4,5 mln

Amount of air-rail travellers

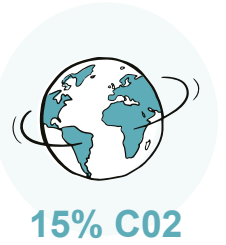
The amount of air-rail travellers could increase substantially. From 380.000 in the current situation to 4,5 million in the ambitious scenario. This means that 12.455 travellers will transfer between air and rail at Schiphol airport every day. That are more than 10.000 air-rail travellers on top of the current number of air-rail travellers.

The share of air-rail travellers compared to the total amount of train travellers, is quite small. In the reference situation this is only 1%. In the ambitious situation this will become 12%, which is still only a small part of the total amount of train travellers. Therefor it seems that the focus should not only be on transfer passengers, but on the OD traveller as well. In the end, the amount of air-rail travellers is not large enough to deploy trains frequent enough to be competitive to flights.

63.000

Substitution of flights

Only in the ambitious scenario actual substitution of flights will take place. This is caused by the high demand for mobility. The substituted flights will be replaced by flights to other destinations, since the demand is high enough to keep on filling planes. In this way, substitution will eventually enlarge the overall mobility sector. However, in the ambitious scenario, a part of the flights will be substituted: 63.000 flights.



15% C02

Impact on the environment

The actual impact substitution has on the environment is difficult to determine. It is not unlikely that except for the ambitious scenario, the impact on the environment could even be negative. The increasing demand for mobility and the substitution paradox, discussed in chapter 3.3, lay at the root of this effect. If the demand of travelling keeps on growing and the released airport slots of short distance flights are filled up by long distance flights, overall the emissions could increase and thus negatively influence the environment.

Within the ambitious scenario it seems that substitution is large enough to start substituting planes for trains. Based on the report of Royal Haskoning DHV (2018), this could mean that 63.000 flights will be substituted and therefor this could have a positive impact on the environment. This means a saving of 232 mln kg of carbon and 82 kg of nitgrogen in a year. The negative impact of the increased train and road travel is taken into account while calculating the impact. To put this in perspective, the carbon emission of flights till 750km at Schiphol was in 2018 3,58 Mton. Substitution of 63.000 flights means a carbon emission reduction of 15% in comparison with the emissions in 2018 (Donners & Kantelaar, 2019). In the end, when action is taken to overcome the paradox, this positive effect could even be bigger.

3.4.3 Potential destinations for air-rail

In the following section, potential destinations for substitution are discussed. There are three main factors that determine potential destinations. First, there should be a direct flight from Schiphol, because when looking at substitution, only destinations that do have a flight to Schiphol can actually be substituted by trains. Additionally, there is an international train connection, otherwise it is not possible to substitute for an international train. Finally, there should be enough demand to fill an international train. This means that at least one train is full with passengers that want to travel from the destination to Amsterdam (Donners et al, 2020). Based on these criteria potential destinations are identified.

Figure 3.15 shows the potential destinations for air-rail. In the medium scenario, there are 13 potential destinations indicated in dark green. In the ambitious scenario, there are another 13 on top of the medium destinations, indicated in light green. It is important to take into account that destinations that are on the 'route' can also be taken to account as potential destinations, this results in 20 potential destinations in the medium scenario and 35 potential destinations in the ambitious scenario.

Destinations with the highest potential

Within the potential destinations, there are 6 destinations for which substitution of transfers has the highest potential, due to travel time, train frequency and amount of transfer passengers. Stakeholders identified these cities as focus cities. The focus cities are Brussels, Paris, London, Düsseldorf, Frankfurt and Berlin. Especially Brussel, Hannover and Düsseldorf are interesting, since these flights consist of almost only transfer passengers (KiM, 2018).

Beyond the 'substitution' potential

To determine the potential of substitution, destinations that are connected with short distance flights with Schiphol were taken into account. However, beyond this potential for substitution , there are potential destinations that do not have flights but do have people that would like to travel with an international train to Schiphol. These are for example destinations that are on the way of the international trains or that are in the catchment area of cities with an international train station connected to Schiphol. These are cities like Antwerp, Oberhausen, Duisburg, Osnabrück, Mannheim, Karlsruhe, Bern and Dijon.

Nuance on the potential: Competition & travel time

An important nuance that has to be made is the competitive hubs in Europe. It is not unlikely that travellers will start to choose other airports over Schiphol, if these airports are easier or faster to reach by international or even domestic train. The airports that are connected to the international train network are the most competitive, this are Brussels, Dusseldorf, Copenhagen, Paris (CdG), Frankfurt and Birmingham. This nuance shows the importance of the quality of the air-rail service at Schiphol airport. The service has to transcend the air-rail and flight options of these competitive hubs, to make it to a success.

Another important nuance that has to be made is the current travel time by international train of some of the potential destinations. Some destinations, for example Copenhagen, have still long travel times which first should be reduced to become an attractive air-rail option.

3.4.4 Conclusion

The factors that influence the choice for air-rail are determined. Based upon the future steps within these factors, three future scenarios are presented: the low, medium and ambitious scenario. The impact of these scenarios is discussed.

To really make a difference with substitution, the ambitious scenario should be the goal of the project. This scenario is resulting in a substantial amount of substituted flights. The project approach is ambitious and therefore focuses on the ambitious future scenario. The project will focus on exploring what is needed to make this ambitious scenario reality.

The amount of air-rail travellers will be relatively small compared to OD travellers. Therefore, the development of the future air-rail journey should be in synergy with the OD journey of rail travellers.

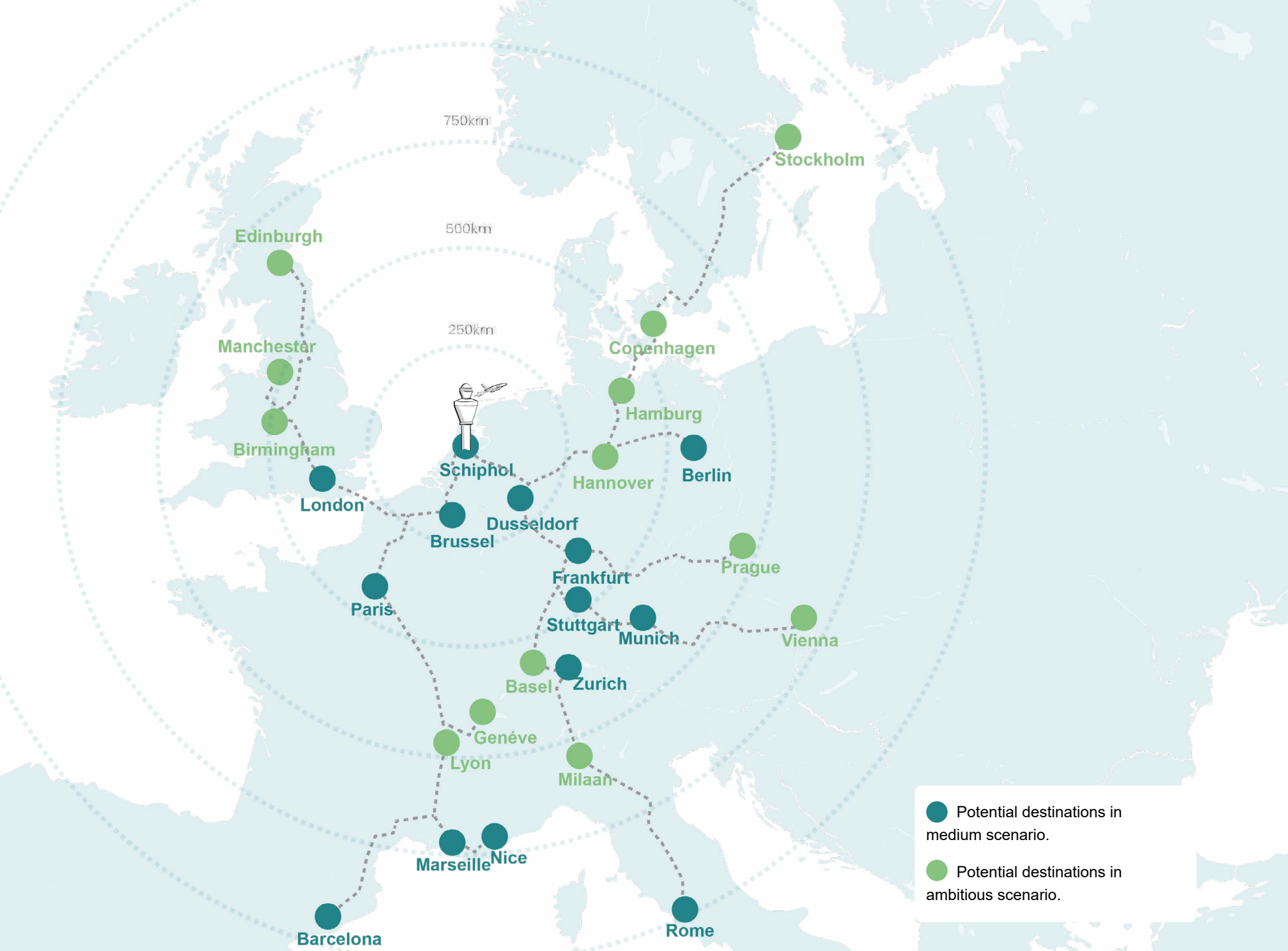
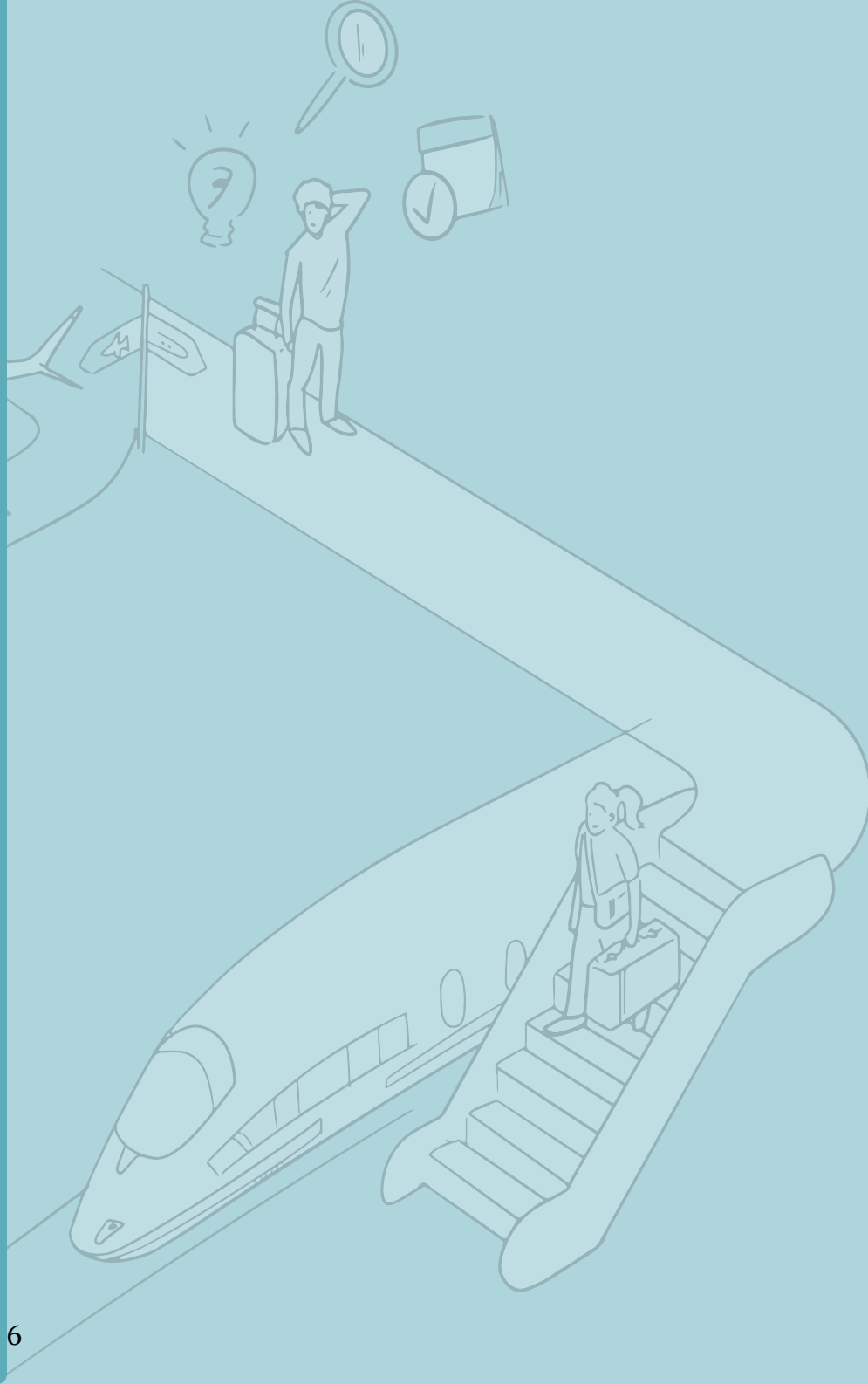


Figure 3.15 Overview of potential air-rail destinations (Donners et al. 2020).

3.5 Conclusion

3.5



In the end the rationale for air-rail journeys can be explained according to four main aspects. First of all, the political and societal incentive for substitution seems to reduce the impact of aviation.

Substitution of short distance flights for international trains, could lead to a more air-rail oriented airport instead of a multi-leg dominated airport. The air-rail journey could add to the international hub function of Schiphol by acting as feeder for long distance flights.

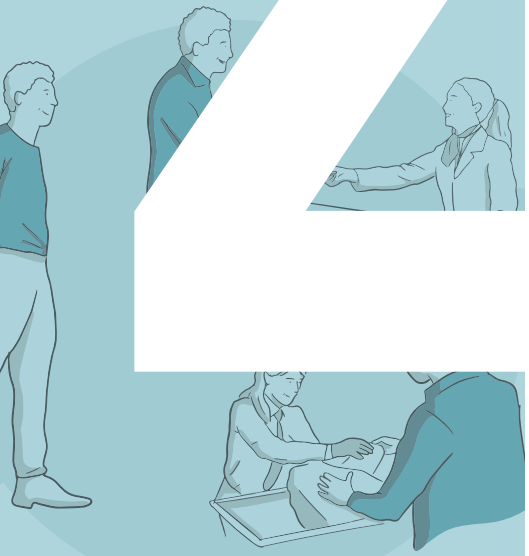
Within the stakeholder environment, there are three key stakeholders, that directly influence the service. These are the traveller, the airlines and the train operators. Other stakeholders operate on the infrastructure and policy level. Due conflicting interests and moderate motivation, it seems that the stakeholder environment is missing orchestration. It seems that motivation should increase to make air-rail to a success and get other stakeholders along.

Three future scenarios for air-rail are presented. The project approach is ambitious and therefore focuses on the ambitious future scenario. The project will focus on exploring what is needed to make this ambitious scenario reality. The development of the future air-rail journey should be in synergy with the OD journey of rail travellers.

Air-rail could act as a sustainable alternative for the multi-leg flight, but the substitution paradox seems true. The growth of the sector and the conflicting interests of stakeholders make it hard to present it as completely sustainable measure. Making it truly sustainable depends on how the aviation sector will develop itself and what policy comes accordingly to regulate the impact of the sector.

However, within the ambitious scenario substitution would be large enough to positively influence the environment by a decrease of 63.000 flights. This would mean a CO_2 reduction of 15% in comparison with the emissions in 2018. In the end, when action is taken to overcome the paradox, this positive effect could even be bigger.

4



In this chapter

Steps, patterns & user experience of air-rail journeys

To be able to define the problem surrounding air-rail journeys, understanding of the current steps and patterns in air-rail journeys is essential. Additionally, how the users experience those steps and patterns, is key to develop user-centered journeys for the future. This chapter discusses the current air-rail journey, the steps, patterns and experience.

First, the current needs and barriers surrounding the choice for air-rail are discussed. This is followed by a comparison between the rail and air experience. Finally, the steps, patterns and experiences of the current air-rail, rail-air and air-air journey are defined in customer journeys. Finally some existing air-rail combinations will be discussed in a benchmark.

User interviews & sensitizing bookl

Desk research

Contextual interviews users & staff

Stakeholder interviews

Service safari & observation

4.1 The differences between the air and rail experience

The traveller experiences a journey in an international train differently than a flight. In this section an overview of the main differences between the two modalities regarding user experience is given. This gives an overview of what the main differences are when it comes to the experience of the train ride versus a short distance flight. This is important to understand, because these aspects also influence the experience of air-rail journeys that consists of both the rail and air experience.

In figure 4.1 the difference between the air and rail experience is illustrated. Seven Main differences can be derived from this comparison.

4.1

1.The upfront hassle of the train journey is less compared to a flight.
I noticed, I did fly a lot couple of years and I got tired that you have to wait so long every time. If you go with the train you go to the station you sit and go. When you fly you have to be early, you wait, and luggage is a hassle with security. It can be annoying. - Belgian traveller

2.Train journeys consist of more down time in relation to door-to-door travel time than a comparable flight , this means less time for waiting, checks, security etc.
The main advantage of the train is that you have more time in the actual train than having to go through all those hassle, so you can work and read. You arrive more relaxed - German traveller

3.Departure and arrival in the city centre makes the train easily reachable.
Also the train is more relaxed journey then flying. Less stress, you just get on the train and get off the train at the central of each city. - English traveller

4.The airport can be more easy to reach when living outside the city, especially by car
I don't live very far from the airport in France. A lot of the time airports are hard to reach from the city, but for me that's not the case. So it's very convenient for me to fly. - French traveller

5.Flexibility of the train is experienced as positive
Also you can more easily arrange like to get on at different cities. Or arrange it like more flexible. Planes aren't that flexible. - English traveller

6.The journey of the train is experienced as more comfortable
In the end I like the train more, more comfort like sitting, walking around. Even walking through a train, than an airplane. You can't pass people, have to wait. - English traveller

7.The plane and train journey both provide enjoyable travel moments
When you have a really clear sky, and you can look outside the window and see the landscape. That's a really nice moment for me. - French traveller
Coming out of the tunnel. It's like nostalgic and romantic. Having a long journey, turning up at a new city. - English traveller

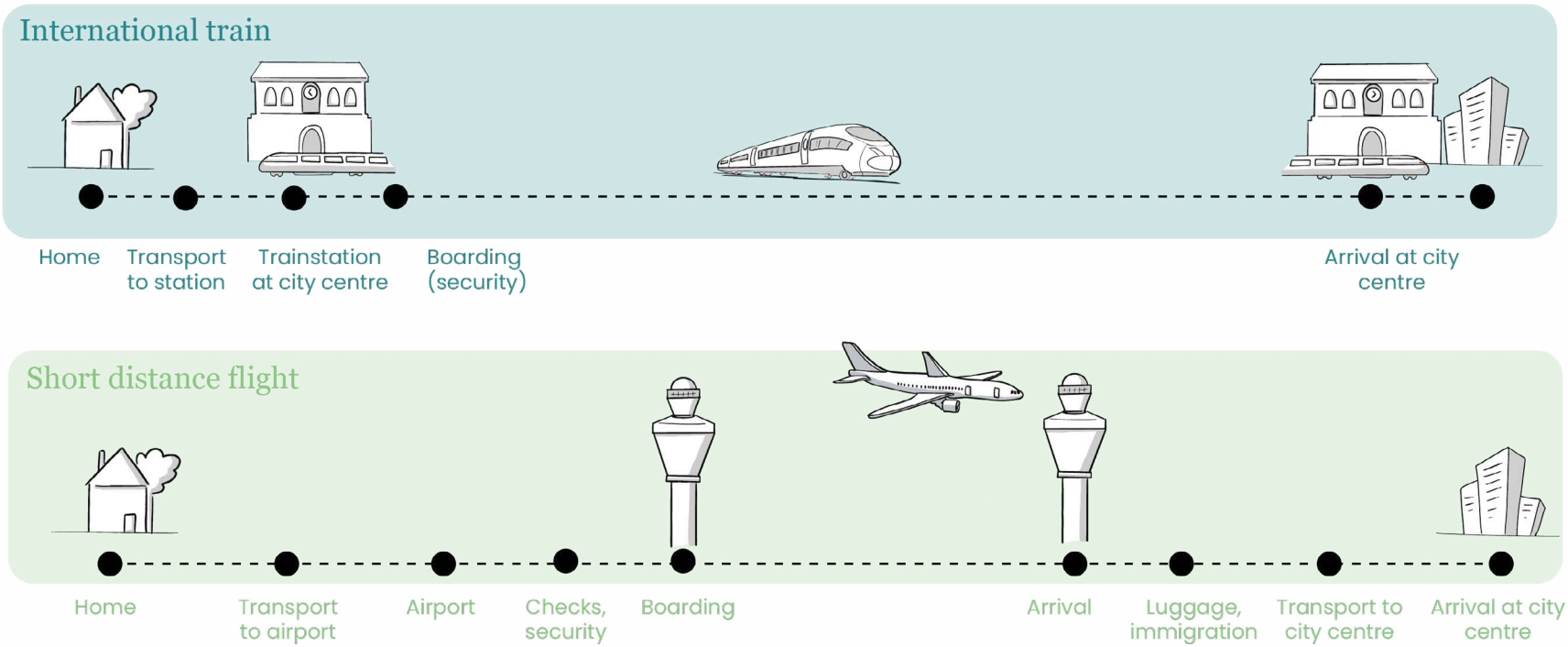


Figure 4.1 The journey of an international train versus a short distance flight.

4.2 The current air-rail experience: Customer journeys

Within this section, the air-rail journey steps and patterns are introduced and the journey is examined from a user perspective. This creates overview of how the user experiences an air-rail journey. Additionally, it makes it possible to identify the main challenges and opportunities to improve the user experience. Additionally, insight in the steps and patterns is important, to be able to design a future journey that fits into these patterns.

4.2

The insights of the user research are combined and mapped on three customer journeys, the air-air, air-rail and rail-air journey. A customer journey is a visual representation of the experience of a user over time, which visualizes the steps that are taken accompanied by the main pains and gains experienced by users (Rosenbaum, 2017).

Both the air-rail and rail-air customer journeys are made, since the journeys differ in steps and experience. An air-rail journey means that first a long distance flight is taken towards Schiphol, at the airport the traveller transfers to the international train. While during an rail-air journey first the international train is taken to the airport where a transfer happens to a long distance flight. The air-air journey creates insight in the experience is of the competing modality, the multi-leg flight.

4.2.1 The steps in air-rail journeys

Journeys that combine international trains with planes, steps that travellers usually take can be identified. These steps are illustrated in figure 4.2.

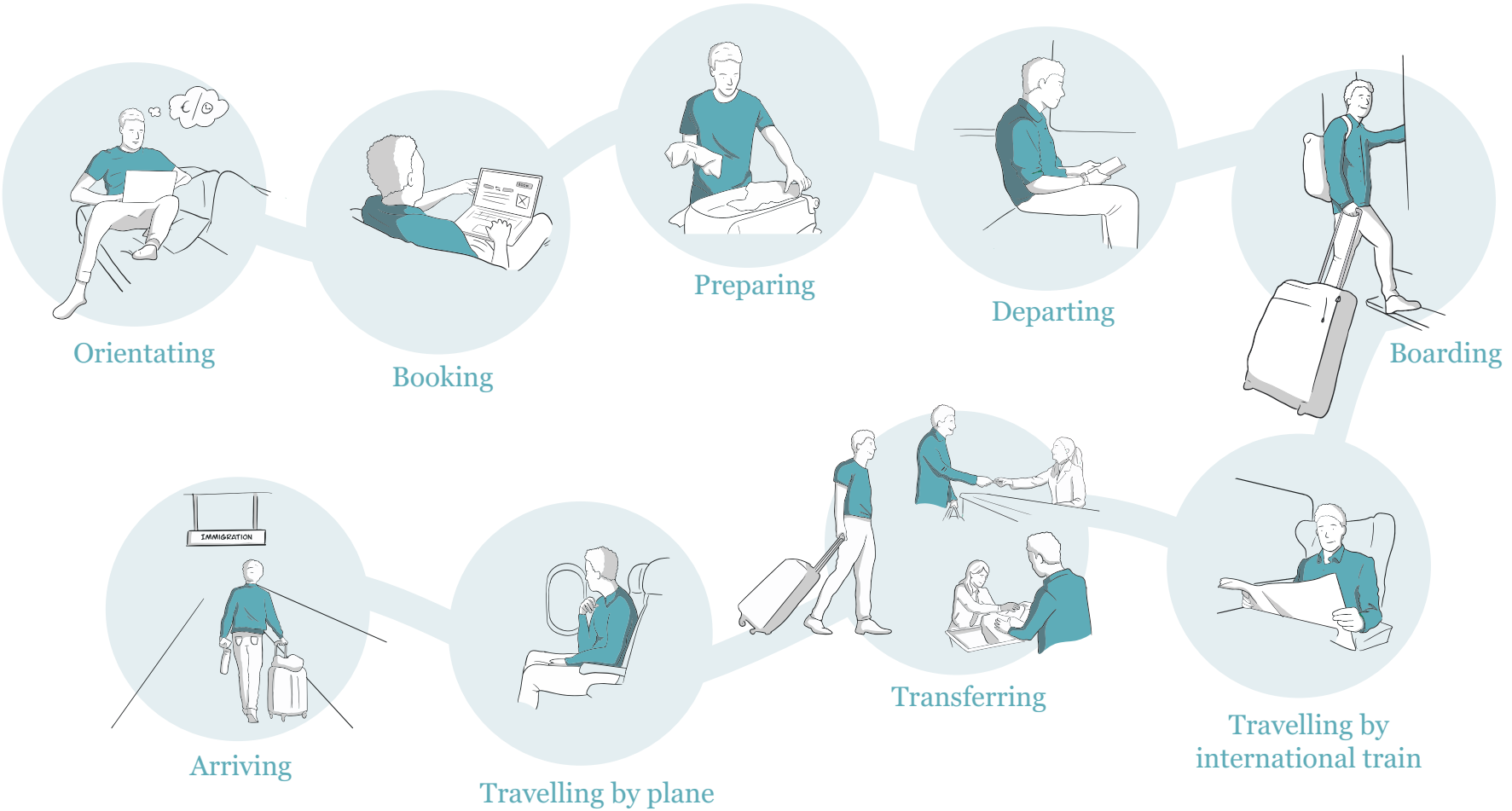
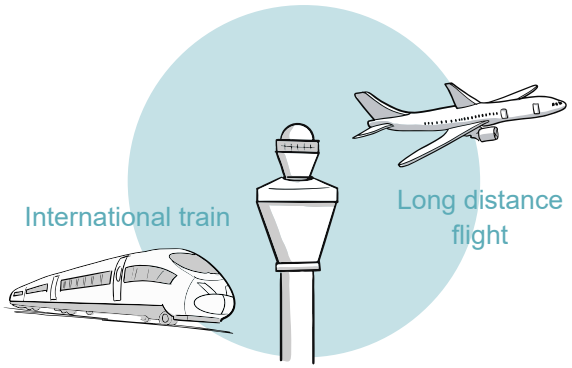


Figure 4.2 The steps of the air-rail journey.

4.2.2 The rail-air customer journey

In the following section the rail-air journey is presented, see figure 4.3. This customer journey summarizes and visualizes the experience of a trip with an international train to Schiphol Airport, transfer at the airport to an intercontinental long distance flight.



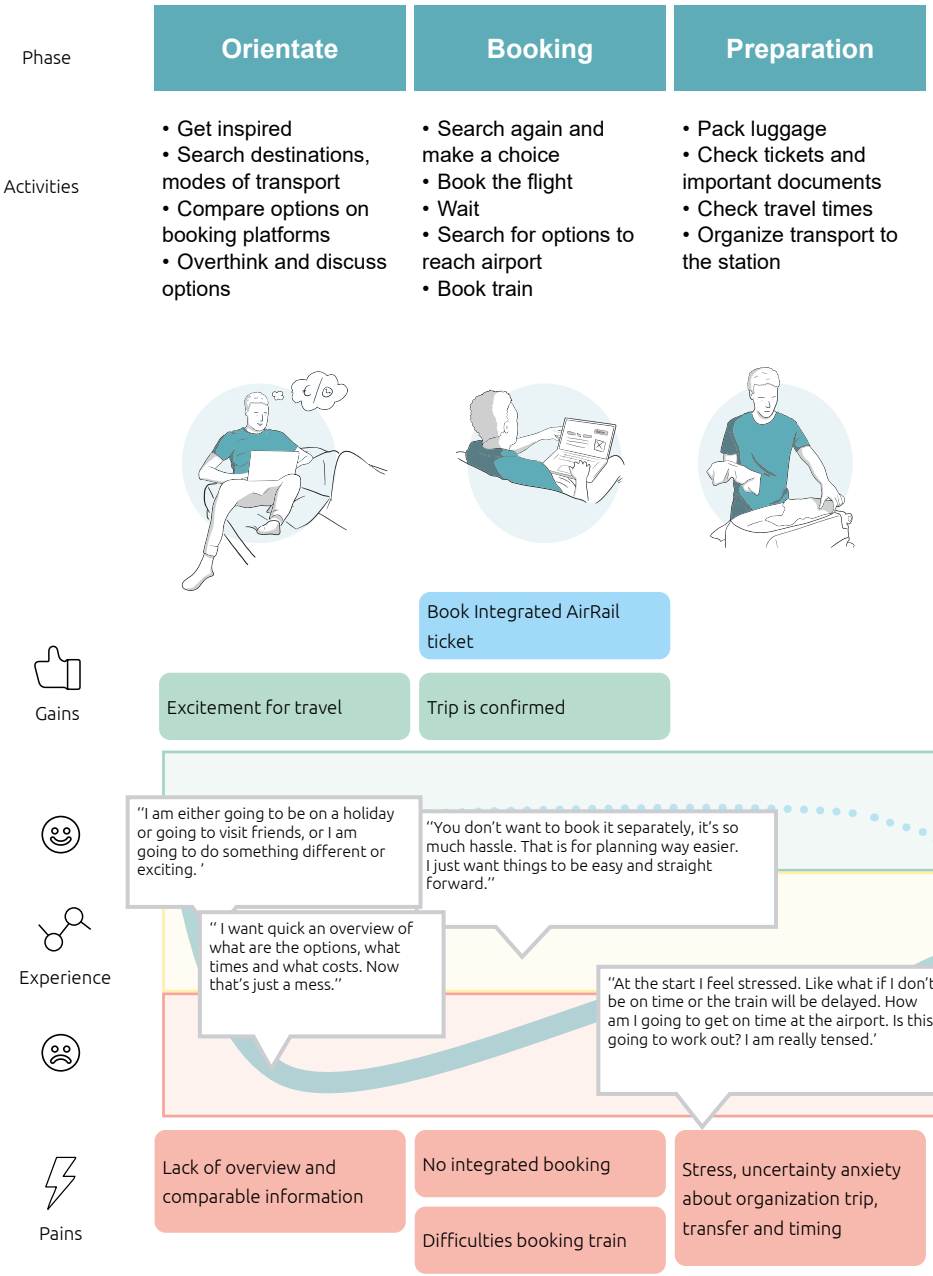
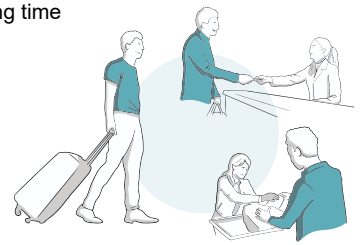
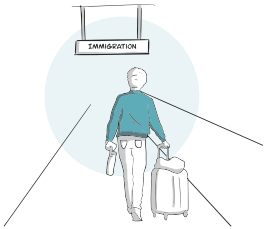


Figure 4.3 The rail-air customer journey.

Departure	Boarding	Travel by train	Transfer	Boarding	Travel by plane	Arrive at destination
• Travel to the station • Find the train • Wait at the platform	• Board the train	• Find place for luggage • find a seat • Ticket control • travel time	• Arrive at train station • Leave train • Orientate to airport • Check-in bags • Ticket control • Security • Passport control • Orientate to gate • Waiting time	• Waiting • Ticket control • Board plane	• Find the seat • Safety instructions • Travel time	• Arrival at airport • Deboarding • Immigration • Luggage claim • Customs • Leave airport • last mile





Excitement for departure

Easy to get to the train station

Quick and easy boarding

Enjoy travel experience

Job is done

Enjoy travel experience

Excited to arrive

''The problem is the suitcases. You have 3 suitcases. So much hassle on the station and in the train.''

'' Is getting up super early. Making sure you get on your first mode of transportation. The bus or the train or something. If you screwed up there, you screwed anyway. .''

'' Then it's always, omg, I have to find a place to sit with your big luggage. You don't want to be super rude to people. So you just sit there in the hallway or something.''

'' The problem is that you are constantly busy, that is just very intensive travelling. ''

'' On the plane finally. I have done my part, now the plane can start what it has to do. ''

''Arriving at an airport is like being at the least interesting place of that destination, so it's always about to find yourself a way to get to the city centre.''

''It is in big airports. It is really crowded. And the time between the checks and everything and your flight. You think you are on time but the many controls and people. The time decrease decrease decrease, so I get stressed. I am not a stressed person mostly. My only concern is the timing.''

Hurrying to get on time

Carry heavy luggage

Hard to find the right train

Hard to find a seat with big luggage

Worrying about safety of luggage

Anxiety about delay, transfer and timing

Difficult to orientate to check in

Hassle & stress of checks and timing

Crowded, stressful vibe, no overview

Waiting and hassle to get into the plane

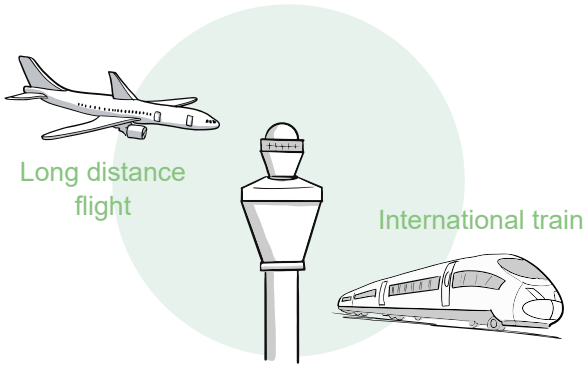
Feeling tired after long journey

Wait for luggage

Arrival outside of the city

4.2.3 The air-rail customer journey

In the following section the air-rail journey is presented, see figure 4.3. The journey summarizes and visualizes the experiences of travelling by an intercontinental flight to Schiphol Airport Amsterdam and take an international train from there.



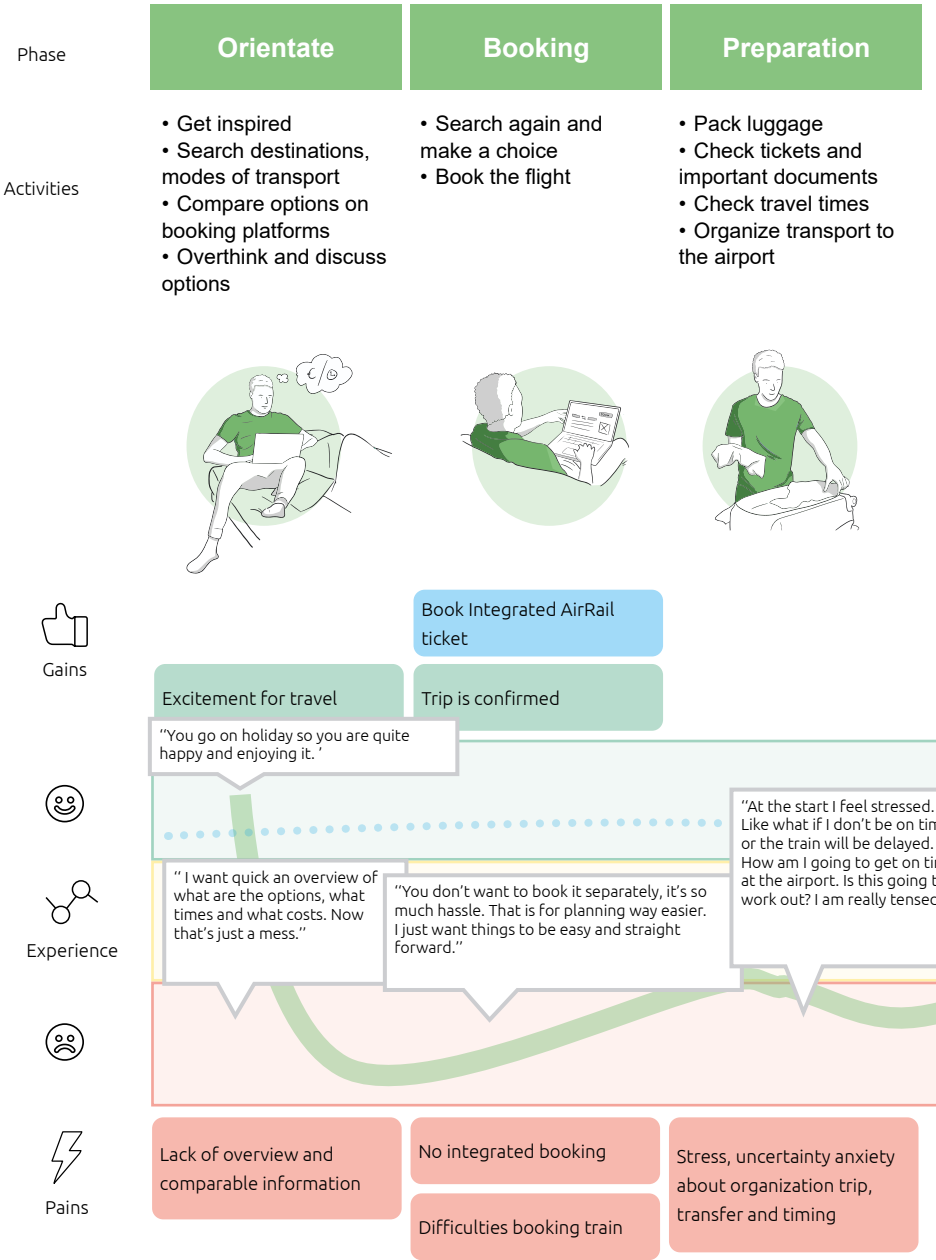
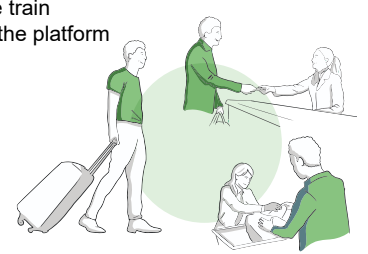
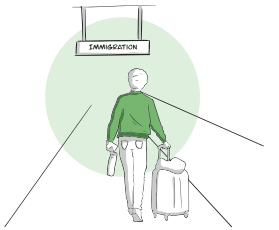


Figure 4.4 The air-rail customer journey.

Departure	Check in and boarding	Travel by plane	Transfer	Boarding	Travel by train	Arrive at destination
• Travel to the airport • Arrive at airport • Find the check in • Wait for check in	• Check in bags • Ticket control • Security • Orientate to gate • Wait • Ticket control • Board plane	• Find the seat • Safety instructions • Travel time	• Arrive at airport • De boarding • Immigration • Luggage claim • Customs • Orientate to train station • Find the train • Wait at the platform	• Board train	• Find place for luggage • find a seat • Ticket control • travel time	• Arrival at train station • De boarding train • Last mile





Good to arrive at the city center

Excitement for departure

Job is done

Enjoy travel experience

Quick and easy boarding

Enjoy travel experience

Excited for arrival

"Annoying that I have to wait because I am so early since I had to do all these checks."

" You have to go to all these checks. Wait, wait again wait again. Not the most exciting process, but you have to pass through."

" When you went through all these checks, I always feel like 'oeff I made it'. Now you can relax untill the flight."

"The last thing you want to do worry about after a long haul flight is an extra mode of transport. "

"The first time you are in a new environment, it can all be very overwhelming. That can cause a lot of anxiety and stress. Especially when it's international travel.."

" When the things are out of your hand but going well. I got here now and I can wind down again."

" Awesome to arrive in the city center, I am exhausted but happy to be there."

Hurrying to get on time

Carry heavy luggage

Hassle to get to the airport

Hassle and stress checks and waiting time

Waiting

Hassle of boarding

Anxiety about delay, transfer and timing

Difficult to orientate to train station & train

Stress for waiting for luggage & douane

Hurrying to get on time & carrying luggage

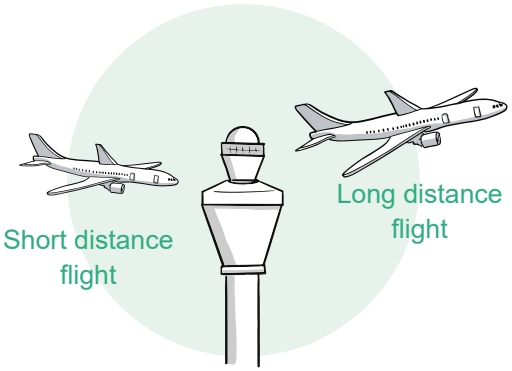
Feeling tired after long journey

Hard to find a seat with big luggage

Not familiar with the destination

4.2.4 The air-air customer journey

In the following section the air-air customer journey is presented, see figure 4.5. The journey summarizes and visualizes the experiences of travelling by a multi-leg flight. This multi leg flight is a combination of a short distance flight originating from Europe to Schiphol airport Amsterdam and an intercontinental flight.



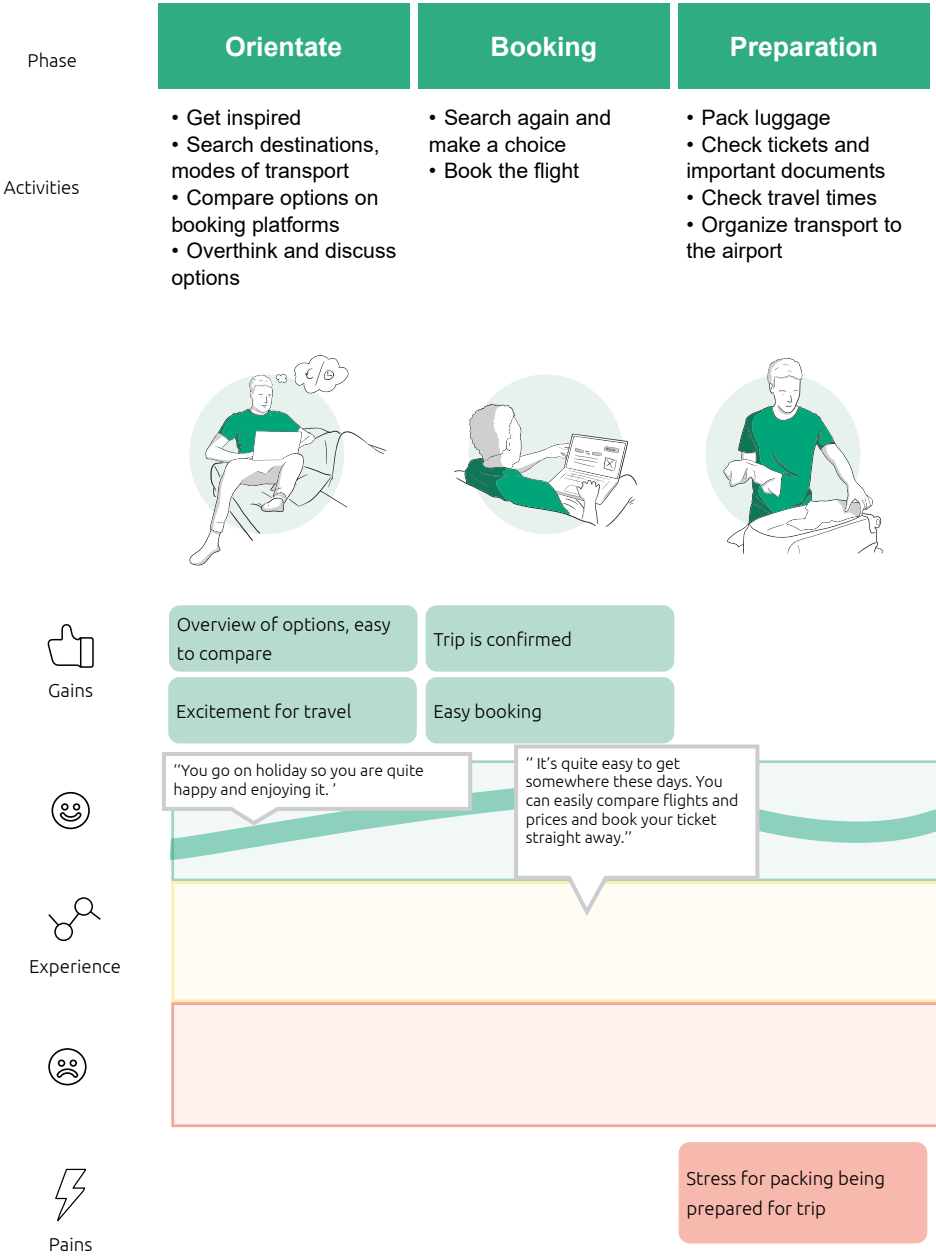
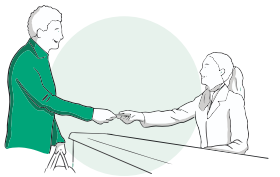
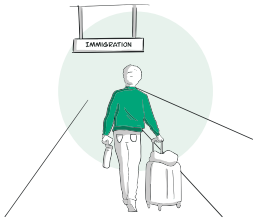


Figure 4.5 The air-air customer journey.

Departure	Check in and boarding	First leg by plane	Transfer	Boarding	Second leg by plane	Arrive at destination
• Travel to the airport • Arrive at airport • Find the check in • Wait for check in	• Check in bags • Ticket control • Security • Orientate to gate • Wait • Ticket control • Board plane	• Find the seat • Safety instructions • Travel time	• Arrive at airport • Leave plane • Orientate to gate • Security • Passport control • Waiting time	• Waiting • Ticket control • Board plane	• Find the seat • Safety instructions • Travel time	• Arrival at airport • Deboarding • Immigration • Luggage claim • Customs • Leave airport • last mile





Excitement for departure

Job is done

Enjoy travel experience

'Security always sucks. It is always a nightmare. I really just like when you have a stopover. They let you through security and you don't even have to leave the terminal.''

Enjoy travel experience

Excited to arrive

'' When you went through all these checks, I always feel like 'oeff I made it'. Now you can relax untill the flight.''

''Like what if I forget this or that. Or gifts or my toothbrush etcetera. And really like when I double check right before I go.''

''Annoying that I have to wait because I am so early since I had to do all these checks.''

'Also I had one ticket, so it's great that when they check you in, they label the luggage for your final destination. Very pleasant''

'' When you have a really clear sky, and you can look outside the window and see the landscape. That's a really nice moment for me.''

''Arriving at an airport is like being at the least interesting place of that destination, so it's always about to find yourself a way to get to the city centre.''

'' You have to go to all these checks. Wait, wait again wait again. Not the most exciting process, but you have to pass through.''

''I had 1 hour, but because it took so long at security I almost missed my flight..''

Hurrying to get on time

Carry heavy luggage

Hassle to get to the airport

Hassle and stress checks and waiting time

Waiting

Hassle of boarding

Stress of timing

Stress when long queues at security

Waiting and hassle to get into the plane

Feeling tired after long journey

Wait for luggage

Arrival outside of the city

4.2.5 Insights customer journeys

In the following section, the insights regarding phases of the three presented customer journeys are discussed.

Orientating

The main gain while orientating is excitement because of the prospect of travelling, this is present in all journeys. However, the main pain in both the air-rail and rail-air journeys is the lack of overview. Additionally difficulties exists in comparing travel options in terms of time, price, modalities, combinations of modalities. Whereas orientation for air-air is relatively easy due accessible platforms to check and compare travel options

Booking

While booking, the main pain is the absence of integrating booking. Travellers indicate booking separate tickets is experienced as a hassle, especially the booking of the train tickets. Whereas with a KLM AirRail ticket, there is a gain of ease of booking and no hassle of booking two separate tickets. The main gain during this phase is when the trip is confirmed and everything is arranged.

Preparation

Within the different journeys stress occurs while packing and collecting all necessities for the trip. Already when preparing the trip there is stress, uncertainty and anxiety about organization trip, transfer and timing. This especially occurs when travelling to an unknown airport. Travellers feel uncertain about how the transfer is going to work out. The main concern is what happens when there will be a delay.

Departure

Travellers are excited since it's the day of the trip. However getting on the first mode of transport is experienced as stressful. This is mainly caused by anxiety that the trip is going to fail if this transport is missed, this could ruin the rest of the journey. Additionally, by uncertainty that everything is organized well.

The main difference between journeys is the reachability of airport versus train station. The main pain for travellers is to carry heavy luggage in for example the bus or train to the airport or train station. Additionally, at busy and big train stations it can be hard to find the right train, the same can happen at the airport to find the right check-in.

Check in / boarding

At the airport, check in and boarding is seen as a real pain. Hassle of checks, waiting and hassle of boarding the plane is experienced as unpleasant. Additionally, having to be there early because of check-ins is also experienced as annoying, since it can result in long waiting times after the check-in. Furthermore, long queues at checks can create a lot of stress and anxiety about being able to get on time to the gate. The main difference when departing with an international train is that there are little checks and boarding procedures. This is experienced as quick and easy.

First leg train or plane

The train ride or flight itself is experienced as enjoyable. However, for the international train journey the main pains are related to luggage. First of all to find a place for a big suitcase can be a struggle. Additionally worries about the safety of the luggage occur, travellers worry that their suitcase might get stolen or lost.

Stress that especially occurs during the rail and air combination, is the anxiety about the transfer and possible delays. The travellers feel insecure about the transfer, which creates already worries while they are travelling to the airport or train station. When delays do occur, this results in a lot of stress, since the travellers are not sure to be able to catch there international flight or train. Additionally they feel little support since they cannot reach out to the airline staff in the train and vice versa.

Transfer

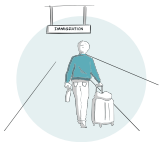
Transferring between planes is experienced as positive, as long as there are no long queues or shortage in transfer time. Mainly because travellers do feel more secure about their connection, especially due support in case of a delay. Additionally travellers indicate that transferring between planes is experienced as less complicated. Travellers do not have to leave the terminal, less checks are present and less struggles with luggage appear. This holds for flights that are linked and luggage is automatically labelled. The air-rail or rail-air transfer does feel complicated to travellers. This is caused by difficulties with orientating to the airport or train station. But also by hassle and stress of checks and timing, especially when the traveller still needs to check in their luggage. Especially long ques and crowds cause stress, since this creates anxiety about timing. Additionally, the airport can be experienced as crowded and stressful which results in the experience of little overview.

The air-rail transfer is experienced as even more negative since the traveller is tired after the long journey and usually does not know the airport very well. Additionally long queues at immigration or the luggage belts can create a lot of stress because of time scrambles.

Disruptions are experienced as really negative since it depends on the travellers own effort to book a new train or plane. They can get support at the service desks of the airline or international trains, but they mostly have to pay for the new ticket themselves. Additionally long waiting times for the new flight or train can occur, which is experienced as really negative. KLM AirRail does provide more support during disruption, since they are obliged to support the traveller due the integrated ticketing.

Second leg train or plane

The second leg is experienced more positively since the stress of progress of the journey is not present anymore. Travellers mainly enjoy the travel experience, but during the second leg this can be less positive since the traveller is probably tired of the long flight. However still stress about luggage occurs within in the international train. This can even be more annoying, since travellers are tired of the long journey and do want to have a place to sit and do not constantly want to watch their suitcase or sit in the hallway.



Arrive at destination

Travellers are excited to arrive at the destination. However they feel tired after the long journey. Travellers experience arrival outside the city centre as annoying. Additional anxiety exists when arriving at an unknown place. Arrival with the train is experienced more positive, since the there are no waiting times for luggage and the traveller is arriving at the city centre.

4.2.6 Main insights user experience current air-rail journeys

In this section the main insights from analysing the customer journeys are discussed. Figure 4.6 shows the main insights.

Positive moments experienced during the journey are mainly related to excitement and relief

Most of the positive moments of the journeys have to do with either excitement, the train or plane travelling itself or relieving stress.

Orientation and booking is hard due lack of overview, comparable options and integration of trains

Another important aspect is the ease of orientation and booking. Lack of overview of options and bookable combinations create negative experiences of travellers.

Travellers experience little insight in progress

Procedures such as the checks and boarding are experienced quite negative, mainly due waiting times and anxiety about the progress. This is mainly an issue when travellers need to be on time for their next leg. This is also clearly illustrated by the moment of stress relief after the checks.

The journey feels incoherent and responsibilities are unclear

Two separate tickets and operators increase the feeling of uncertainty and give the traveller the feeling the journey is fragmented instead of coherent. Questions and worries arise regarding responsibilities, who is responsible for me and where do I need to be for questions? There is little support in the total progress of the journey.

Luggage handling is also an important aspect, this can be a pain on different levels: safety, finding a place for big luggage, carrying and waiting at reclaim.

The transfer of air-rail is experienced as a hassle due luggage, checks, orientating and timing

The main difference between air-air and air-rail or rail-air is the transfer. The air-air transfer is smoother since the traveller does not have to leave airside, luggage is automatically handled and there are no check in procedures. For air-rail transfers, the main issues experienced by travellers are hassle due checks, lack of luggage integration, uncertainty while orientating and finally the anxiety about progress and timing.

Delays and disruptions are the main concern, little support causes anxiety

The biggest concern is missing the second leg of the journey, which can be a train or a flight. Since the control of the progress of the journey is mainly at the train operator or airline, uncertainty and anxiety of making it to their next mode of transport exists. Within the air-air journey, this is solved by integrated ticketing and disruption management during delays. Additionally, one operator increases the feeling of certainty. The KLM AirRail ticket partially addresses this issue.

Current rail-air journey

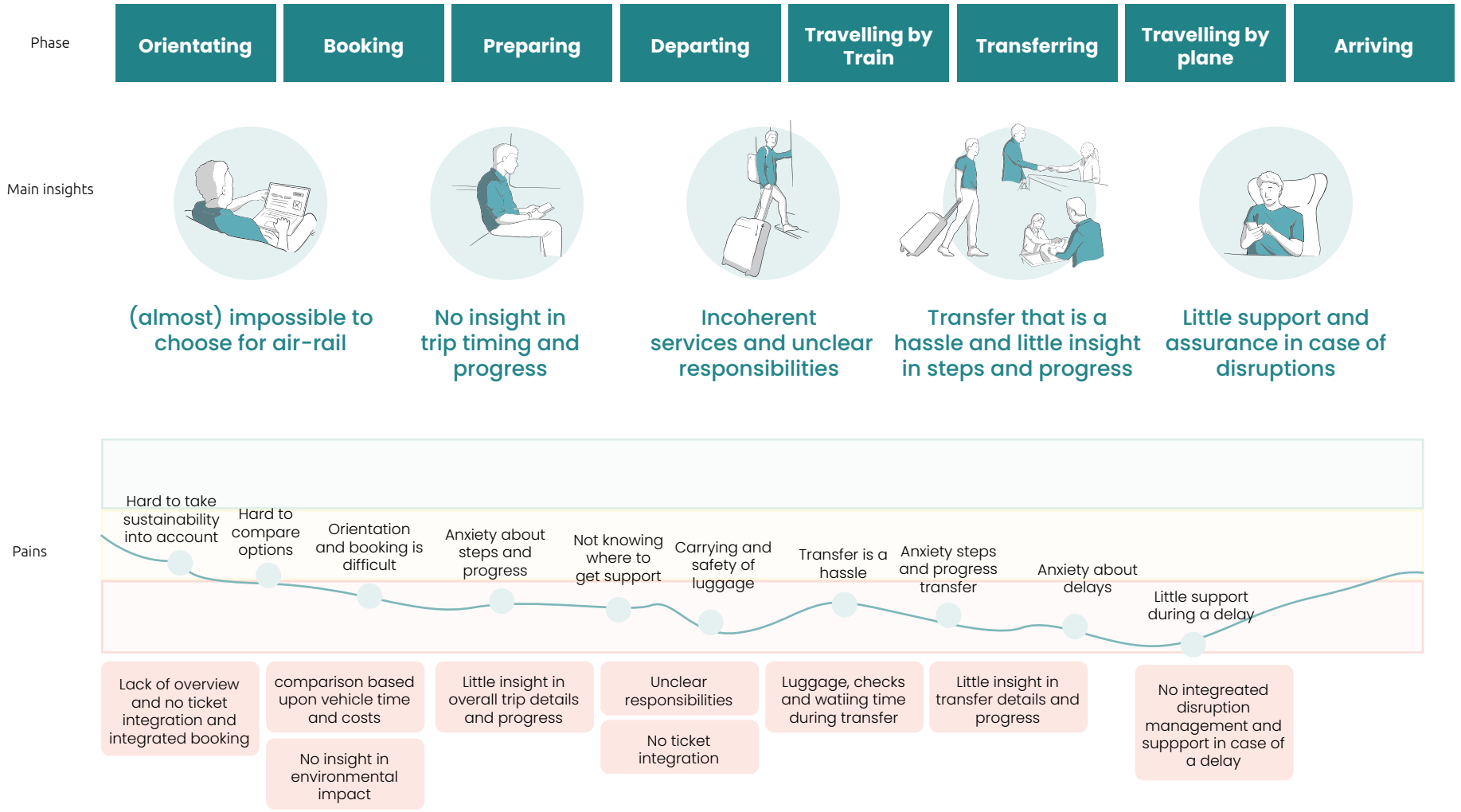


Figure 4.6 Main insights user experience current air-rail journeys.

4.3 Barriers that influence the choice for air-rail

The current air-rail journey is evaluated regarding the factors that influence the choice for air-rail, presented in chapter 5. It is important to understand how travellers currently experience those factors. These insights can be used to fulfil travellers needs and take away barriers, in order to make the air-rail journey an attractive option. Additionally, the factors are evaluated from a stakeholder perspective, to create an complete overview of the existing barriers. Within this section, the main insight are presented. For a detailed analysis, see appendix D.

4.3

4.3.1 Main barriers from the perspective of the travellers

Access to the system, awareness, findability & bookability

The factors of awareness, findability and bookability are crucial to let travellers make the choice for air-rail. Absence of these factors creates difficulties with accessing to the system. Additionally if travellers are not aware about air-rail in the first place, travellers cannot even consider the option.

Three main barriers seem to exist. Awareness about the existence of international train travel and air-rail is lacking. Additionally, the options are hard to find due unclear information and overview. Finally, due lack of integration of trains in booking platforms, the air-rail journey is hard to book.

I usually look at websites with these combo fields. So I try to do it. But one thing that is really not well integrated into that are the trains. So then you mostly end up with booking a multi-leg flight. - German traveller

Appreciation for the system, costs, time & travel options

It seems that costs and time are the most important factors when it comes to making a choice for air-rail or not. The perception of travellers regarding costs and time plays a big role. Within costs, additional travel costs are not always taken into account, such as costs to go from an to the airport and luggage and seat reservation costs. This also occurs regarding time, mostly the time in the vehicle is considered as travel time, instead of the time from door to door. Flights seem to look like a more attractive option compared to trains due little insight in extra costs and time.

For air-rail the main challenge regarding time is to make sure the transfers are well connected so this does not negatively influences the total travel

time. Regarding costs, the costs need to be in balance, and due the perception of expensive train tickets, fairer pricing can help to make air-rail a more attractive option.

For travel options it is most important that traveller have the option to departure from a reachable place and have enough options to find a logical time that fit into their schedule.

Then you have to calculate the time to actually get to the airport which takes time. If you count all those things, it is quite the same time as a train. But this is not very visible while you are booking. - German traveller

I think is the most important, for me, if there are no really long waiting times between the train and the flight. Imagine you arrive at 11 in the morning and you have a plane at 6 in the evening. You will just waste a lot of time. - Belgian traveller

Appreciation for the system, comfort, certainty & sustainability

While making a choice travellers take into account the comfort of travel options. The main concerns that exist regarding comfort and air-rail journeys, are lacking luggage integration and difficulties with the transfer, as discussed in the section 4.2.

Certainty is an important aspect for many travellers. As discussed in section 4.2, the main challenge is to create certainty of the progress of the trip, since the main concern of travellers is that they miss their connection. For this the traveller needs to be assured of getting to the final destination. Additionally, the main concern is disruption management, due lack of integration between the train and plane this is not arranged well. This creates anxiety and stress by travellers.

Finally, sustainability is mentioned as an important topic for many travellers, but is not often taken into account while making the choice for a certain modality, only when travel options are almost equal, then sustainability can be a the decisive factor. To make this to a real factor of influence, there should be a shift in mind-set of priorities. From cost and time, towards environmental impact.

I tell you why, unless you let this train stop at Schiphol. Why would you do that? Then you have to get off at Amsterdam Central. You talking about taking a big aircraft. So it will be a long haul journey. So you are going to have really big bags. The stress of taking that off a train, to another train and then get it to the airport and check it in again. - English traveller

I only booked like 2 or 3 days before. The day we booked it was so cheap to fly. Like 40 euros, while the train was 200. I left my environmental principles there, it was just too much. - Belgian traveller

4.3.2 Main barriers from the perspective of the stakeholders

Access to the system, awareness, findability & bookability

Stakeholders indicate that access to the system is crucial. The enhance awareness, Schiphol indicates that the flight dominated mind-set should change. The main barrier that exists is the absence of a generic booking platform. However to create this, cooperation between airlines and train operations is essential. Additionally, collaboration between stakeholders is needed to be able to provide integrated tickets. Due the need for collaboration, these interventions are difficult to introduce.

We have to change the mindset. Now you just first look at a flight. Not for train tickets. – Schiphol

Most importantly that people can find it and that it's offered to them. And also from abroad, like I fly via Schiphol let's first catch a train. – Ministry of Infrastructure and Water management

Appreciation for the system, costs, time & travel options

The main issue brough forward by the stakeholders is the absence of a fair playing field. According to the stakeholders, changes are needed regarding fair pricing of tickets, excise duties on kerosine and taxes on flight tickets , to create such a fair playing field.

Furthermore, stakeholders indicate that matching train and flight schedules are necessary to assure short transfer times. Frequency of trains and planes should fit to each other's timetables to create combined travel options. Currently this is not always the case, resulting in trains and planes that to not connect well.

Finally, it is argued that it is valuable for the air-rail service if international trains would stop at Schiphol. However, this asks for enough capacity at Schiphol. According to the airport itself, this should be possible. The main barrier that exists regarding this issue, is the Eurostar. Which can not depart from Schiphol due platform restrictions.
Quite a few trains can pass through that tunnel. If you look for maximum potential, and you take out all your slow trains, it is no problem at all. – Schiphol

Not all international trains are following the departure times of the planes, now early in the morning and late in the evening there are no connections possible. – NS international

Appreciation for the system, comfort, certainty & sustainability

Stakeholders indicate that the mainly barriers exists regarding luggage handling. Currently this service is not available for air-rail travellers. Additionally, this is an operational barrier for the stakeholders. Especially if luggage should be transported by international train or handled at the platforms of Schiphol train station. Additionally, disruption management is key to make the air-rail service to a success, but this asks for close collaboration and sharing of information between train operators and airlines. Finally, stakeholders argue that environmental aspects do not seem to be a priority for travellers. The main issue is that the current mind-set focusses on costs, this should be pushed towards more awareness about the environmental aspects of travelling.

In Paris, the train stops to unload the luggage. That is an operational challenge. That would also have to be done at Schiphol and driven around with luggage carts where people are almost falling off the platform. I don't see it happening on those trains or at Schiphol. – Ministry of Infrastructure and Water management

4.3.3 Conclusion

In conclusion, access to the system is insufficient and is key to let travellers consider and choose air-rail journeys. Costs, time and travel options are the most important factors when travellers make their choice. These need to be competitive to make the air-rail journey an attractive option. Finally, the comfort aspects can enhance the attractiveness of the air-rail journey greatly. Certainty is key to create trust in and during the option. Sustainability is getting a bigger topic, but is still not leading.

4.4 Benchmark of existing air-rail combinations

This section discusses the existing air-rail combinations. It is important to have insight in the existing options and current developments surrounding air-rail journeys, to be able to build upon those initiatives and services and learn from them.

Air-rail is not new, it already exists domestically and internationally. Domestic air-rail means that the train is a national train to the corresponding airport, for example the train from Maastricht to Schiphol Amsterdam. International air-rail means that the train in international, for example the train from Cologne to Schiphol Amsterdam.

The existing air-rail combinations of the 4 largest hubs of Europe are discussed, including Schiphol Amsterdam, Charles du Gaulle Paris, Heathrow London and Frankfurt am Main. For a detailed analysis of existing air-rail combinations, see appendix E. In the following section the main insights are discussed.

4.4

4.4.1 Overview of existing combinations

The different air-rail combinations differ in the level of detail. Due rail integration at the airports, most services can provide direct connections to the airport. On top of that, two services provide international connections. All services provide integrated ticketing and some of the services also integrate elements of luggage handling. Additionally, service desks are present at the train station or airport. Finally, some of the services provide staff at the train or even a special section in the train. Figure 4.7 on the next page shows an overview of the existing air-rail combinations of the four biggest airport hubs of Europe.

	London Heathrow	Schiphol airport Amsterdam	Charles du Gaulle Paris
Air-rail service	British airways Rail-fly	KLM AirRail	Air France Air&Rail
long distance trains at airport	X	V	V
International vs national service	National	International	International
Integrated ticketing	V	V	V
Ticket guarantee	V	V	V
Air-rail desk	X	At airport	At train station
Luggage service	X	X	V
Air-rail staff	X	X	Staff at train station
Air-rail section in train	X	X	First class in train

Figure 4.7 Overview of the existing air-rail combinations of the four biggest airport hubs in Europe.

Frankfurt am main

Lufthansa Rail&Fly	
	V
National	
	V
	V
At airport	
Luggage drop off	
Staff at train	
Dedicated air-rail section	

4.4.2 Main insights benchmark

From the four presented combinations, the air-rail service of Air France seems and the Rail&fly service of Lufthansa seem to be most advanced. However, the service of Lufthansa only operates on a national level.

Most of the air-rail services serve only a small part of the air-rail travellers at the airports. However the service of Air France between Brussels and Paris seems most successful, since no flights are operating on this trajectory.

Little reviews are found about the different services, but from the read reviews, the main issues seem to occur regarding information about ticketing of the train and the orientation to the air-rail desks or area. Travellers seem positive about the features of the service, especially about integrated luggage handling and integrated ticketing.

4.5 Conclusion

4.5

The main differences between a short distance flight and an international train are defined and include: upfront hassle, the relation between downtime and door-to-door travel time, reachability of the train station versus the airport, departure and arrival in the city centre, flexibility and comfort.

The findings regarding the steps and patterns of air-rail journeys are captured in three customer journeys. From these some main insights can be derived. Orientation and booking of air-rail journeys is experienced as difficult. Overview of options and bookable combinations is lacking. No integration in ticketing creates a fragmented journey and uncertainty for travellers. Additionally, the traveller does not feel supported over the whole progress of the journey. Procedures such as the checks and boarding are experienced as quite negative, mainly due waiting times and anxiety about the progress. Luggage handling is also an important aspect, this can be a pain on different levels: safety, finding a place for big luggage, carrying and waiting at reclaim. The biggest concern in the journey seems uncertainty about and during missing a leg in the journey due delays.

The main differences between air-air and air-rail or rail-air seems the orientation and booking process and the transfer. Air-air journeys are more easy to find and book. Additionally for air-rail journeys uncertainty exist due no assurance of disruptions management when delays occur. The air-air transfer is smoother since the traveller does not have to leave airside, luggage is automatically handled and there are no check in procedures.

The factors that influence the choice for air-rail are evaluated. Access to the air-rail system is insufficient and is key to let travellers consider and choose air-rail journeys. Factors regarding the appreciation of the system are negatively influenced by lacking comfort, such as absent luggage handling and uncertainty about the trip. Sustainability is getting a bigger topic, but is still not leading in making choices.

Finally, the existing air-rail options are reviewed and thee air-rail service of Air France and the Rail&fly service of Lufthansa seem to be most advanced. Air France seems most successful due no operating flights on the air-rail trajectory.

5

In this chapter

Air-rail travellers

In the previous chapter the current air-rail experience is discussed in terms of steps and patterns. This gave a clear overview of the differences between rail and air and how the user experiences the different journeys from air-air, air-rail to rail-air.

However, to truly understand the user experience, insight in air-rail travellers is essential. Understanding who the user is and what their needs are is crucial to be able to emphasize with the user and ultimately, design a future journey that truly fits the user and their needs. An extensive user analysis was held to unravel the true needs of the air-rail travellers.

Within this chapter, first the process of the user analysis is explained. Followed by the types of air-rail travellers. A morphological tension model of the air-rail traveller is discussed. This is a model of key drivers of users. The needs of the air-rail traveller are discussed and need based personas are introduced. Additionally, user insights from the perspective of the train operator and airline staff are shared. Finally, the moments of truth of the personas during the customer journeys are defined and discussed.

User interviews & sensitizing bookl

Desk research

Contextual interviews users & staff

Service safari & observation

5.1 User analysis process

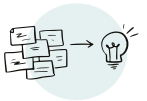
A user analysis was held to reveal the true needs of the air-rail travellers. This process is described to create understanding of the origin of the results.

To define the drivers and user needs, the interviews were transcribed and quotes were identified that illustrated the pains, gains and needs of travellers. These were clustered to define the key user needs and 6 key drivers based on morphological psychology (Koos Service Design, 2020). A tension or morphological model was built and the user needs were mapped on the model. Finally, needs segments were identified and need based personas were created (Idoughi, Seffah & Kolski, 2012). Need based personas represent the different types of users based upon their needs. They are created to structure the needs and make it possible to empathize with the user.

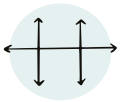
5.1

1. User research, in-depth interviews with sensitizing booklets

2. Identify user gains, pains and needs



3. Clustering needs



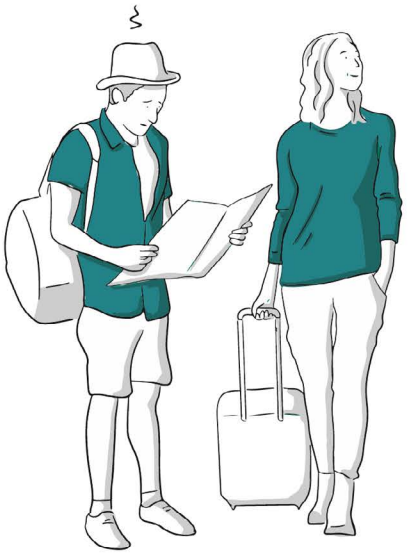
4. Identify 6 key motivations that drive travellers emotionally and create morphological tension model

5. Map the user needs on the model

6. Identify needs segments and create need based personas

5.2 Types of travellers

To understand who the air-rail traveller is, also types of travellers were identified. Travellers can be distinguished regarding three aspects: reason to travel, origin and expertise. For more details about the types of travellers and their relation to the personas, see appendix F.



Expertise

Experienced versus novice traveller

Travellers can differ in experience with travelling in general or with a certain journey or airport.

Origin

rail – air versus air – rail traveller

The origin of travellers differs in countries, but also due the order of the journey. Rail-air travellers are originated from Europe, while air-rail are probably originated from outside Europe

Reason to travel

Business, leisure and relative or family visit

There are three main reasons people travel. For their job, to go on holiday or visit family, friends or relatives.

5.3 Morphological tension model

Based upon the conducted user research with international travellers, a tension model of the drivers is created regarding the air-rail experience. This model is based upon morphological psychology of Salber, this theory argues that experiences include 6 key drivers and those relate to each other in the form of tensions (Koos Service Design, 2020). To create this model, 6 key motivations of air-rail travellers are identified. These represent what emotionally drives the traveller within an air-rail experience. These drivers influence each other and can be paired in 3 'tensions'. In this way a tension model is created of the air-rail experience.) This model unravels the true motivations of the user and is used to structure the needs of the air-rail travellers.

5.3

Survive the journey vs. experience the journey

The horizontal axis shows the tension between survive the journey versus experience the journey. On the one hand, travellers want to get from A to B, and survive the journey with the least amount of hick ups. On the other hand, travellers want to experience the journey to its fullest.

Trusting on the system vs. striving for independence

The left vertical axis shows the tension between trusting on the system versus striving for independence. On the one hand, travellers want to have a supportive environment which guides them through the journey. On the other hand, travellers want to be independent and be able to complete the journey on their own capabilities.

Knowing where I stand vs. get inspired

The right vertical axis shows the tension between knowing where the travellers stand versus getting inspired. On the one hand, travellers want to be informed of where they stand and feel assured about the journey. On the other hand, travellers want to gain inspiration from the journey.

User needs

From the user analysis, a set of key needs are identified. With the use of the tension model, the needs are structured and clustered. This resulted in 6 clusters of needs. An overview of the identified user needs in relation to the tension model is illustrated in figure 5.1. For detailed descriptions of the needs, see appendix G.

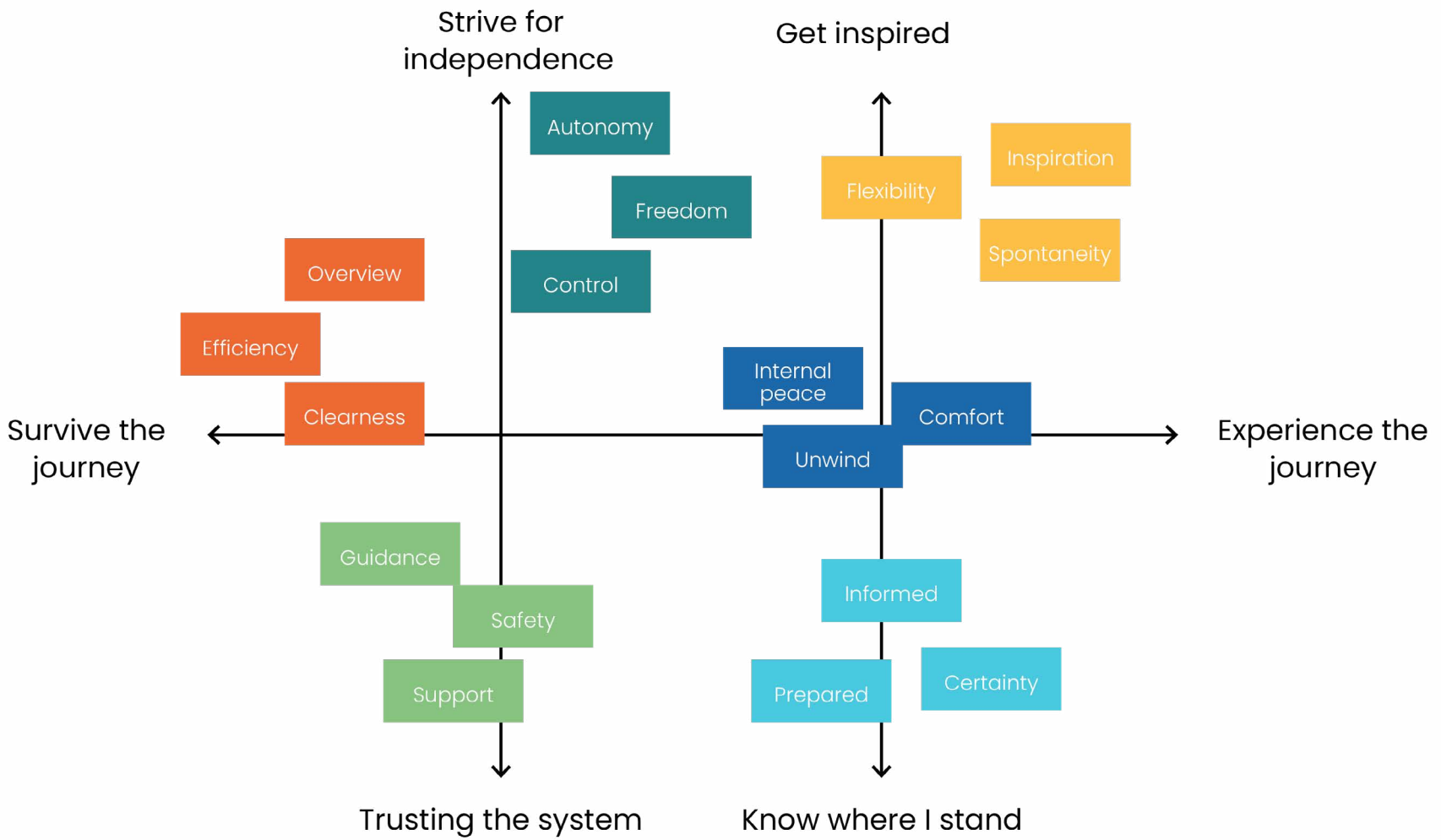


Figure 5.1 The tension model consisting of six key drivers and the identified needs of air-rail travellers.

5.4 Need based personas

Demographics such as age, sex and origin can tell something about the behaviour of people, however two women of 36 living in London can be still be very different kind of travellers. One of these can feel very insecure while travelling and is in need of lots of guidance, whereas the other really strives the be a strong independent woman and is in need of control. Therefore, personas are created based on the needs that where revealed from the interviews with international travellers.

5.4

The needs are clustered in segments. The six segments that were identified formed the basis for the six need based personas, see figure 5.2. Based upon the user research, these personas are further developed and enriched with user data to create clear and relatable personas of air-rail travellers. The personas create structure and common understanding of the user needs. Figure 5.3 on the next page shows an overview of the six personas .

Not every traveller necessarily fits into one persona. The personas should be seen as fluent and dynamic. One traveller can relate to multiple personas in various degrees. Additionally travellers can transform from one persona to another because they take different routes or gain more experience over time.

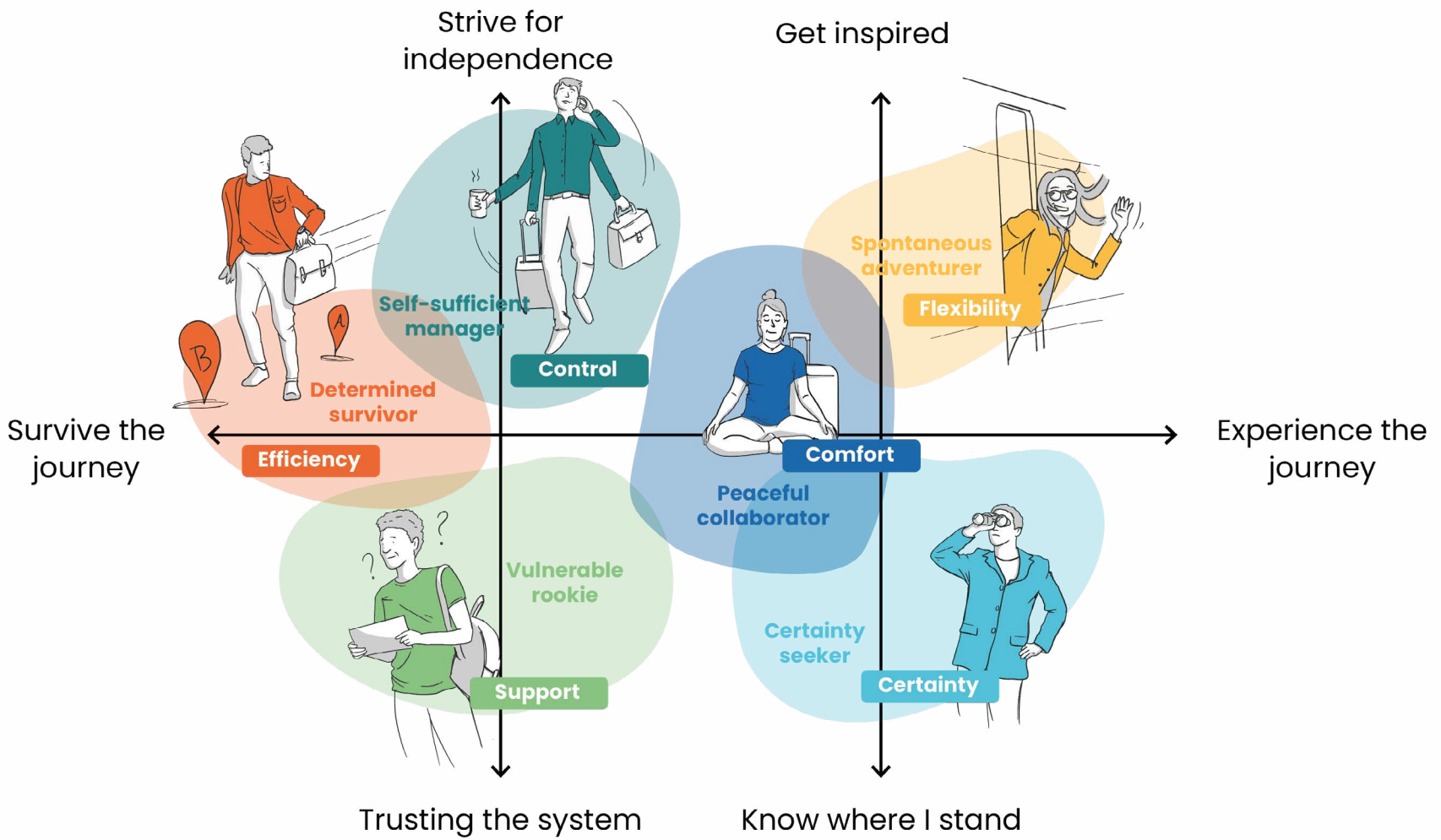


Figure 5.2 The need based personas plotted on the tension model.

Determined Survivor

I just want to get to my final destination in the easiest and efficient way as possible.

Efficiency
Clearness
Overview

It would depend if it's cost effective. If it's cheaper I will do that.But also factoring the time as well. I factor in like a flight to Amsterdam, then how much time I have to wait for the train. - Australian traveller

Self-sufficient manager

I am independent and want to complete this journey as far as it's possible on my own.

Control
Autonomy
Freedom

When I have a lot of options so I can decide if I want to take this train or a different one. A different time of travel. Even different types of seats. - English traveller

Vulnerable rookie

I am not sure about this, I need someone who gets me through this.

Support
Guidance
Safety

Because I can go from central to central. Like the Eurostar, you get from the central of London to the central of Amsterdam. It's feels like less hassle and much easier - English traveller

Figure 5.3 Overview of the need based air-rail personas.

Peaceful collaborator

During this journey I want to get my mind off, so as long when it a bit comfortable and relaxed I am a satisfied person.

Comfort
Unwind
Internal peace

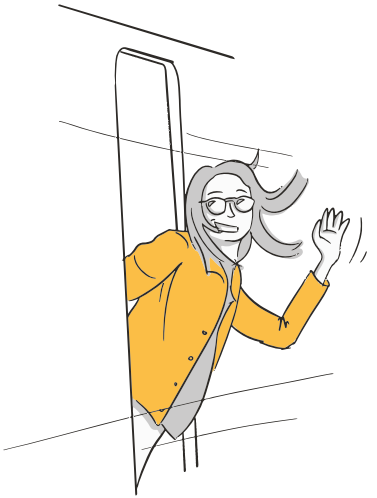
The comfort. The ease. Being able to sit in your seat. Being able to walk to the next carriage. And there will be a bar there or something. - English traveller

Certainty seeker

I just want to know where I stand and what is going to happen. No surprises please.

Certainty
Informed
Prepared

I think like this combination is good. Because you are more motivated to take the train. It's kind of planned for you. - German traveller



Spontaneous adventurer

Let's go!

Flexibility
Spontaneity
Inspiration

Environmental aspect, would be reason number one, and the experience. It is just amazing to be in a train. - German traveller

5.5 Moments of truth

The customer journey is a quite general perspective on the user experience of the different journeys. Since the personas have different needs, some moments and steps appear differently to each persona. To make clear what the important moments are for the personas and what their needs are during those moments, the moments of truth are defined per persona (Groth et al. 2019). For the detailed analysis of the moments of truths and needs per persona, see appendix H.

Determined survivor

Orientate	Booking	Preparation	Departure	Check in and boarding	First leg by plane	Transfer	Boarding	Second leg by plane	Arrive at destination

The determined survivor wants the whole journey to be as quick and efficient as possible. Therefore, mainly the moments that can cause time waste due to complicated and inefficient procedures are important for these kind of travellers.

Self-sufficient manager

Orientate	Booking	Preparation	Departure	Check in and boarding	First leg by plane	Transfer	Boarding	Second leg by plane	Arrive at destination

For the self-sufficient manager the most important moments in the journey are the moments where the traveller hands the control to the train operator or airline. These moments are crucial since the self-sufficient manager want don't want to feel they lose control over the situation.

Vulnerable rookie

Orientate	Booking	Preparation	Departure	Check in and boarding	First leg by plane	Transfer	Boarding	Second leg by plane	Arrive at destination

The vulnerable rookie wants to be taken by the hand and guided through the whole journey. Especially during new and uncertain moments which asks effort of the traveller, the vulnerable rookie is in need of support and guidance and wants to feel safe.

Peaceful collaborator

Orientate	Booking	Preparation	Departure	Check in and boarding	First leg by plane	Transfer	Boarding	Second leg by plane	Arrive at destination

Especially the moments that can cause stress are important for the peaceful collaborator, since this traveller wants the exact opposite: unwind and internal peace. Additionally, the moments that there is room for comfort are important.

Certainty seeker

Orientate	Booking	Preparation	Departure	Check in and boarding	First leg by plane	Transfer	Boarding	Second leg by plane	Arrive at destination

The most important moments are the moments that are uncertain, for this traveller this is from the very start of the journey.

Spontaneous adventurer

Orientate	Booking	Preparation	Departure	Check in and boarding	First leg by plane	Transfer	Boarding	Second leg by plane	Arrive at destination

The most important moments for this traveller are the moments that make the traveller able to experience the journey to its fullest.

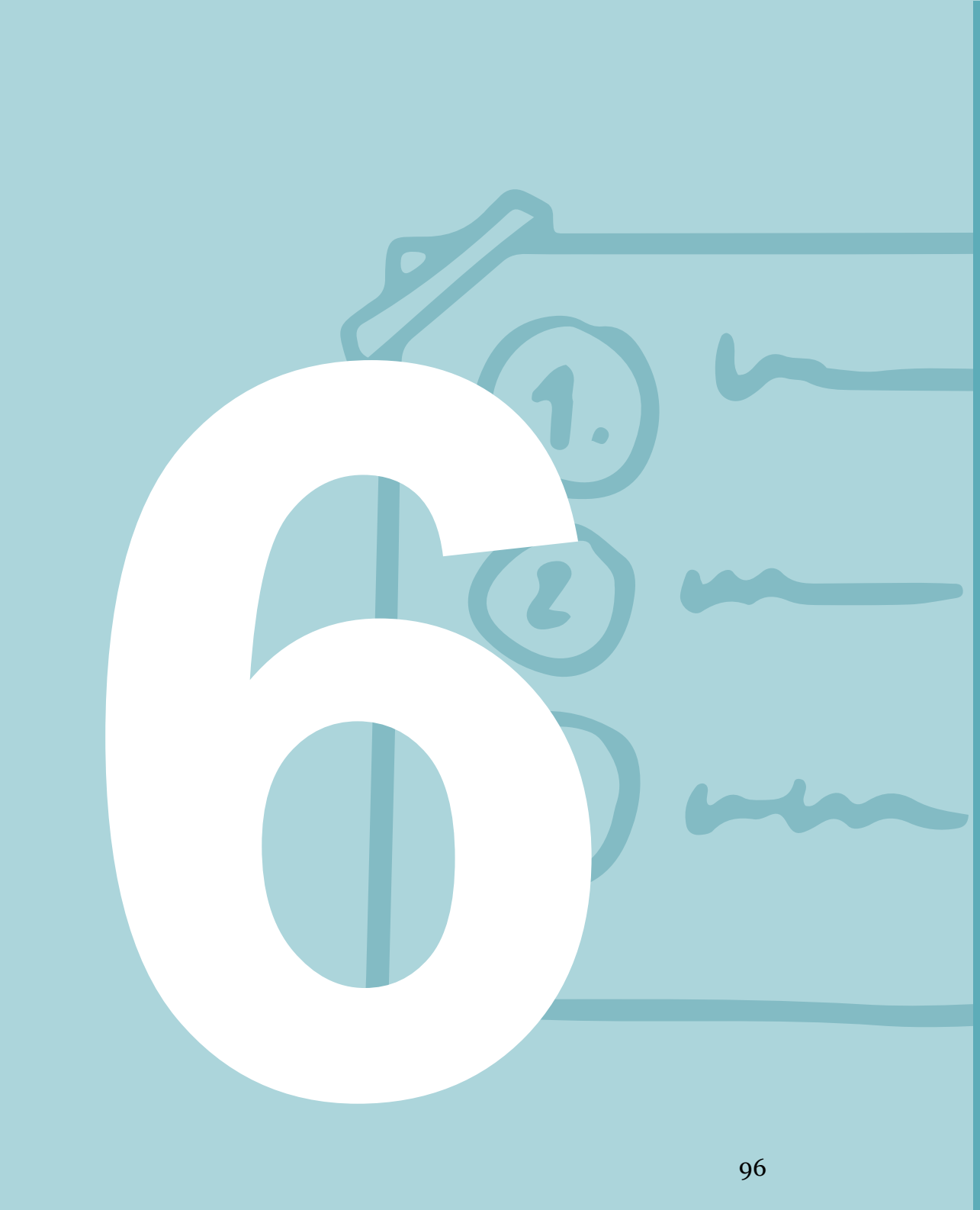
5.6 Conclusion

5.6

Six key drivers of the air-rail traveller are defined and these are paired into three main tensions. This is structured in the tension model. The revealed tensions are: Surviving the journey versus experiencing the journey, trusting on the system versus striving for independence and finally knowing where one stands versus gaining inspiration from the trip.

The key user needs are identified and structured based upon the model. This resulted in six need based personas of air-rail travellers. These personas are the determined survivor, the peaceful collaborator, the self-sufficient manager, the vulnerable rookie, the certainty seeker and finally the spontaneous adventurer. Finally, the moments of truth in the current air-rail customer journey are identified.

These personas create deep understanding of the users' needs. They can be used to guide the development of the future air-rail journey based on the user needs. Ultimately, the personas act to put the user at the centre of the design process.



6

In this chapter

Design brief

Within this chapter the design brief will be discussed. The design brief concludes the first research phase of the project, it is based upon the conducted research and analysis. This brief forms the assignment that is the starting point for the next phase of the project: the design phase. This creates guidance and a clear focus for the next phase. To ultimately solve the right problem.

The vision and mission of the project will be discussed. Additionally, the focus of the project is discussed with regard to the ambitious scenario. Furthermore, the problem definition will be discussed, including the problem owners, experience factors and involved stakeholders . Finally the design goal and its' main challenges will be discussed.

6.1 Vision & mission

To steer the project towards a desired future, a vision is created, to bring this vision to reality, the approach is defined in the mission. The main incentive of this vision & mission is to reduce the impact of travelling, to ultimately achieve climate goals. A first step to achieve this is to offer more sustainable travel options and stimulate travellers to make a choice for these options.

Vision

A world where travelling has little **impact on the environment.**

Mission

Create **air-rail** *journeys that can* **compete** *with air-air journeys to* **stimulate** *travellers to make a more sustainable choice.*

6.2 Problem definition

The problem surrounding air-rail journey is defined as follows:

International trains and flights are **not well integrated**, *this makes the system* **hard to access**, *results in an* **incoherent service** *and creates an* **uncertain** *travel experience.*

This negatively influences the choice for a more **sustainable alternative** *than the air-air journey.*

Hard to access: Due the lack of awareness about air-rail journeys, lack of integration in finding and planning travel options and absent possibilities of integrated booking, the system is difficult to access.

Incoherent service: Due lack of integration of the air and rail journey, the service is incoherent. This results in obstacles in check-in procedures, transferring between modalities and luggage handling.

Uncertain travel experience: Lack of integration creates uncertainty for travellers if the journey can deliver what it should: bring them to their final destination. Travellers are uncertain about future steps to take, progress of the journey and disruption management.

Sustainable alternative: Due the barriers regarding air-rail journeys, air-air journeys are a more attractive option. This negatively influence the choice of travellers for the more sustainable choice of the air-rail journey.

6.2.1 The people who own the problem

The people who own the problem are the air-rail travellers. The air-rail travellers are defined as six need-based personas, see figure 6.1. Each of these personas have different key needs. To survive the journey, the most important need is efficiency. Additionally, to trust on the system, support is key. Furthermore, control is essential to make the traveller feel independent. Certainty is key to make sure that travellers know where they stand. Flexibility is key to go beyond certainty and get inspired. Finally, comfort is key to be able to relax and enjoy the experience. These needs create guidance in the development of the future air-rail journey. In this way, the design of the future air-rail journey will truly fit to the needs of the user. For more details about the personas, see chapter 5.

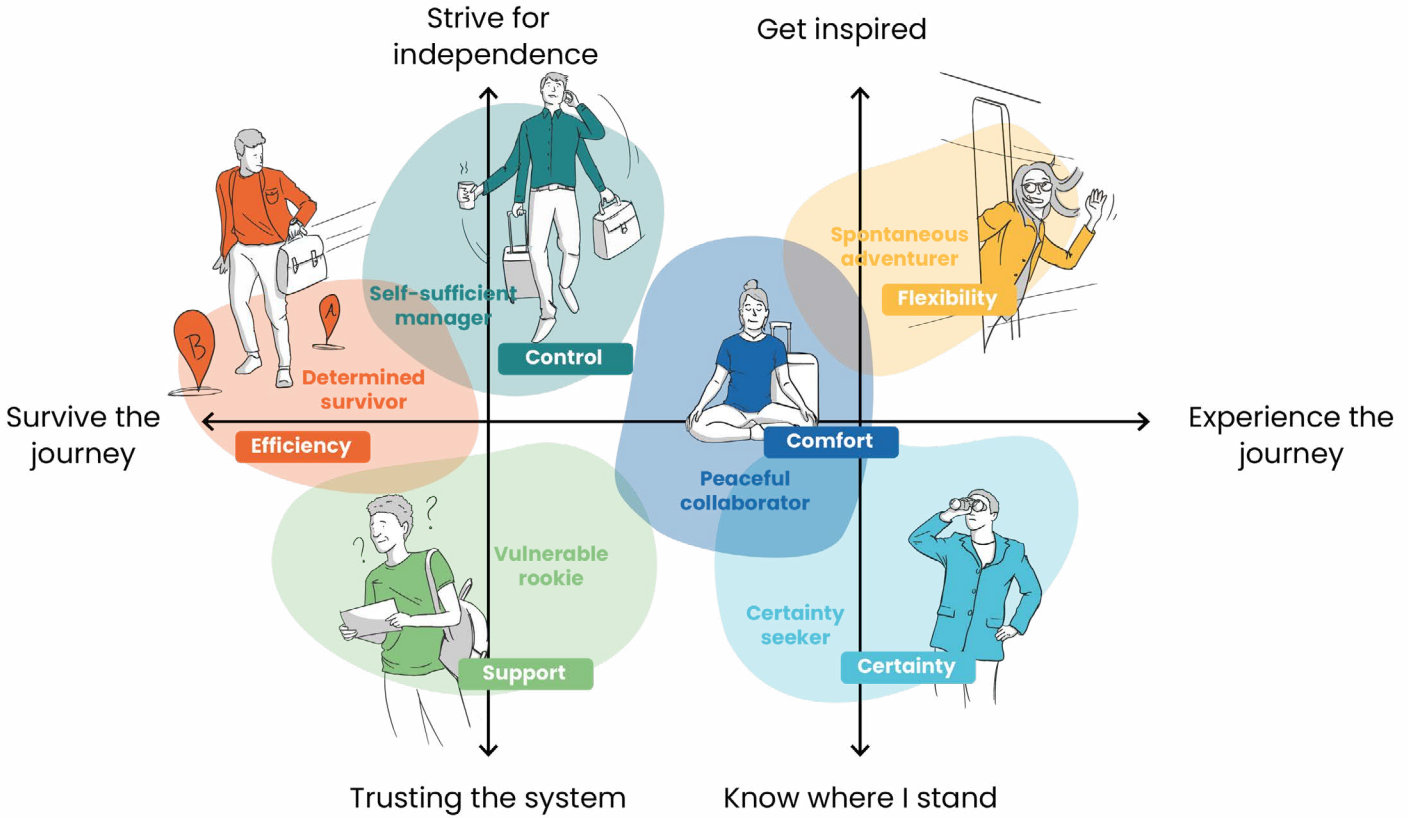


Figure 6.1 Overview of the need based air-rail personas.

6.2.2 The key stakeholders

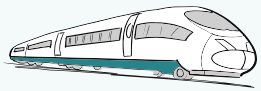
The key stakeholders that should facilitate future air-rail journeys are airlines and train operators. The airport is key in facilitation in infrastructure. Travellers will be the users of the product, finally the government and society can stimulate air-rail journeys in policy and support. Figure 6.2 shows an overview of the key stakeholders surrounding air-rail. The requirements of the different stakeholders will be taken into account while developing the future air-rail journey, but the focus will be on fulfilling the travellers' needs.

Travellers

Users of the product and service

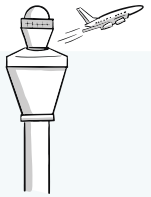
Airlines

Provide an international network



Train operators

Provide the international train network from the Netherlands



Airport

Provide infrastructure to create international connections

Government

Policy regarding mobility and infrastructure, quality of network, sustainability

Society

Representative of positive impact, sustainability and well-being

Figure 6.2 Overview of the key stakeholders surrounding air-rail.

6.3 Design goal

The design goal of the project is defined as follows:

Design an **unified** *air-rail service, that* **stimulates** *travellers to choose for air-rail journeys and is aligned with the traveller needs', creating an enjoyable air-rail experience that makes international air-rail travellers feel* **assured**.

Unify: Connect international air-rail, create a unified journey. The international train and flight should be well integrated. Create a well-integrated service with no hick ups and obstacles, regarding check-in process, transfers & luggage handling

Stimulate: Stimulate the choice for the air-rail journey, in terms of awareness, findability and book ability. Making it into an attractive and appealing option and an easy to access option.

Assure: Create certainty in the air-rail journey. The traveller should feel confident about and during the journey and feel assured to get to their final destination.

6.4 Ambitious scenario for substitution potential

The project takes the **ambitious scenario of the substitution from air to rail,** as its starting point. This means that a wide range of measures is taken to make rail a more attractive option. The development of a vision for future air-rail journeys will focus on what it takes to work towards this scenario with the horizon of 10 to 15 years. This should lead to a service that can serve around **12.000 air-rail travellers a day**. This will lead to the substitution of **63.000 flights** on a yearly basis.

However, while the focus of the project is on the air-rail traveller, the development of the future vision of air-rail journeys will be in **synergy with the needs of the international train travellers** that travel from origin to destination (OD). For more details about the future scenarios, see chapter 3.4.

Design

Development of a service design vision for the future airrail journey

In this part

A service design vision for the future air-rail journey is developed based upon the insights gathered in the research phase. These insights were concluded in the design brief, this brief formed the starting point for this phase.

Within this phase ideas are generated and through an iterative process a service design concept is developed. This concept is prototyped with the use of storytelling, to be able to test and evaluate the ideas with international travellers and the involved stakeholders.

Eventually, the concept is redesigned based upon the evaluation, this led to the final design of the future air-rail journey, the AirRail Alliance.

7

Design approach

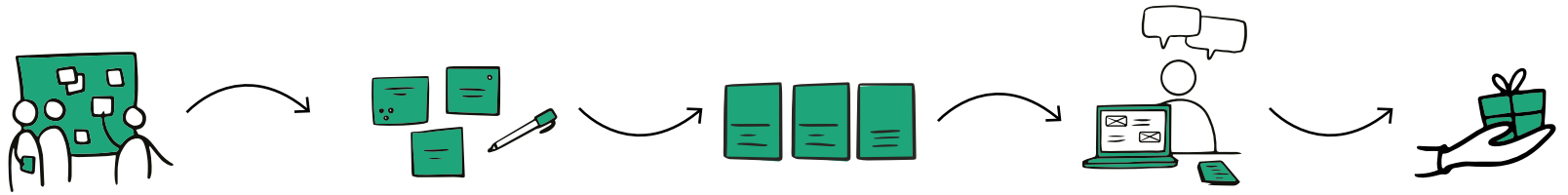
This chapter discusses the design in more detail. The design approach and corresponding methods are explained to create understanding of the origin of the final design.

In this chapter

7.1 Design process & activities

The design brief formed the starting point for the design phase. The three elements, unify, stimulate and assure of the design goal and the travellers' needs presented in the design brief, acted as guidance within the design process.

The process starts with ideation, in which a wide range of ideas is generated. These ideas are clustered and structured. By the use of storytelling user stories are developed and translated into a service design concept. This concept is evaluated with users and stakeholders, to finally develop the final service design vision for future air-rail journeys. Figure 7.1 visualizes the design process and explains the activities.



Ideation

Several ideation and brainstorming techniques are used (Heijne, van der Meer, 2019). These techniques stimulate to come up with a wide range of ideas and finally structure and works towards a specific set of ideas. The ideation process is starting with a wide range of ideas, also called diverging. Secondly, the ideas are structured by clustering. Finally, the ideas are specified by converging.

Storytelling

Storytelling is used to transform the ideas into user stories. This is valuable to do since these stories can communicate what the users think, feel, consider and remember. Additionally it can empower other actors in a service in the same way. (Peng, 2017) These stories are visualized in user scenarios, these makes it easier to empathise with the story, character and context. (Interaction Design Foundation, 2020).

Conceptualize

The ideas and user stories form the basis for the service design concept. This concept consist of visual user stories accompanied with mock ups of the service elements, such as screens, application mock ups and sketches. This concept is created to make the ideas more specific and work towards a more detailed design.

Evaluation

To be able to test and evaluate concept, user and stakeholder evaluations are held. Within this evaluation sessions, users and stakeholders are led through the concept step by step. The goal of these sessions is to evaluate if the concept fit the user and stakeholders needs, what the possible improvements are and what the priorities should be.

Final design

The input of the evaluation forms the basis for the final design. Insights are gathered and are used to redesign the concept. This leads to the final design, which consist of a service design vision, a desired customer journey, a user scenario to illustration the user experience and finally recommendations for implementing the vision.

Figure 7.1 Overview of the design process and corresponding activities.

8

Ideation

This chapter discusses the ideation phase. To generate ideas, creative sessions were held. A small brainstorm at the human factors conference and a creative sessions with travellers were held. With the use of storytelling from the perspectives of the personas defined in the research phase, ideas are further defined towards user stories, according to the needs of the users. From these stories, the ideas are further developed and defined into a set of ideas that form the base for the service design concept for future air-rail journeys.

In this chapter

8.1 Creative sessions

In the following section, creative sessions to generate ideas are discussed.

8.1.1 Workshop at the Human Factor Conference

The first creative session entails a workshop at the Human Factor Conference of the Dutch association of ergonomics Human Factors (HFNL). This workshop aimed to show the value of personas in the design process. The participants were six experts in the field of ergonomics.

Method

A short presentation about the topic and the personas was given. This was followed by two small brainstorm sessions. Within these brainstorms participants were asked to emphasise with the personas and take the persona needs as starting points for the ideas. The session was held online and therefore the tool Miro was used to create an online brainstorm environment, see figure 8.1.

Figure 8.1 Impression of the brainstorm at the Human Factors conference.

Results

The results of the workshop are a range of ideas based upon these questions. The workshop acted as a kick-starter for the ideation phase. Ideas were generated ideas for the project and the session is used as a pilot for some of the techniques in the next creative session. For the detailed results of the session see appendix I.

8.1.2 Creative session with travellers

To generate ideas for the future air-rail journey, a more extensive creative session was held with six travellers. The session was structured in different steps. The goal of this sessions was to generate a wide range of ideas based upon the four aspects of the design goal: unify, assure, stimulate and address the travellers' needs. This ideas are used to develop the future air-rail journey.

Method

The session was structured in 4 steps.

1. Introduction to the problem
2. Warming up and getting into the topic
3. How to's based upon the design goal
4. Role playing and ideal user stories and journeys

The final step in the session was a role playing activity. The participants were appointed to a certain persona that fit their personality and teamed up with an opposite persona. These teams acted out their envisioned future air-rail journey.

Results

The session resulted in a wide range of ideas and user stories of the different persona's. For detailed results of the session see appendix I.

Main insights

The session is used as input of the future air-rail concept. The main insights of the session are:

- Guide travellers by constant overview of their trip
- Make travellers feel confident by creating insights in the steps and notifications about what is happening
- Unifiy the journey by creating an 'airplane' feeling in the train
- Stimulate travellers by create a first class feeling in the air-rail journey, with elements such as priority boarding and lounges.

8.2 Storytelling

Storytelling was used to iterate on the ideas and conceptualize the ideas from the perspective of the users. Various stories are generated from the perspective of the six personas. Figure 8.2 shows an user story. For the complete range of developed stories see appendix J.

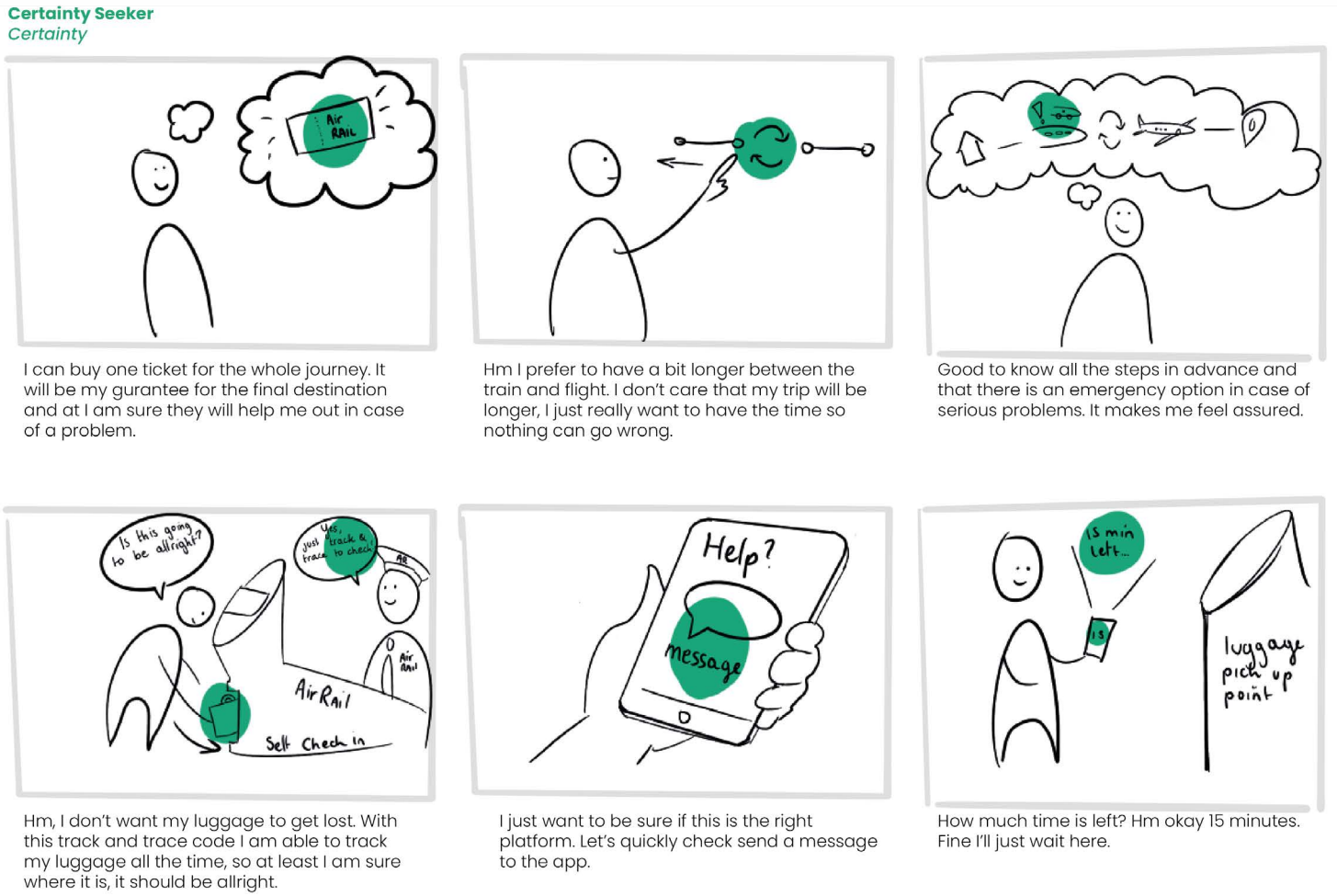


Figure 8.2 An user story, describing the possible future air-rail experience from the perspective of the certainty seeker.

8.3 Final ideas

A final iteration was held and the potential ideas were defined and visualized. In total 22 ideas were defined. The ideas are based upon the four main aspects of the design goal: stimulate, unify, confidence and the traveller needs.

The ideas are not completely defined concepts that are worked out in detail. The ideas mainly serve as a tool for discussion and evaluation the key aspects they represent. Three of the ideas are shown in figure 8.3. For the complete overview of ideas, motivations, needs and goals see appendix K.

Continuous air-rail service food & entertainment

Air-rail fastlane

Transfer instructions

	Continuous air-rail service food & entertainment	Air-rail fastlane	Transfer instructions
What	Service of food & entertainment that is offered in both the air and rail part.	A Fastlane to enter the terminal.	A video in which the steps of the air-rail transfer are explained and visualized.
Why	To create the feeling of one journey and provide comfort in both parts of the journey.	To create a seamless transfer in which the traveller is able to enter the terminal quickly. Additionally make the air-rail benefit visual for other travellers.	To avoid misunderstanding during the transfer. Make travellers aware of what the steps of the transfer are and create confidence about the transfer.
Needs	Comfort / Safety	Efficiency / control	Guidance / Prepared / Informed
Goal	Unify	Stimulate	Assure

Figure 8.3 Three of the final ideas regarding future air-rail journeys.

9

Concept future air-rail journey

Within this chapter the concept for a future air-rail journey is discussed. The final ideas of the ideation phase are transformed into one service design concept.

First an overview of the concept is given by discussing the design goal elements, unify, stimulate and assure in relation to the concept. The concept is explained in more detail by the user scenario and the desired customer journey.

9.1 Concept vision

The concept is created in relation to the 3 aspects of the design goal: unify, stimulate and assure. Figure 9.1 shows a visualization of the concept vision.

Unify

To unify the air-rail journey, several elements that were not coherent will be integrated. This includes integration in ticketing, booking and luggage service. Additionally, coherence is created by branding and service elements such as food and entertainment.

Stimulate

To stimulate travellers to choose for the air-rail option, a clear and fair overview of travel options is created. Additionally the benefits and steps of the journey are made clear while orientating. Finally, an air-rail lounge and fastlane should stimulate travellers to choose for the air-rail option, by creating an comfortable transfer.

Assure

To assure travellers and make them feel confident during the air-rail journey, a trip overview is available throughout the journey. Additionally, travellers can adjust the transfer time. Furthermore, the traveller is notified about planning, can track and trace luggage and will be pro-actively helped in case of disruption.

9.2 User story & scenario

The concept is defined and visualized in a user story and scenario. Figure 9.2 on the next pages, shows an impression of the concept story and scenario. These are developed to place the concept elements in context and show how the user would experience the concept.

Within this story, visuals of service elements are created. These are visuals of interfaces and sketches of service elements. These are used to communicate the concept, enable the users and stakeholders to experience the service elements and act as a discussion tool for the evaluation. For the detailed concept, see appendix L.

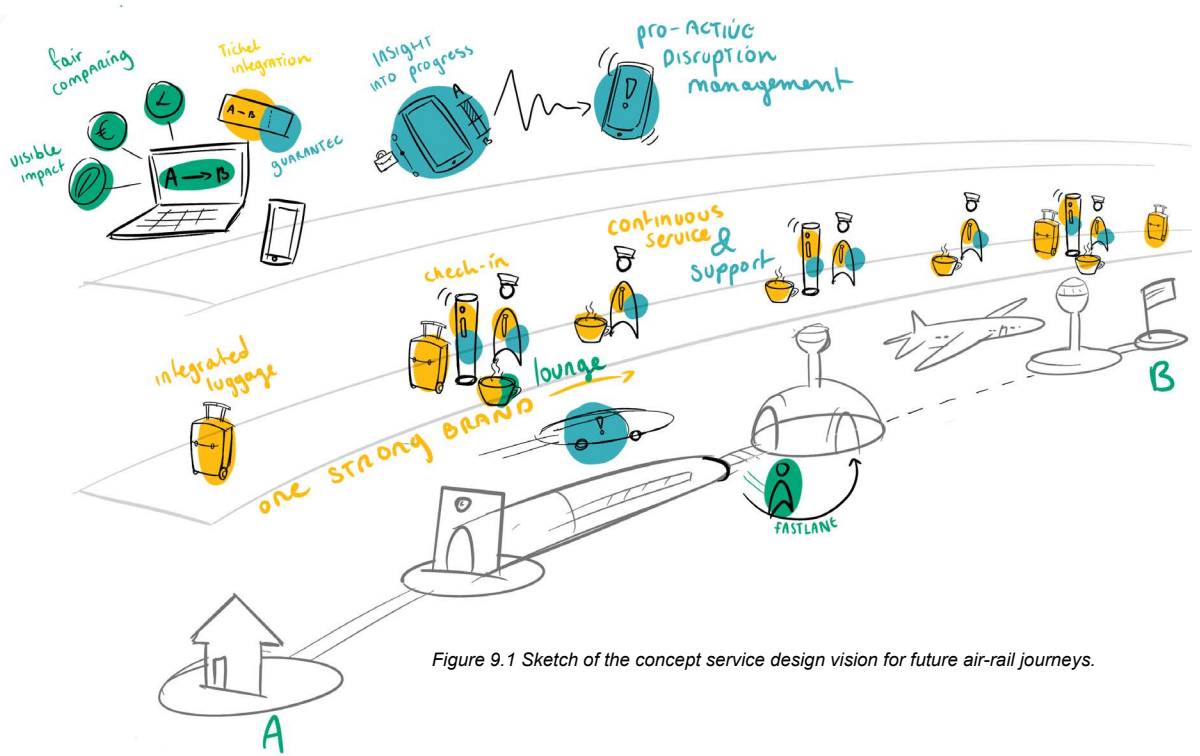
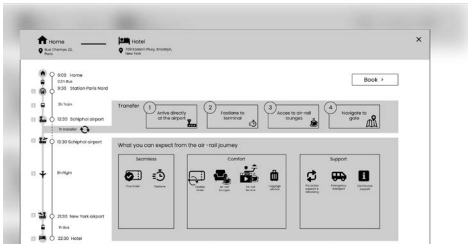


Figure 9.1 Sketch of the concept service design vision for future air-rail journeys.

Orientating

An integrated platform for both train and flights.

Fair comparison due: Door to door travel time & costs, show impact on the environment. show distrbution of time



While orientating already give insight in air-rail steps and especially the steps during an air-rail transfer.
Also comfort and support aspects.

Figure 9.2 Concept user scenario for future air-rail journeys.

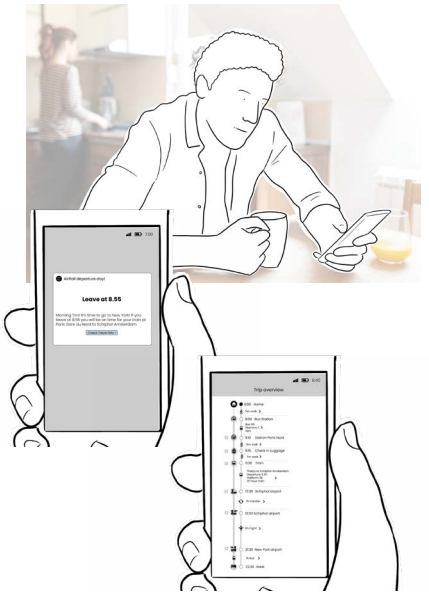
Booking

Choose your air-rail transfer time.

Choose luggage service.

Receive an integrated ticket.

Departing

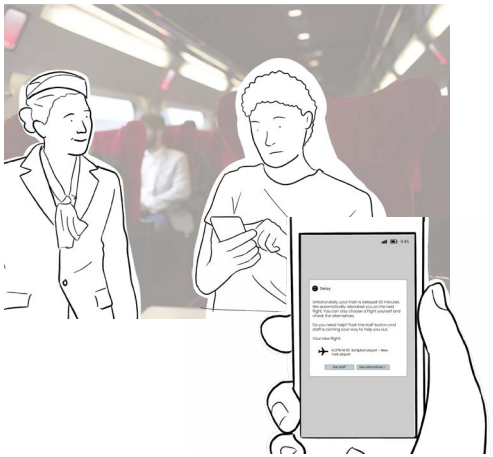


Trip overview including an overview of all steps, real time travel info & duration of steps and reminders to leave.

Option to book an air-rail shuttle to the station

Train

Continuous air-rail service (similiar to inflight services)



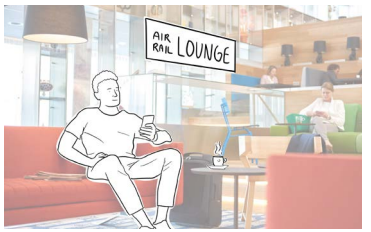
- Pro active disruption management
- Support from empowered staff at the train
- Emergency transport in case of serious disruptions

Transfer

Info video to prepare for transfer

Supportive staff at platform at Schiphol station

Air-rail fastlane



Acces to (air-rail) lounge

Plane

Continuous food & entertainment service

10

In this chapter

Concept evaluation

In the previous chapter the service design concept for future air-rail journeys is discussed. Within this chapter, the evaluation of the concept is discussed. Evaluation sessions with both users and stakeholders were held. These sessions were held to evaluate if the proposed concept does address the user and stakeholder needs. In both sessions the participants are taken through the proposed concept by storytelling. While experiencing the concept and commenting the insights are gathered. The insights are presented in this chapter. The chapter concludes with the main insights.

10.1 User evaluation

To evaluate the concept from a user perspective, evaluation sessions with users were held. Within this section the method, results and main insights of the user evaluation are discussed.

10.1

10.1.1 Method

Goal

> Evaluate the concept of a future air-rail journey.
> Evaluate to what extend the ideas fulfil the user needs
> Discuss what possible improvements could be.

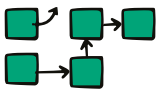
Session structure

The sessions were held online with the use of Zoom and Miro. In figure 10.1 an impression of the session is shown. The session started with a short introduction. This was followed by gathering insights via a concept walkthrough. This is an evaluation method in which participants are led through a concept and are asked to comment along. This method allows evaluation of concepts that are not worked out in detail. For the walkthrough a story accompanied with context visuals and digital service mock ups is created (Polson, 1992).

While going through the concept the participants were asked to think out loud. In this way, the thoughts, considerations and reasoning behind choices became more clear (Someren et al, 1994).

After going through the concept, a debrief interview is held to discuss the concept and the experience of the participant. The session is concluded with a questionnaire in which all the concept elements are rated on likeliness by the participants.

Introduction



Concept
Walk through &
think out loud

Debrief interview &
questionnaire

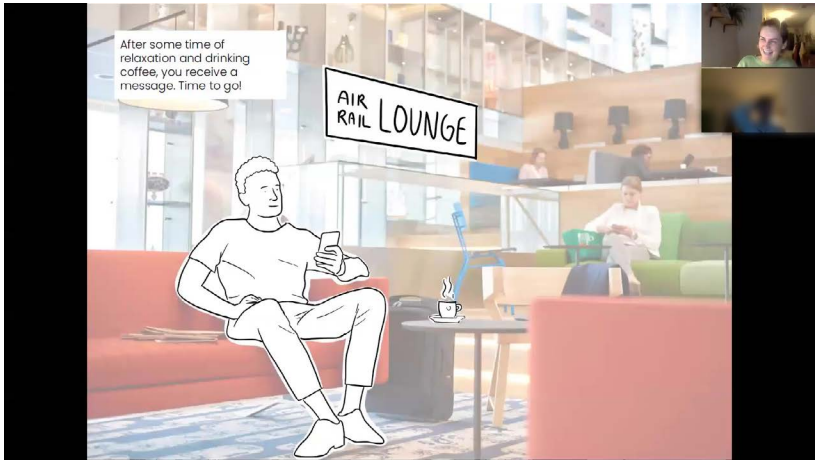


Figure 10.1 Impression of the evaluation session with international travellers.

Participants

In total seven sessions are held. The interviewees are recruited via snowball sampling, this means that the personal network of the researcher recommended the participants. To decrease personal biases, the participants were indirect contacts of the researcher. To make sure all personas are represented, the participants were screened in advance. They were asked questions and filled in a questionnaire to determine to which of the personas they relate the most.

Table 10.1 Overview of the participants of the user evaluation.

Nationality	Residential city	Sex	Age	Occupation	Persona
Indian	Bombay	M	34	Accountant	Self-sufficient manager
German	Munich	M	28	Public relations	Self-sufficient manager / Spontaneous adventurer
Chinese	Xiamen	M	37	Electrical engineer	Vulnerable rookie / Certainty seeker
Belgium	Gent	V	26	Logistics	Peaceful collaborator / Determined survivor
French	Paris	M	32	Service engineer	Certainty seeker / Vulnerable rookie
English	London	V	37	Law consultant	Certainty seeker

10.1.2 Qualitative results

In this section, the insights per element of the concept are discussed. For detailed results, see appendix M.

Orientation

Fair comparison: door to door

Time is an important element for travellers, together with costs this is the most important decisive factor. All travellers seem to agree upon that comparing from door to door is useful and insightful, which makes the comparison more fair. However, the main concern of travellers is if they can rely on the travel information, a tight planning might not work out well.

I think that in itself is quite nice. It is always a bit of disguised travel time what it contains. Just like flying cheaper from Germany or something, but then you are on the road for 4 hours.– Belgium traveller, determined survivor

Environmental impact

Participants argue that this aspect is important to them, however they also make clear this is not the first decisive factor. However, when options are similar in price and costs, most travellers do indicate the impact can be decisive. Travellers indicate that this should stand out, since it's not the first thing they will look at.

Me personally I always would go by price. I would consider the Co2 impact if the prices are similar. – English traveller, certainty seeker

Time distribution

For travellers, the concept of time distribution was hard to grasp. Since there are many activities during a trip, time distribution is hard to make. For travellers the most important element regarding time distribution is the total travel time, transfer time and time in the train or in the plane.

First costs. Next thing I would look at is the transfer time and travel time.
– English traveller, certainty seeker

Trip overview, transfer steps & benefits

This moment seems important to convince the traveller to choose for a certain travel option. Travellers argue that insight in timing and support is important to be confident during booking and travelling. Comfort and service, such as luggage service and integrated ticketing could convince travellers. Travellers even argued later in the journey, that if service elements would have been more clear at the start, they would have been more motivated to choose for air-rail. However, the main concern is if the transfer time will be enough. Therefore, it should be made clear if the timing of the trip is doable. Additionally it is suggested that a FAQ can be added. With questions like, what if I miss my train?

Booking

Choose your transfer time

Being able to choose your transfer time is experienced as very pleasant and helpful by travellers. It makes them feel in control of their journey and tailor it to their specific needs. Their choice mainly depends on the purpose of the travel, business or holiday, long or a short trip. Travellers also indicate that they base their decision for a travel option mainly on the shortest total travel time and would like to extend this while booking, since this enhances confidence during the trip. Travellers argued that being able to be flexible in the transfer time is a unique selling point of the train that can make the air-rail option appear more attractive than the air-air option.

Okay here I would go for the relaxed version. For me it is because 2 hours nothing can go wrong, or not much could go wrong. With the seamless option something could happen. In the relaxed version I feel like I have more time in the two hours. – German traveller, self-sufficient manager

Luggage service and track & trace

Overall almost all travellers indicate they do want to use this service. Mainly to not have to carry the luggage in the train and during the transfer. After dropping luggage, travellers feel like travelling can really begin and they can relax. The home service is seen as efficient, however having to prepare in advance is seen as a downside. Additionally, travellers indicate that the option is less sustainable. Travellers feel more confident about the drop off at the train station, since it is part of the system.

Travellers indicate that safety of luggage and confidence that it will arrive at the final destination is of huge importance of a good travel experience. Track & trace can be very valuable to make travellers feel more confident about the luggage service.

I will go for number the drop off. They need of course some employees to do that at the train station but no additional way of transport. Then it's out of the mind. It's the middle way of convenience and impact on the environment. – German traveller, spontaneous adventurer / self-sufficient manager

Departure

Air-rail shuttle

Most participants argue that they could book it just when it would be offered to them, but they can also figure this out themselves, using taxi services or public transport.

I would book the air-rail shuttle. If I would be confident enough with the public transport I would take that one, but if not I would choose for such an option. – English traveller, certainty seeker

Train & plane travel

Continuous air-rail service, food & entertainment

Most travellers reacted really enthusiastic towards these elements. Although these are minor service elements, travellers indicate that these

elements can enhance comfort and their travel experience, creating the feeling of one journey.

It kind of gives me the feeling of being in an airplane and also sort of travelling, that it's happening. How it happens in flights, the journey has begun. That kind of a thing. – Indian traveller, Self-sufficient manager

Transfer

Transfer video

Travellers indicate that this video is very useful whenever you are new to the airport or never did an air-rail transfer. By creating the feeling of being prepared, it could enhance confidence in the transfer. More experienced or confident travellers argue they won't need it. Travellers mention that the video should mainly contain directions and transfer steps, duration of steps and important checks and locations for support.

Because an a video is always good to see where I should go and it's more clear for me the instructions. Than the map or the text on the phone, if it's a video that would be great. From getting of the train and arrive at the security check. The signs I have the look and the key points. – Chinese traveller, vulnerable rookie

Staff at the platform / station

This is very much appreciated by travellers, but not necessary. With the video, app and signs travellers feel like it should be enough to be able to find their way.

Fastlane

Travellers are very positive about the Fastlane. First of all it creates confidence within the transfer, due no stress about ques and waiting times. Additionally, it creates a special feeling of travelling like business class, which is appreciated.

That's really good service, I would give me confidence that I wouldn't get stuck in the que. I would like feel like VIP. – English traveller, determined survivor

Air-rail lounge

Travellers like the lounge, nice to have a place to go to at the airport. Again they feel like a special treatment, which enhances the experience of the service. However, travellers indicate that when in a seamless transfer they might not have the time However important that it's clear where it is and how much time it costs, so travellers don't run late due this visit.

General elements

Trip overview & progress

The trip overview and insight in progress is experienced as very valuable by travellers. It made travellers feel prepared for their trip and constantly informed, which made them feel confident about the trip. The main concern within this overview were buffers. This is what travellers would normally plan themselves, if they are not included in the planning, they feel less confident that there journey is going to work out well.

You have an overview of the whole journey. You are not missing out of something. Because it shows you what to do so it makes you more confident for the trip. – German traveller, spontaneous adventurer, self-sufficient manager

In-app navigation

Opinions of travellers were very divided towards this idea. Some find it very useful and others did not like it, since navigating should be done by looking at the signs. However for travellers that are not that confident with navigating, they find it very helpful.

Depends if I have time. If I have enough time, Paris Nord is quite clear. If I don't have time, I would use the application. Or too afraid to miss it or something. – French traveller, certainty seeker, vulnerable rookie

Notifications

Travellers argued that the notifications were really helpful and were making them feel guided through the journey, creating confidence. However overloading travellers with information could be a pitfall. Travellers should

be able to turn it off and adjust this to their preferences.

It's hard be at the wrong place or at the wrong time, it's almost impossible to forget something. It can happen of course, but with the little reminders, it really makes you at ease I think. So if you forget, you will be reminded. – German traveller, spontaneous adventurer, self-sufficient manager

Pro-active disruption management

Being supported in a situation of disruption, is of huge importance for feeling confident during the journey. Travellers argued that they felt guided within the process of the delay and generally trusted the system. Having the possibility to see alternatives is also very valuable and enhances the feeling of being in control, although most travellers would stick to the advice of the system. However, to increase confidence, it should be very clear what happens to their situation in terms of luggage, their reservation and the planning.

I feel still confident because I can catch the next flight. It feels like the whole situation is under control. – German traveller, spontaneous adventurer, self-sufficient manager

Empowered staff / helpline

Staff being present throughout the journey is creating a feeling of guidance and support, enhancing the feeling of confidence. However, travellers won't always expect that they can ask questions to staff of the train or plane about their air-rail journey, so in some way it should made clear that these people can help them with their air-rail questions. Travellers also indicate that they don't want to bother staff to much and they would prefer to be able to fix most things themselves via the app or via an helpline or live chat.

I prefer to have live chat. I can go into live chat, the person who I will chat has access to my information. And they can help me out with my flight. If you have like 20 people coming to the staff when there is a delay. It would annoy the staff. Then I rather look at my phone to fix it. – English traveller, certainty seeker

Emergency transport

The idea of emergency transport is very much liked by the travellers. This can really enhance confidence in the system. In case something goes wrong, there will always be an alternative.

Yes it helps a lot. Especially for the first part. For the airport. Because an emergency transport car would pick me up if something doesn't work out. That helps a lot actually to be more at ease with the booking. Also with travelling then. The morning of the travel that you know that there is a backup. – German traveller, spontaneous adventurer, self-sufficient manager

Continuous & visible air-rail branding

Having subtle cues of the air-rail brand helps to create a feeling of a unified journey. It contributes to confidence, since also this enhances that travellers feel like support is always close by.

Also if the staff would be all air-rail staff throughout. I know the airline is different and the train is from a different company, but they would have that one thing throughout the journey, that would make me feel relaxed. – English traveller, certainty seeker

10.1.3 Quantitative results

At the end of the evaluation, participants were asked to rate the different ideas on a four pointer scale: dislike, slightly dislike, slightly like and like. The numbers in the rating represent the amount of participants that rated the idea on that score. Figure 10.2 shows the results of the questionnaire.

In the end, none of the ideas appeared as negative to travellers. Four ideas appeared as the most positive, with almost a 100 percent like score. The trip overview and progress, choosing your transfer time, the air-rail fastlane and the emergency transport were seen as the most valuable ideas by the travellers.

The trip overview and progress created the feeling of guidance, being informed and prepared, in the end enhancing confidence greatly. Choosing your transfer time and the fastlane made travellers feel confident about transferring between trains and planes and gave them the feeling of being in control. Finally the emergency transport gave travellers the feeling it can't go really wrong.

The time distribution in the comparison, the AirRail shuttle, the navigation

in the app and the staff at the platform were seen as the least valuable elements of the concept. The time distribution was mainly too detailed for making a choice, the navigation, AirRail shuttle and staff were experienced as too much guidance for a great part of the participants, however for more inexperienced travellers this were valuable elements.

10.1.4 Conclusion

Overall the travellers reacted positive to the service concept. Travellers felt supported and guided through the air-rail journey. The air-rail option seem to became a competitive option compared to a multi-leg flight, mainly due the integrated booking platform and the door to door comparison. Other elements such as environmental impact and service elements help to stimulate travellers, but still time and costs are the main decisive factors.

From the evaluation it became clear that not all elements are needed for all travellers. Especially the elements that should create confidence are mainly valuable for certainty seekers and vulnerable rookies. Other travellers don't always need this level of support and should be able to reduce the amount of support during the journey, to not feel overloaded.

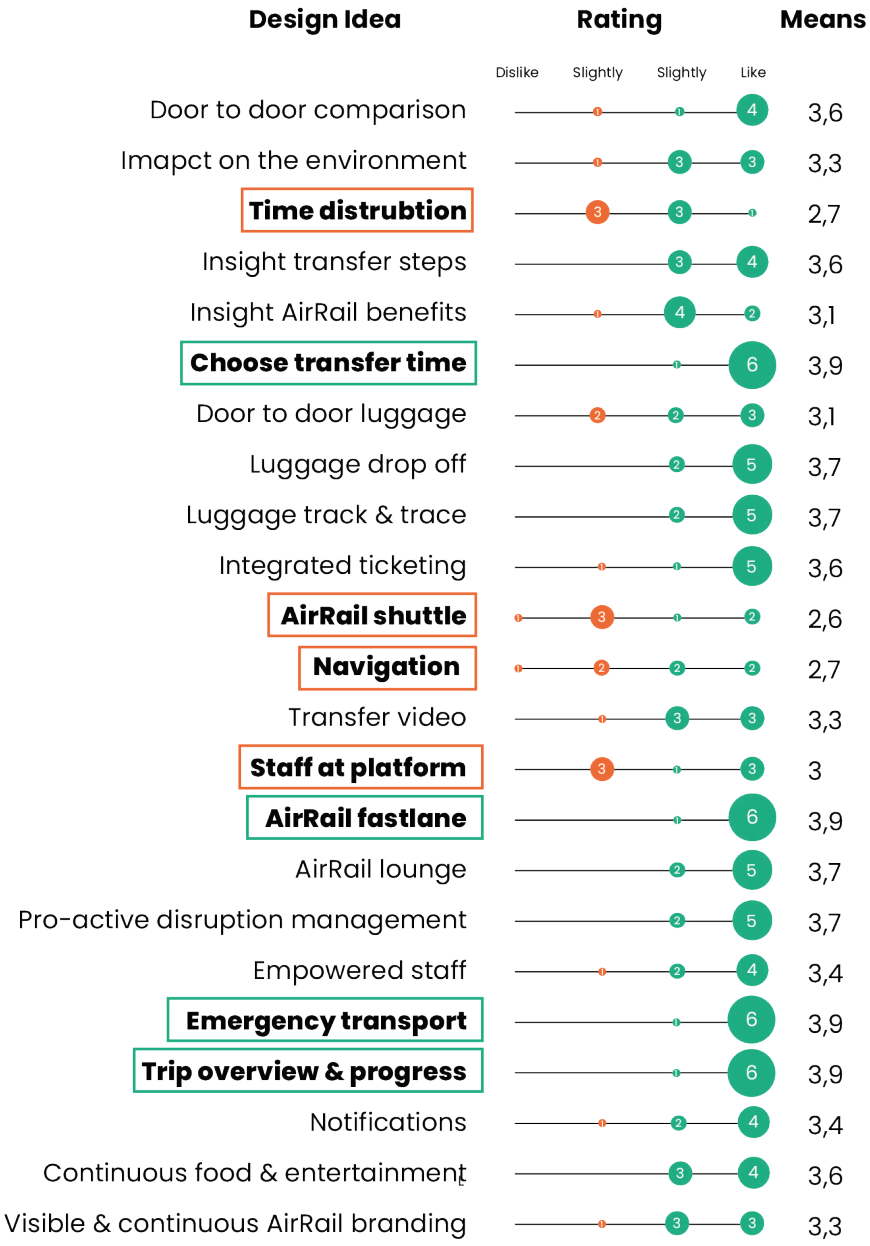


Figure 10.2 questionnaire results of user evaluation.

10.2 Stakeholder evaluation

To evaluate the concept from the perspective of the stakeholders, evaluation sessions with different stakeholders were held. Within this section the method, results and main insights of the stakeholder evaluation are discussed.

10.2

10.2.1 Method

Goal

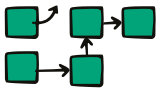
> Evaluate the concept of the future air-rail journey.
> Evaluate to what extend is the concept in line with the stakeholders needs and wishes.
> Evaluate what should be the priorities of the concept.
> Discuss what the possible barriers of the concept are.

Session structure

The sessions were held online with the use of Zoom and Miro. The session started with a short introduction and recap of the ideation process, to create understanding of where the concept was based upon. This was followed by a concept walk through, with a focus on the stakeholders perspective.

After going through the concept, a debrief interview is held to discuss the concept, the different elements are evaluated on strengths and weaknesses. Additionally, the possible barriers are discussed. The session was concluded with an priority exercise in Miro, the stakeholders were asked to prioritize the different concept elements and explain the importance of the elements.

Intro &
recap ideation



Concept
Walk through

Debrief interview &
prioritising ideas

Participants

Evaluation sessions are held with the key stakeholders of the air-rail project, this are the representatives of KLM, Schiphol airport, NS International and the ministry of Infrastructure department aviation and the department of rail.

10.2.2 Results

In this section, the results of the stakeholder evaluation are discussed. First the prioritised elements are discussed, followed by the bottom concept elements. For the detailed results, see appendix M.

Prioritised concept elements

Tripscanner & door to door

The stakeholders unanimously decided that door to door comparison and the idea of having a 'Tripscanner' with integration of train and planes in journeys is the most important element of the concept. According to the stakeholders, this element is essential, since without this travellers are not able to find, choose and book the option. With the elements in the Tripscanner, this barrier could decrease. Therefore, all stakeholders agreed upon that this should be the priority.

I think that's a priority, that's what makes the difference with trains and what can help persuade people to see that they don't have to register at the station so quickly in advance. - Representative of KLM

Disruption management

Dealing well with disruptions is key to make the air-rail journey to a success, according to the stakeholders. Also all stakeholder agreed upon that this really should be part of the concept, since without this the service won't be trustworthy and travellers won't feel confident within the air-rail journey. This includes both proactive rebooking and emergency transport. However, emergency transport could be positioned better as an alternative route. In the ideal situation, a traveller should be able to get to their final destination in the most efficient way, if that involves going to another airport and take a flight there than this should be possible.

I think that people also want to have a kind of certainty that everything is well arranged, even if it is a more complicated journey than usual. If there is anything, then get me there. Representative of Ministry of infrastructure, rail

Trip overview, progress and application integration

The overview and information given by the application was also experienced as very positive by the stakeholders. This can really make a difference in creating a more confident journey, by constantly supporting, informing and preparing travellers.

Within this overview, more real time data could be used to make it even more insightful. Such as adjustments in de planning according to how crowded the airport is or how long the que is.

Actually, that app is kind of your personal travel assistance, because first you have integrated ticketing and the door-to-door comparison, than the app brings it together. That makes it strong. He can monitor that you are on time on your train, that if your train is delayed that you do not have to search, but these are the alternatives. It takes away a lot of important barriers. – Schiphol

I think that has great added value. Because we don't have that yet, but it really should be there actually. – Representative of NS International

Choose your transfer time

Stakeholders were enthusiastic about this element. It can give the traveller control over their trip and moreover can strengthen the unique selling point of the train, namely that it's more flexible than flying. Additionally, stakeholders argued that choosing a travel option based on a seamless transfer and later on give the possibility to extend the transfer is interesting. In this way, while orientating the air-rail option still appears as attractive due the short transfer time as a default.

This is a unique selling point of the train. That you can go to Paris, if I see when booking that I have my transfer time, that I can walk 8 hours in Paris, if I fly away in the evening and arrive in the morning. This is something airlines do but don't really offer. The way you have positioned it now makes it fun. That is cool. - Representative of Schiphol

Continuous branding

This element is very much appreciated by KLM and the ministry of Infrastructure (aviation). However, Schiphol and NS International are not

that enthusiastic. This seems to be based upon the competitive nature of both parties, continuous branding would namely mean this also includes branding in the trains and stations, in which train operators prefer to promote train services instead of flight services. This might also holds vice versa in planes.

Involving the train and Thalys regarding branding is an interesting discussion, they also wants their own staff and their product. - Representative of KLM

Bottom concept elements

Staff at the platform

According to stakeholders, elements that are in need for extra staff were placed as bottom elements. Especially staff at the platform seems not fit the stakeholder wishes, mainly because this is an expensive solution and could, according to the stakeholders, not necessarily need if the instructions and signs are clear in advance. However, they also argued that there should be good balance between self-service, digital services and staff.

It is very busy station, just try to find those people, they already have an app, do they still need it? I don't think there will be one. – Schiphol airport

Air-rail shuttle

Additionally, for some elements it is argued that there should be made use of existing services or infrastructure, such as the air-rail shuttle. This is could be the KLM taxi service or an integration with Uber or another taxi service, a special shuttle is not needed.

Continuous food

Finally, continuous food was placed at the bottom by most stakeholders. This element was argued to be a nice to have but not of a priority for an air-rail journey, mainly because it is not addressing the main existing insecurities of air-rail journeys.

10.2.3 Conclusion

Stakeholders seem to prioritise the digital elements of the concept. According to the stakeholders, priorities should be the Tripscanner, door to door comparison, disruption management and the integration of the journey via the application.

However, most of the physical aspects are also appreciated, but for these aspects it could be wise to see whether the concept can make use of existing infrastructure and services, such as existing fast tracks and lounges. Additionally, it would be beneficial if the service elements blend with the existing services and system, making implementation more promising.

10.3 Limitations

In this section the limitations concerning the evaluation sessions are discussed.

10.3

The evaluation was online. This could have limited the participants to express themselves. Additionally it made it more difficult to interpret reactions and expressions by the researcher.

The evaluation was based upon storytelling and visuals, this is a stimulated version of reality, which does not include all external factors that are present in a real life situation. In the story, not all aspects of the journey are taken in to account, such as boarding or security checks. This could have influenced the experience of the journey.

In addition, the description of the researcher can have influenced the results. Additionally, the visuals can have influenced the results whether participants liked an idea or not. Sometimes details of the visuals could have distracted participants and could have influenced their opinion. Such as difficult wording or unclear images.

Furthermore, the participants were indirect contacts of the researcher and therefor they might not be neutral towards to proposed concept. Additionally, the researcher is at the same time the designer of the concept and therefore the possibility exists that the data is not interpreted neutral. Finally, within the evaluation, one example was used, from Paris to new York. This could have influenced the results, especially for travellers who or not familiar with Paris.

10.4 Recommendations for the concept

The insights gathered during the user and stakeholder evaluation are used to create a set of recommendations for the concept. These are used to iterate upon the concept and define it further towards the final design. The recommendations are discussed in the following section.

10.4

Create confidence with time

From the evaluation it became clear that insight in timing and duration is important to create confidence in the air-rail journey. Therefore, providing insight in advance of in how long steps is essential to make people feel confident. Additionally, including buffers helps to increase the confidence. By choosing the transfer time but also by including buffers in the planning. Furthermore, during the trip, providing constant information about the duration of steps by providing information about walking times, waiting times etc. can increase confidence greatly. Additionally it gives travellers control over the journey, since the traveller knows what to expect, they can adjust their trip and planning accordingly.

Balance guidance

Travellers indicated they felt guided through the journey. However a pitfall of guidance is overloading the travellers with information and support. To let the concept address the needs of all travellers, guidance should be balanced. Travellers should be able to adjust the service to their preferences when it comes to support.

Take support one step further

The supportive elements in the concept could be enhanced. First of all, the emergency transport could be improved by providing alternative routes in case of serious disruptions. Additionally, travellers indicate that they would like to be able have access to direct support via the app in the form of a live chat or helpline. This can give travellers more control over gaining support.

Keep an eye on sustainability

The new elements of the service should also be in line with the goal to create a sustainable travel option. Therefore, while designing the concept, it should be considered to what extend these added services have impact on the sustainability of the trip. This was mainly a concern regarding the luggage service from home, which might not be a sustainable solution for the luggage service. Additionally, communicating impact of travel options could become more specific by providing more information than just CO2 emissions.

Make use of existing services & infrastructure

Finally, the an important insight from the evaluation is that existing services and infrastructure can be used to make the concept feasible and easier to implement. Many aspects of the concept could be in synergy with existing elements within the train, airport and planes.

10.5 Conclusion

Through the evaluation sessions with users and stakeholders, a wide range of insights are gathered. From the different evaluation sessions, it became clear to what extend the concept addresses the user and stakeholder needs and wishes.

Finally, the insights lead to a set of five main recommendations for the concept: create confidence with time, balance guidance, take support one step further, keep an eye on sustainability and finally make use of existing infrastructure and services. These recommendations are used to redesign the final concept and create the final design.

10.5

11

In this chapter

A service design vision for air-rail journeys: The AirRail Alliance

The concept is redesigned based upon the user and stakeholder evaluation and developed into the final design: The AirRail Alliance. Which is a service design vision for air-rail journeys, that combines international trains and long distance flights, that transfer at Schiphol airport.

This chapter discusses the service design vision in detail. First, the desired customer journey summarizes and visualizes the service. This is followed by a detailed explanation of the different vision components with corresponding service touchpoints. The user experience is illustrated by an user scenario. In addition, the implementation of the service is discussed according to a strategic roadmap. The final design is evaluated with mobility partners of the Seamless Personal Mobility Lab. Finally, conclusions are drawn.

11.1 The AirRail Alliance

The design vision describes how international trains and flights could be combined on a service level, to address the needs of the international air-rail travellers.

The service is called the AirRail Alliance, since the collaboration between air and rail is fundamental for the service. Consequently, the traveller experiences this strong collaboration in the feeling of a coherent and unified journey. The traveller should feel that nothing can go wrong, they should feel assured. Ultimately, air-rail travellers should be stimulated to choose for air-rail journeys instead of multi-leg flights.

The service design vision consist of five components, see figure 11.1. Each of which represents a main aspect of the future air-rail journey, which consists of multiple service touchpoints.

The first component is a fair choice. This focuses on making the decision process between travel options more fair. It aims to make the air-rail option appear as attractive and competitive compared to flights. Continuous guidance is the second component. This guides the air-rail travellers through the journey, by making clear what travellers should do and what is going to happen next. The third element is a confident and comfortable transfer. This focuses on creating a transfer that is enjoyable and that makes travellers feel assured. A coherent service is the fourth element. This element aims to unify the rail and air services and make them appear as a whole. The Final element is multi-modal disruption care. This element focusses on handling and managing delays and disruptions. Which will make travellers feel supported and never left to their own devices.

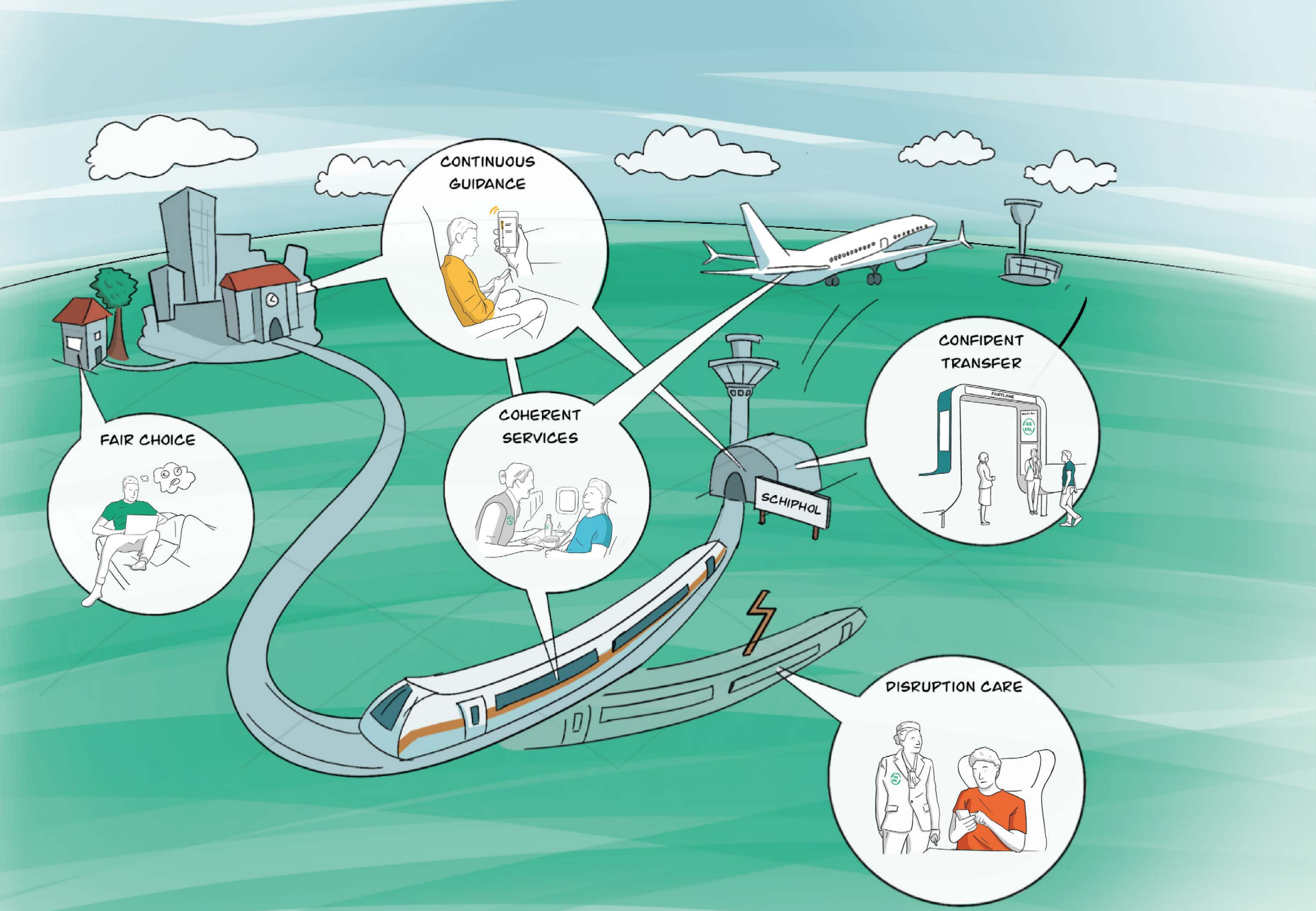


Figure 11.1 Overview of the five components of the AirRail Alliance.

11.2 Desired customer journey

A desired customer journey is created to visualize and capture the future air-rail service. It creates overview of how the components and their service touchpoints are integrated in the customer journey. This is visualized in figure 11.2.

Phase	Orientating	Booking	Preparing	Departing	Travelling by train
Activities	• I easily compare options based on door to door travel time, costs and environmental impact due to an overview of the available options.	• I am confident to choose for a multimodal trip by insight in the steps, timing, service and support. • I book the journey from door to door, including luggage service and one ticket. • I adjust the transfer time to my preferences.	• I prepare for the journey, I find all my travel info at one place.	• I receive real time travel info about the journey, steps and timing. • I get a notification when I have to leave. • Drop luggage at the train station.	• I feel like my journey has started with the air-rail services in the train. • I receive food and can use the AirRail entertainment platform.
Service touchpoints	Tripscanner Insight in benefits & steps	Choose transfer time Choose Luggage service	Receive one ticket	trip overview & status Track & Trace	Continuous service, food and entertainment
Needs	Overview Informed Prepared	Control Efficiency Flexibility	Efficiency Certainty	Informed Certainty Guidance	Comfort Unwind Safety

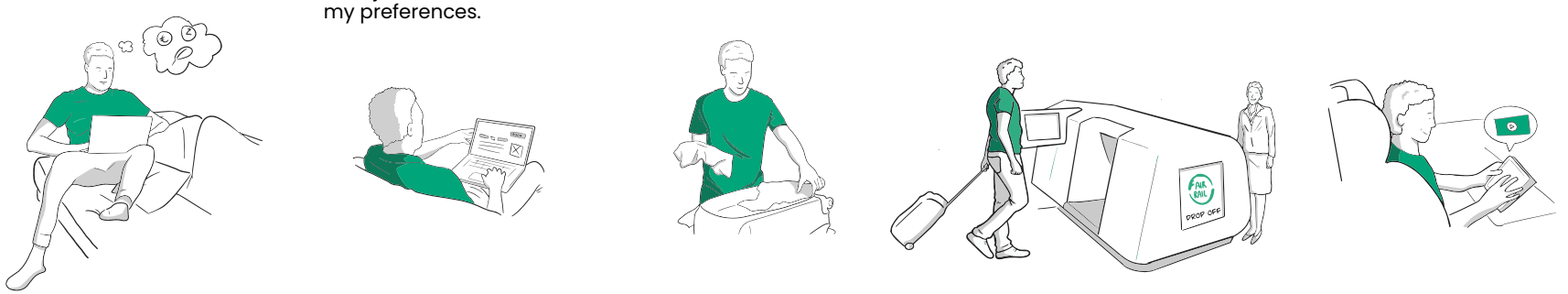
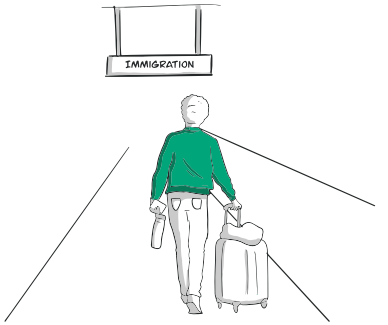


Figure 11.2 Desired customer journey with the AirRail Alliance.

DIsruption	Transferring		Travelling by plane	Arriving
• I am automatically rebook ed on the next flight or I can arrange it myself via the app. • I can call the helpdesk or ask someone in the train. • I feel guided through the proces.	• I prepared myself already in the train with the video. I follow the air-rail signs to the fastlane. • I enter the terminal via the fastlane.	• I go to the lounge and drink a coffee before my flight. • I receive a reminder that it's time to go and I navigate to the gate. • I board the plane.	• I am notified that my luggage is also on the plane. • I continue my movie.	• I arrive at the final destination. • I reclaim my luggage at the drop off (or receive it at my hotel). • I am ready to enjoy my trip.
				


Pro-active rebooking


Empowered staff & helpline


Alternative route


Transfer video


AirRail Fastlane


Acces to lounges


Notify Track&Trace


Continuous service, food and entertainment


Luggage pick up or delivery

Support	Guidance	Efficiency	Informed	Efficiency
Certainty	Prepared	Comfort	Unwind	Control
Control	Clearness	Unwind	Certainty	Safety

11.3 Vision components

The following section discusses the components in detail. Every component is introduced and the corresponding service touchpoints are described. Additionally, the way in which component addresses current pains, fulfils the needs of the travellers and how this fits with the personas is discussed.

Figure 11.3 visualizes the vision components. The pain the component is based upon is shown, followed by the corresponding touchpoints that contribute to the vision element. This element causes gains for travellers. Ultimately, the vision element contributes to aspect(s) of the design goal.

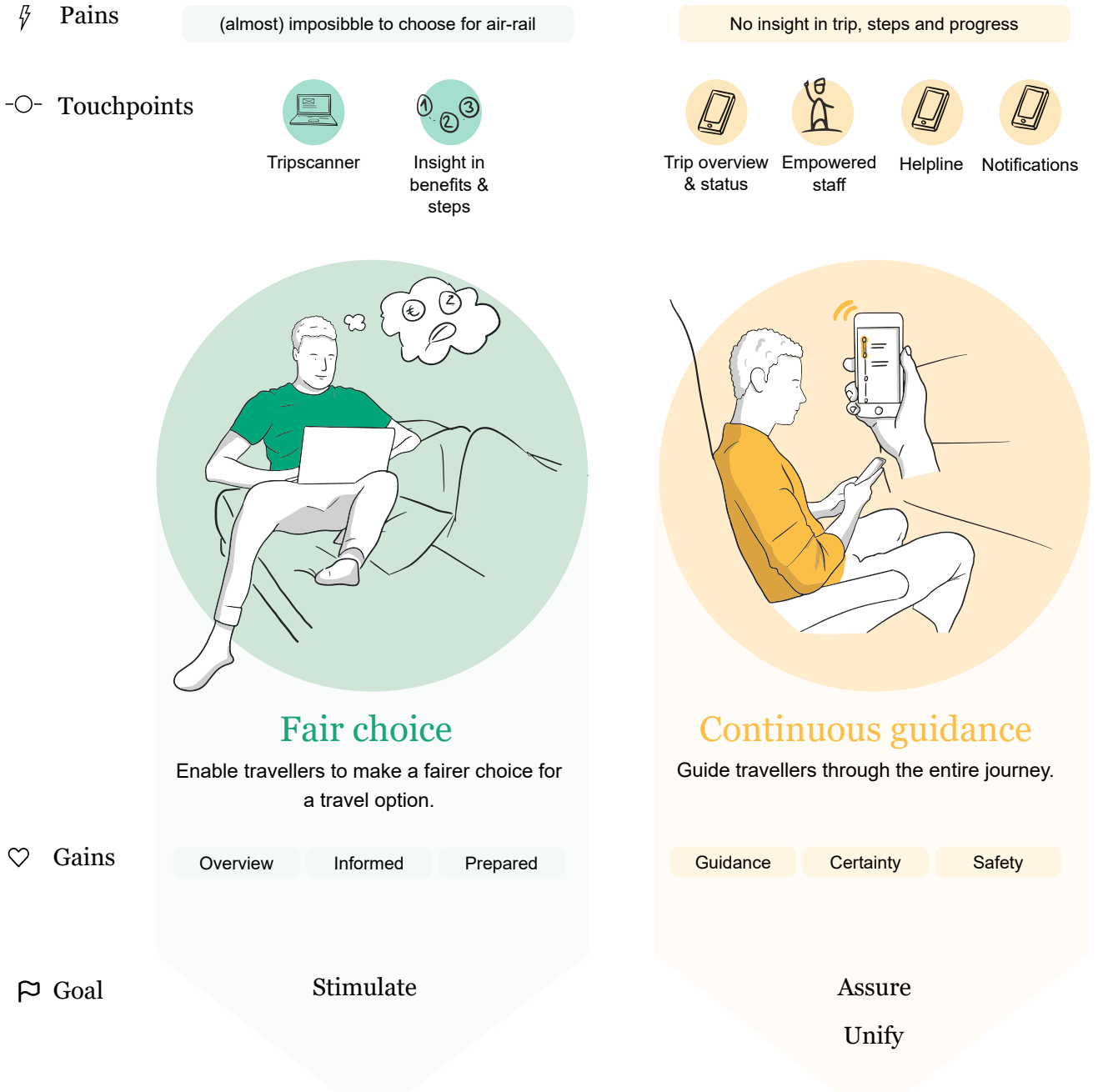


Figure 11.3 Overview of the vision components of the AirRail Alliance.

Little integration and incoherent services

Luggage integration | Ticket integration | AirRail branding | Food & entertainment

Coherent services

Integration of the services of the train and plane.

Comfort | Unwind | Certainty

Assure

Unify

Hassle and no insight in steps and progress

Transfer time choice | Video & insight steps | Fastlane | Lounges

Confident transfer

A confident and comfortable transfer between the train and plane.

Comfort | Prepared | Flexibility

Assure

Stimulate

No integrated management and support

Empowered staff | Helpline | Emergency alternatives | Pro-active management

Disruption care

Multi-modal disruption care in case of delays.

Support | Certainty | Safety

Control | Autonomy

Assure

Unify

11.3.1 Fair Choice

The fair choice component aims to enable travellers to make a fair choice between air-rail journeys and multi-leg flights, by creating a balanced and fair overview of available travel options. As such, the goal is to make air-rail journeys appear as competitive and attractive, while orientating and booking tickets for a trip. An integrated booking platform is created in which travel options are presented based upon door to door travel time, total costs and environmental impact. The benefits of air-rail options are made clear already during orientating on travel options. Ultimately, fair choice aims to stimulate international travellers to choose for the air-rail option.

Pains

Currently, booking platforms barely integrate trains and planes, therefore there is a lack of overview of travel options and comparable information. International trains and air-rail journeys appear less attractive, since the travel options are compared based on transport time and transport costs instead of door-to-door travel time and costs. Travellers have no insight in the environmental impact of the travel options. On top of that, travellers experience stress and uncertainty about the air-rail option, since it is unclear how the trip is organized, how the transfer works and if all important elements are included.

Gains

Travellers have a clear overview of the travel options because of the integrated platform. Travellers can compare travel options more fairly because of the comparison based upon door to door travel times, costs and environmental impact. Travellers feel informed and prepared for the trip because of insights in the steps. Travellers feel less anxiety about the trip and feel assured that the air-rail journey will work out. The personas that benefit the most of the fair choice are the certainty seeker and the determined survivor.

Certainty seeker

Informed

Prepared

"This is good to know because it depends on each airport. They are always different, in each country, each kind of travel national and international, you have different steps. And especially for such new options of a train and a flight. So that's good to have a clear view, makes you feel ready for it."

– English traveller, certainty seeker.

Determined survivor

Overview

Efficieny

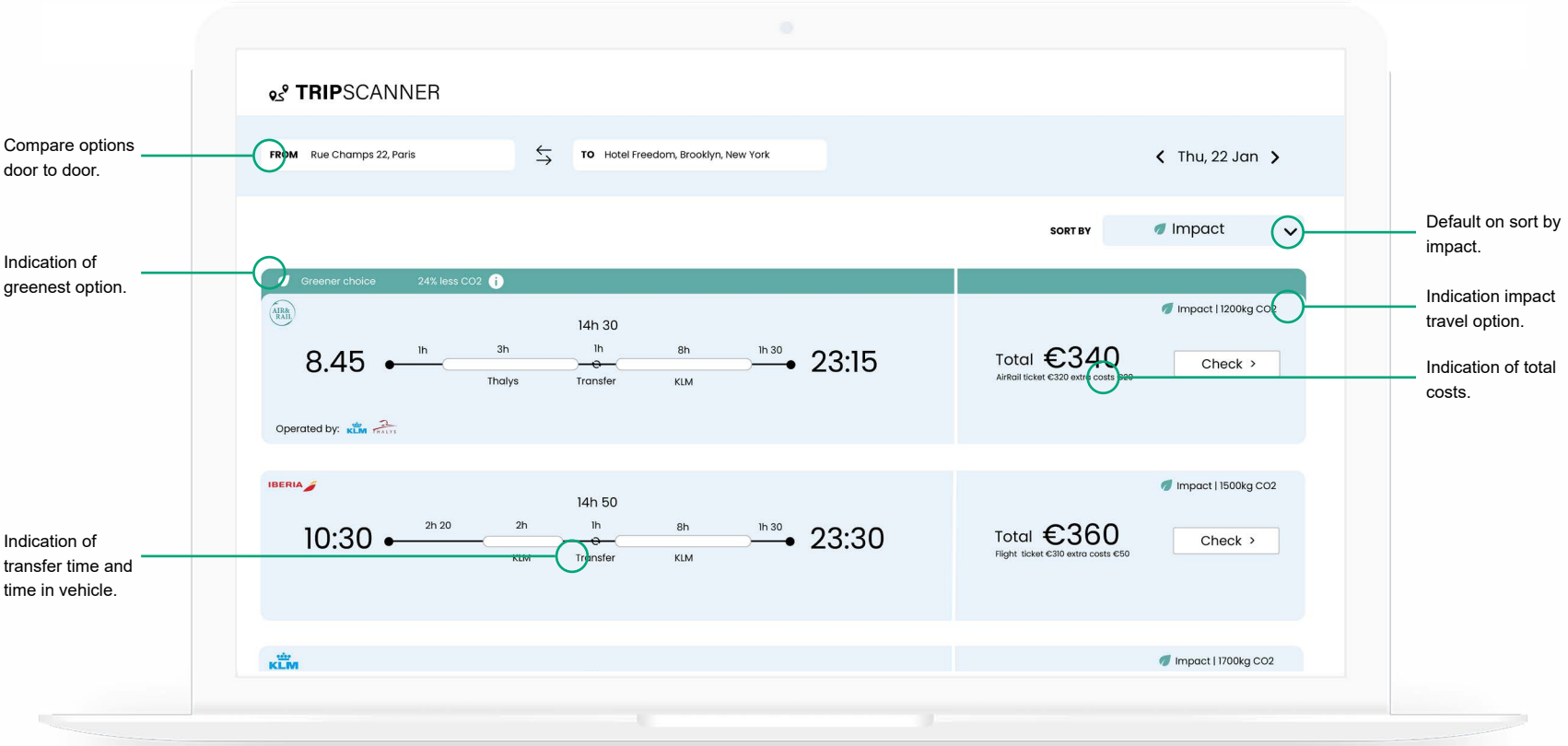
"I think that in itself is quite nice. It is always a bit of disguised travel time what it contains. Just like flying cheaper from an airport far away. Then you are on the road for 4 hours extra, you don't see that clearly when you compare options. In this way, you can compare on what they will mean for your trip in terms of time and costs."

– Belgium traveller, determined survivor

Service touchpoints

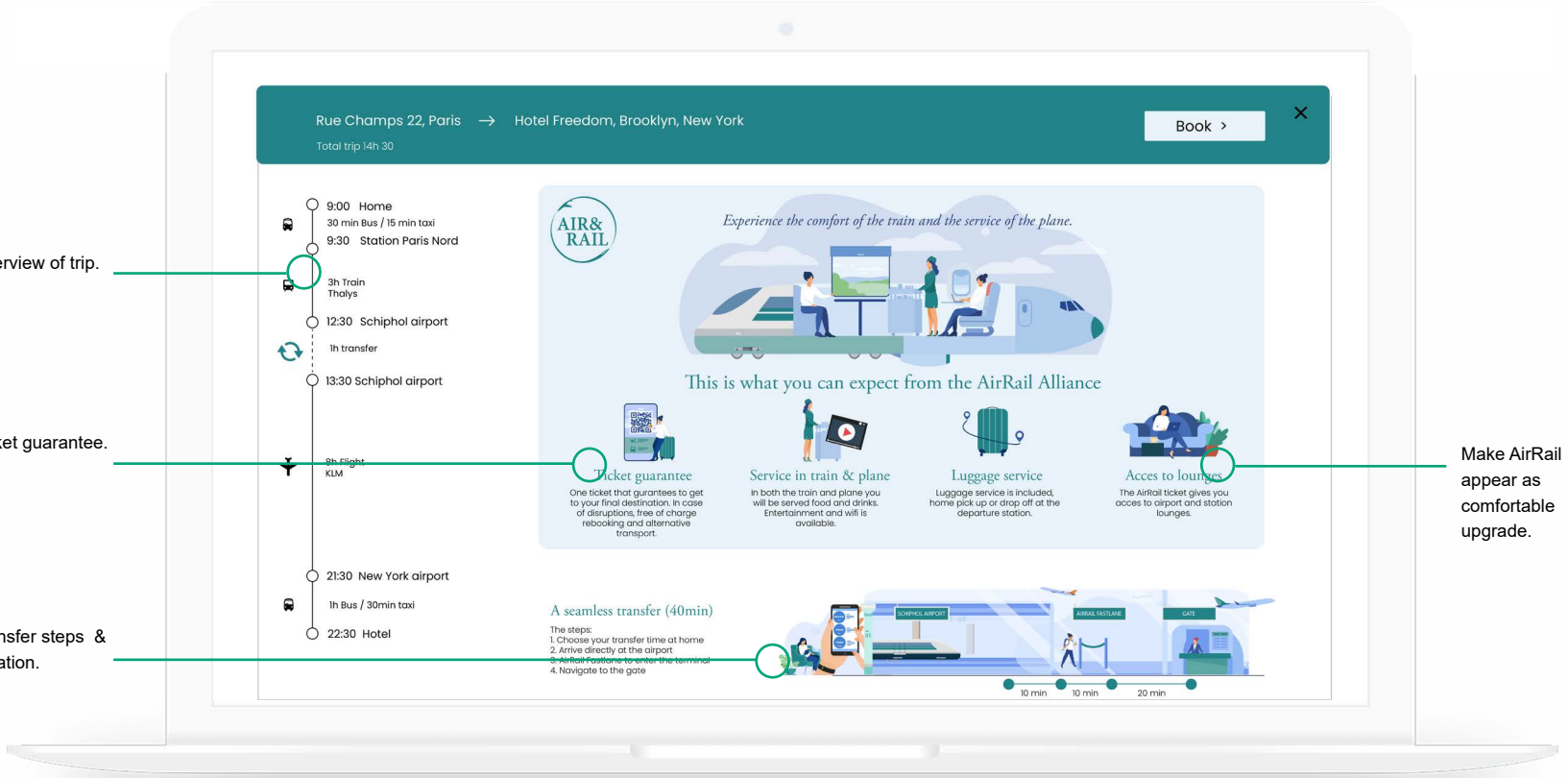
Tripscanner

Tripscanner is a booking platform that integrates international trains and flights. Travellers can compare options based upon door-to-door travel time costs and environmental impact. To make the impact stand out even more, the most sustainable option is marked as ‘greenest option’. The default of the searching tool is set on sorting by impact. The distinction between air and rail should decrease and the traveller should become more aware of the environmental impact of travel options.



Insight in benefits & steps

This service element aims to make air-rail appear as an upgrade and a comfortable travel option. It shows that air-rail combines the benefits of both the train and plane. Travellers become aware that all important aspects are included, like luggage and one ticket. Service like food and entertainment is available in both parts of the journey. Additionally, it shows air-rail that the journey includes access to lounges at the train station and airport. It indicates how a transfer with the AirRail Alliance works, in terms of steps and timing. Finally, it emphasises that the traveller is guaranteed to arrive at their final destination. In case of disruptions, alternative transportation will be included in the ticket.



Overview of trip.

Ticket guarantee.

Transfer steps & duration.

Make AirRail appear as comfortable upgrade.

11.3.2 Continuous Guidance

Continuous guidance aims to create guidance throughout the entire journey, in both the international train and flight. The traveller is guided through every step as if there is a virtual travel assistance. The traveller has access to all available information about the international train and the flight at every moment in the journey. Notifications about important information and changes in the journey support and guide the traveller. Staff is available throughout the journey to provide guidance. Ultimately, travellers feel assured through the guidance and experience the journey as a whole, a unified journey.

Pains

Currently, travellers experience a lack of overview of the steps and durations of the steps during the journey. Travellers feel anxiety to arrive on time, especially because of little insight in the duration of ques. Travellers worry about the safety of their luggage. Travellers have difficulties with orientating and finding places, especially when it is crowded. Finally, travellers experience little guidance and support because of unclear responsibilities of staff.

Gains

The different service touchpoints create insight in steps, duration and possible changes. Travellers know what to do, where to go and how long steps will take. This creates assurance. Additionally, travellers feel more assured because of buffers. Since mistakes will not immediately ruin the entire journey. The staff and helpline create the possibility to ask for help throughout the entire journey. Travellers feel more confident about their luggage because of track and trace and notifications.The personas that benefit the most of continuous guidance are the vulnerable rookie and the certainty seeker.

Vulnerable rookie

Guidance | Safety

''It's very convenient and it's hard to make a mistake. To be at the wrong place or at the wrong time, it's almost impossible to forget something. It can happen of course, but with the little reminders, it really makes you at ease I think. So if you forget, you will be reminded. It makes you feel that they care about you.''

– French traveller, vulnerable rookie

Certainty seeker

Certainty | Informed

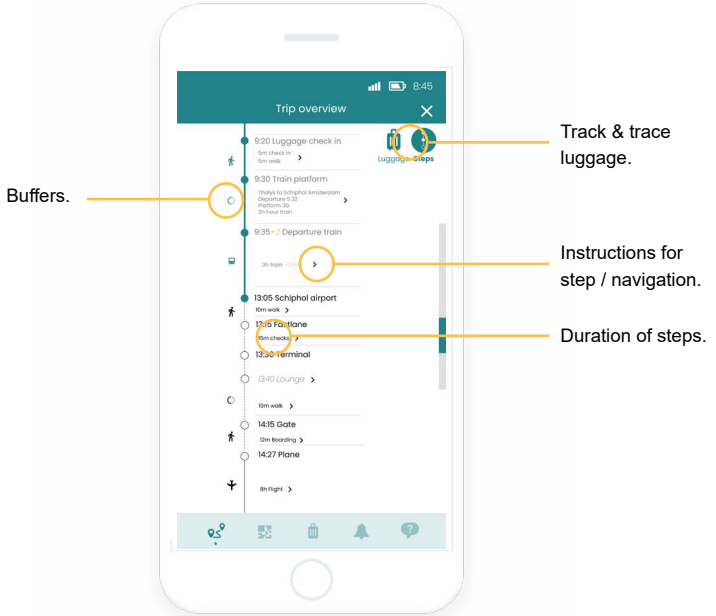
"That is fantastic, so you know each little point it is going through. It makes you feel more confident. I lot of big worry is when you have big luggage if it's going to arrive where you need to be or that you are without luggage a certain amount of time."

– Belgium traveller, determined survivor

Service touchpoints

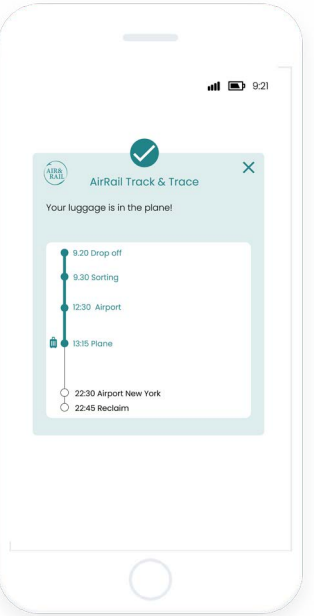
Trip overview & status

The trip overview creates insight in the journey steps and timing. It uses real time data to show the exact durations of steps, for example the waiting time at the security or the gate. It contains instructions to navigate, information about platforms and instructions for steps like the luggage check in. It contains buffers between steps, to avoid that mistakes will ruin the entire planning. Finally, it contains track and trace which shows locations and times of the checked in luggage.



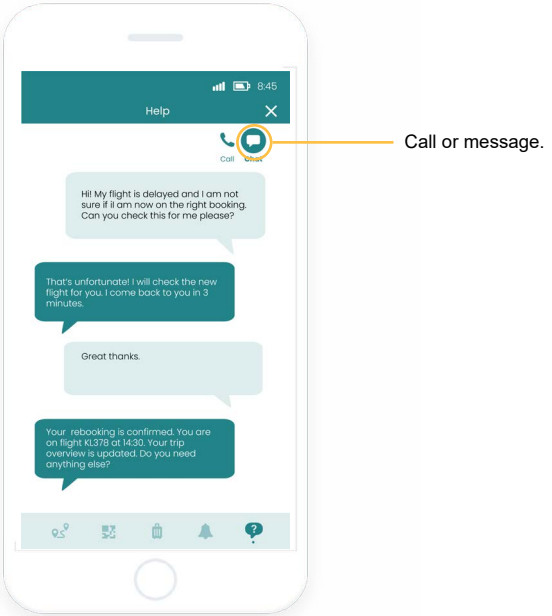
Notifications

Notifications remind travellers, mainly about timing and luggage. Since this is very personal, travellers can adjust this to their needs by setting preferences.



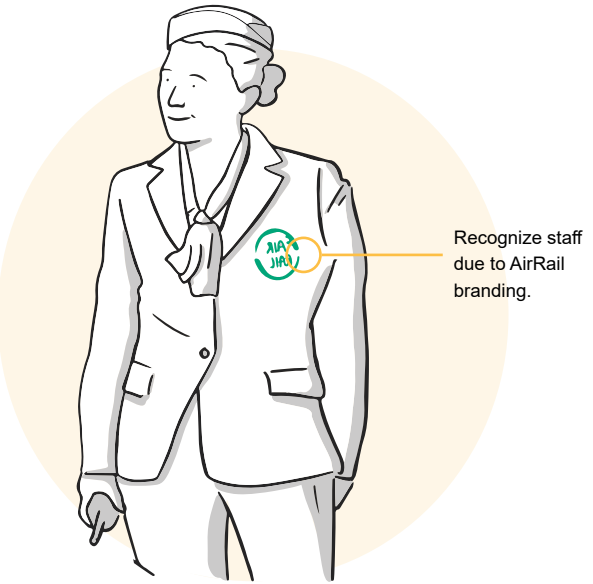
Helpline

Travellers have access to an AirRail helpline via their phone,. Travellers can chat or call with staff at the service desk. The service desk can help travellers in case of problems or disruptions during their journey.



Empowered staff

Staff is informed and empowered to guide air-rail travellers throughout the journey. Staff is available for support and questions at the train station, train, airport and plane. The staff is recognizable by AirRail Alliance branding.



11.3.3 Coherent Services

The AirRail Alliance aims to provide air-rail travellers with a coherent service. The services of the international train and plane are integrated; aspects as the luggage handling, ticketing and food services. The service communicates one strong brand. Consequently, the air-rail traveller experiences the journey with the AirRail Alliance as unified.

Pains

Currently, travellers experience the journey as incoherent. Travellers feel uncertain as the two parts are not connected well. Travellers experience hassle because they have to take extra steps in the journey like checking in for both modalities and checking in luggage during the transfer. Travellers experience anxiety up untill the transfer, since only after the check in moment they can really relax. Furthermore, travellers are annoyed by carrying heavy luggage, little space for luggage in the train and the lack of safety of their luggage. On top of that, travellers feel uncertain about the trip because they are not provided with a guarantee for an alternative in case of disruptions. This is because the tickets are not integrated.

Gains

Travellers experience more comfort with the service, because the luggage, food and entertainment is integrated. Travellers feel that their journey starts when entering the train. Because of this the traveller feels more relaxed and the transfer is smoother, since the important checks are already fixed by that time. Travellers feel more confident about the journey, because the unified journey indicates a strong collaboration between the train operator and the airline. Ultimately, it indicates that the train and plane work together to support the traveller. The personas that benefit the most of coherent services are the certainty seeker and the peaceful collaborator.

Certainty seeker

Prepared | Certainty

"It kind of gives me the feeling of being in an airplane and also sort of travelling, that it's happening. How it happens in flights, like the journey has begun. You don't feel the stress anymore of the things that you need to fix, like checking in your luggage."

– English traveller, certainty seeker.

Peaceful collaborator

Comfort | Unwind

"So when I take my luggage on the train I have to take care of it, get it into the airport and still check it in. Since it is international travel I probably have a large suitcase. I don't want to carry it on the train. I don't want to worry about it 3 hours. I just want to get it out of my mind as soon as possible."

– Belgium traveller, peaceful collaborator

Service touchpoints

Ticket integration

The AirRail Alliance provides an integrated ticket. The ticket for the international train and the flight is one ticket with one QR code. The traveller can check in for both the train and plane at the start of the journey.

Luggage integration

Travellers can choose for a luggage service. They can either choose the door to door service, in this case the service picks up the luggage at home and delivers it at the final destination. Another option is that the traveller drop off the luggage at the departing train station and pick it up at the arrival airport. Travellers can also choose to not use the luggage service.

AirRail branding

AirRail Alliance branding is visible and continuous throughout the journey. Branding will be present on screens in both the train and plane. Travellers can recognize staff as part of the alliance. They can also recognize elements like the fastlane and lounge by cues as ‘supported by the AirRail Alliance’.

Food & entertainment

The traveller receives continuous service of food and entertainment throughout the journey. Travellers receive food and drinks in both the train and plane which is identified as part of the AirRail Alliance. Additionally, they have access to the AirRail Alliance entertainment system in both the train and the plane, to watch movies or read newspapers and magazines.

11.3.4 Confident Transfer

The transfer between the international train and plane is crucial to make the air-rail journey successful. The goal is to make this process as comfortable as possible. In addition, travellers should feel confident. Travellers can prepare for the transfer and are guided through the process. Travellers can spend their waiting time comfortably and can easily and quickly enter the terminal.

Pains

Currently travellers experience little insight in transfer steps, what to do and where to go. Besides travellers have little insight in timing and duration of the steps of the transfer. Consequently, travellers feel insecure about the transfer. Travellers have doubts about the timing of the transfer already in the first stage of the journey, while orientating on travel options. Furthermore, travellers experience stress before and during the transfer. This mainly occurs when there are long ques at checks and there is little insight in the duration of the que. In the end, travellers feel stressed because they do not want to miss their connection.

Gains

Travellers feel informed and prepared for the trip, by insight in the steps and timing of the transfer. Travellers feel less anxiety about the transfer. The video informs and guides travellers through the transfer process. Travellers feel in control and are able to tailor the transfer to their needs, by choosing the transfer time themselves. Travellers experience more confidence, because being able to extend the transfer time allows them to have extra buffer time.Travellers enter the terminal quickly and experience shorter waiting times. Consequently, the transfer feels more efficient. In addition, travellers experience wating times more comfortably by having access to lounges. Ultimately, travellers feel more confident and comfortable and are stimulated to choose for air-rail. The personas that benefit the most of confident transfer are the certainty seeker, peaceful collaborator and spontanuous adverturer.

Certainty seeker

Informed

Prepared

''I want to see it. Because a video is always good to see where I should go and the instructions are more clear than just text. […] And the fastlane is really good service, I would give me confidence that I wouldn't get stuck in the que. I would like feel like VIP. ''

– English traveller, certainty seeker.

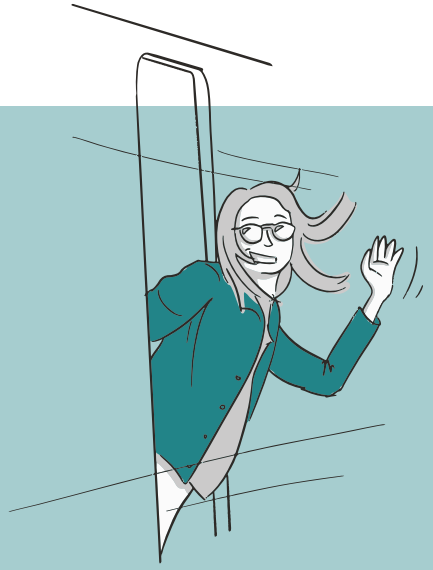
Peaceful collaborator

Comfort

Unwind

''At first I would book with as little time as possible, but what if you asked me 'do you want to hurry up or do you want to take it easy?', if you put it like that, I think 'oh, I actually want to take it easy.' ''

– Belgium traveller, peaceful collaborator



Spontaneous adventurer

Flexibility

''I would choose the flexible option. That is the whole point of the train, that it feels more flexible than the plane. So, it would be great to be able to depart when you want and use the transfer how you want it. You might use it to visit some friends in Amsterdam or just go out for a couple of hours. ''

– German traveller, spontaneous adventurer

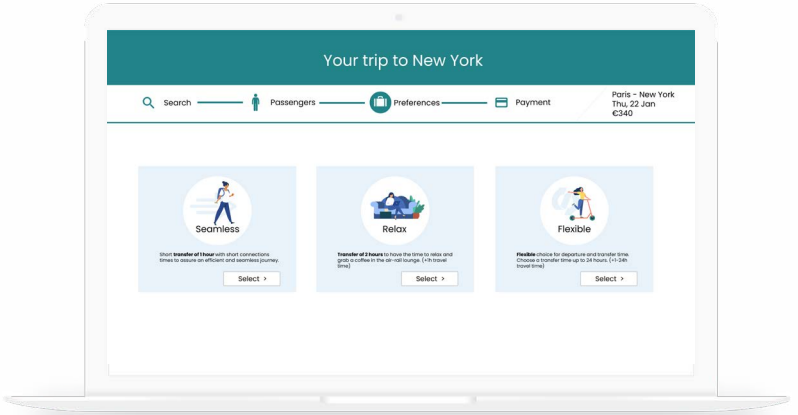
Service touchpoints

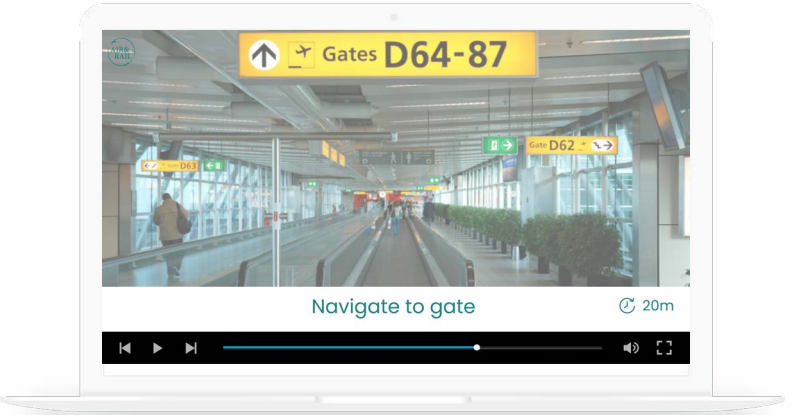
Transfer time choice

Travellers can choose the transfer time while booking an air-rail ticket. They can make a choice between three options: a seamless transfer of one hour, a relaxed transfer of two hours and a flexible transfer up to 24 hours. Travellers can use the transfer as a stopover with the flexible option.

Transfer details & video

The steps of the journey and specifically the transfer are made clear while the traveller orientates on travel options. Travellers also see an indication of the duration of the steps.
Just before arriving at the airport, travellers receive a video explaining the transfer. The video contains information about navigation, duration of steps and important checkpoints.





Fastlane

Travellers can enter the terminal via an AirRail fastlane. This fastlane provide travellers with quick passport and security checks to effectuate short connection times. This creates a seamless transfer.

Lounges

Travellers have access to lounges in both the train station and the airport. These lounges provide air-rail travellers with a comfortable place to spend their waiting time. Supplementary the lounges provide drinks, bites and entertainment. This is especially valuable when disruption leads to long delays.

11.3.5 Disruption Care

Disruptions are unavoidable. However, it is crucial that travellers receive support during these moments. Disruptions should be managed well and handled with care. Multi-modal disruption care aims to provide disruption support throughout the entire journey. Travellers feel supported by integration of disruption management of the train and the plane. Travellers are constantly supported and never left to their own devices.

Pains

Currently air-rail travellers experience little support or help, especially at train stations or within international trains. Help and support is not integrated well, it does not cover both the train and plane. Travellers need to rebook tickets themselves in case of disruptions. On top of that, travellers receive no alternatives in case of serious delays. Consequently, travellers feel uncertain about what will happen if a delay occurs.

Gains

Travellers become aware of support and disruption management while orientating. Consequently, travellers feel less anxious about delays. Travellers have access to support during the entire journey by support via staff and the app or they can solve disruptions themselves by the helpline and insight in alternatives. As a result, travellers feel in control and autonomous. In addition, because of emergency alternatives, travellers feel assured that they will reach their final destination. Ultimately travellers experience the service as coherent and supportive, by integration in disruption management between the train and plane.The personas that benefit the most of disruption care are the vulnerable rookie, self-sufficient manager and the certainty.

Vulnerable rookie

Support | Safety

''Also if the staff would be all air-rail staff throughout. I know the airline is different and the train is from a different company, but they would have that one thing throughout the journey, that would make me feel supported. ''

– French traveller, vulnerable rookie

Self-sufficient manager

Control | Autonomy

''I prefer to have live chat. I can go into live chat, the person who I will chat with knows everything about my flight. Then I can ask what I want, but fix it myself. Since, if you have like 20 people coming to the staff when there is a delay. It would annoy them. ''

– Indian traveller, self-sufficient manager

Certainty seeker

Certainty | Informed

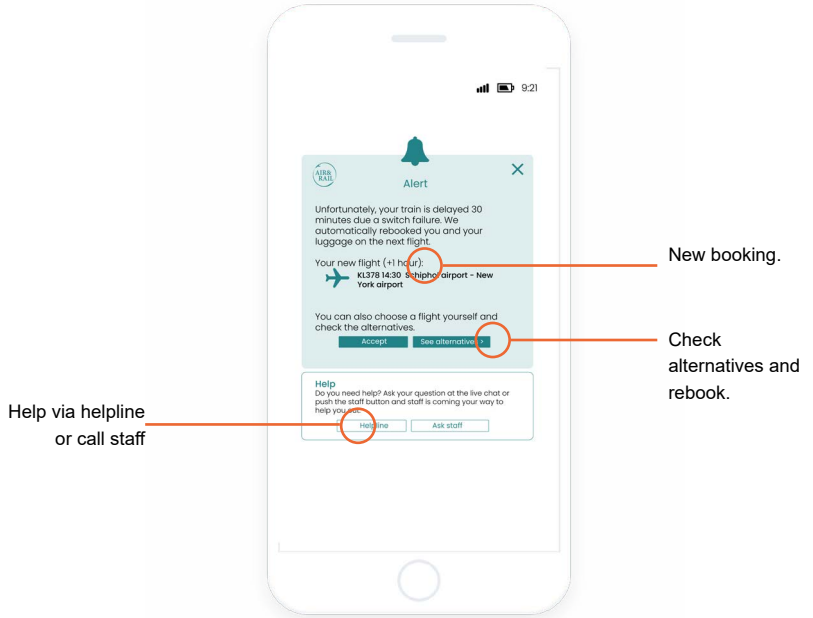
''Because an emergency transport car would pick me up if something doesn't work out. That helps a lot actually to be more at ease with the booking. Also with travelling then. The morning of the travel that you know that there is a backup. ''

– English traveller, certainty seeker

Service touchpoints

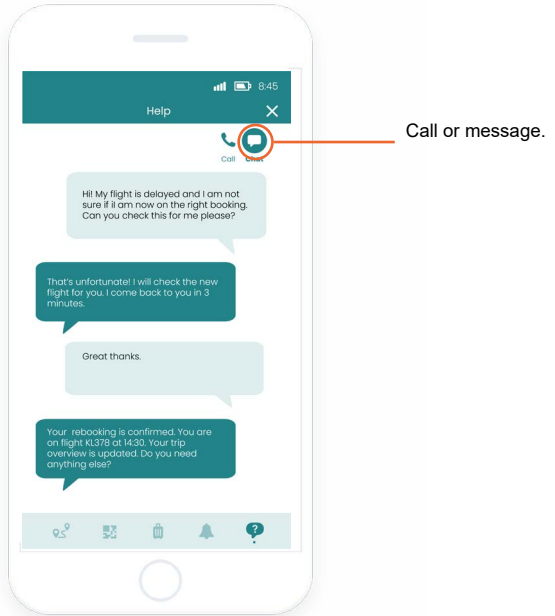
Pro-active disruption management

In case of a disruption, travellers are automatically rebooked on the next available flight and they are updated about this change. Travellers can accept this or have insight in alternatives and do the rebooking themselves



Helpline

Travellers have access to an AirRail helpline through their phone,. Travellers can chat or call with staff at the service desk. The service desk can help travellers in case of problems or disruptions during their journey.



Empowered staff

Staff of the train operators and airlines are informed and empowered to help air-rail travellers with questions especially during disruptions. The staff is present at train stations, trains, the airport and the plane. The staff has access to the system and can check travel schemes and the booking of the traveller. Consequently, staff is able to help out in case of disruptions by answering questions or assist with rebooking.

Emergency alternatives

In case of serious delays, emergency alternatives are provided to the traveller. This means that the traveller could travel via another airport or with another train. In this way, the traveller is still able to reach the final destination. This service is already offered while booking the AirRail Alliance ticket in the form of a ticket guarantee.

11.4 The current versus the desired situation

A service design vision is created to overcome the barriers users experience within air-rail journeys and tailor it to the needs of the international air-rail traveller. Each of the vision components contributes to overcome these barriers. The current and desired situation is visualized in figure 11.4, to create an overview of how the barriers of the current air-rail journey are addressed by the components of the AirRail Alliance. In this section, the current situation versus the desired situation with components of the AirRail Alliance is explained.

Fair choice

Currently, it is almost impossible to choose for air-rail, because of the lack of overview of travel options and there is no ticket and booking integration. On top of that, trains and air-rail journeys appear less attractive because platforms are based on vehicle times. Finally, travellers have no insight in the environmental impact of their journey, which makes it hard for them to take sustainability into account.

The AirRail Alliance gives travellers an overview of the travel options. The ticketing and booking is integrated and travellers can compare options based on total travel time, costs and environmental impact. This enables travellers to make a fair choice.

Continuous guidance

In the current journey, travellers have little to no insight in the steps and progress of the air-rail journey. Travellers feel anxious about the trip because they have no clear view of the process.

The AirRail Alliance facilitates integrated trip details and status. Travellers have insight in what happens and what is going to happen in their air-rail journey because of this overview. This makes travellers feel more assured.

Coherent services

In the current journey, the service lacks integration and is incoherent.

Ticketing, luggage, food, entertainment and support are all separate services. This creates annoyance about carrying and safety of luggage and checking in multiple times. Travellers experience unclear responsibilities, resulting in confusion about where to address their questions.
With the AirRail Alliance, ticketing, luggage, food, entertainment and branding are integrated. The responsibilities are more clear. Travellers feel that there is always someone out there to provide help and support.

Confident Transfer

In the current situation travellers experience the transfer as a hassle due to luggage, checks and waiting time. Additionally, travellers worry and feel anxious about the transfer because they have little insight in the steps and progress of the transfer.

With the AirRail Alliance, travellers can choose their transfer time, prepare themselves with a video, and seamlessly transfer with the fastlane. Eventually, travellers experience more comfort while waiting because of the access to station and airport lounges.

Multi-modal disruption care

Currently, disruption management is not integrated in the journey and the service provides little support during delays or disruptions. This makes travellers feel anxious about delays. Travellers feel left to their own devices during a delay.

The AirRail alliance integrates disruption management. Support is always close because of pro-active rebooking, alternative routes, empowered staff and a helpline. Travellers feel more assured about disruptions and are ensured to get to their final destination.

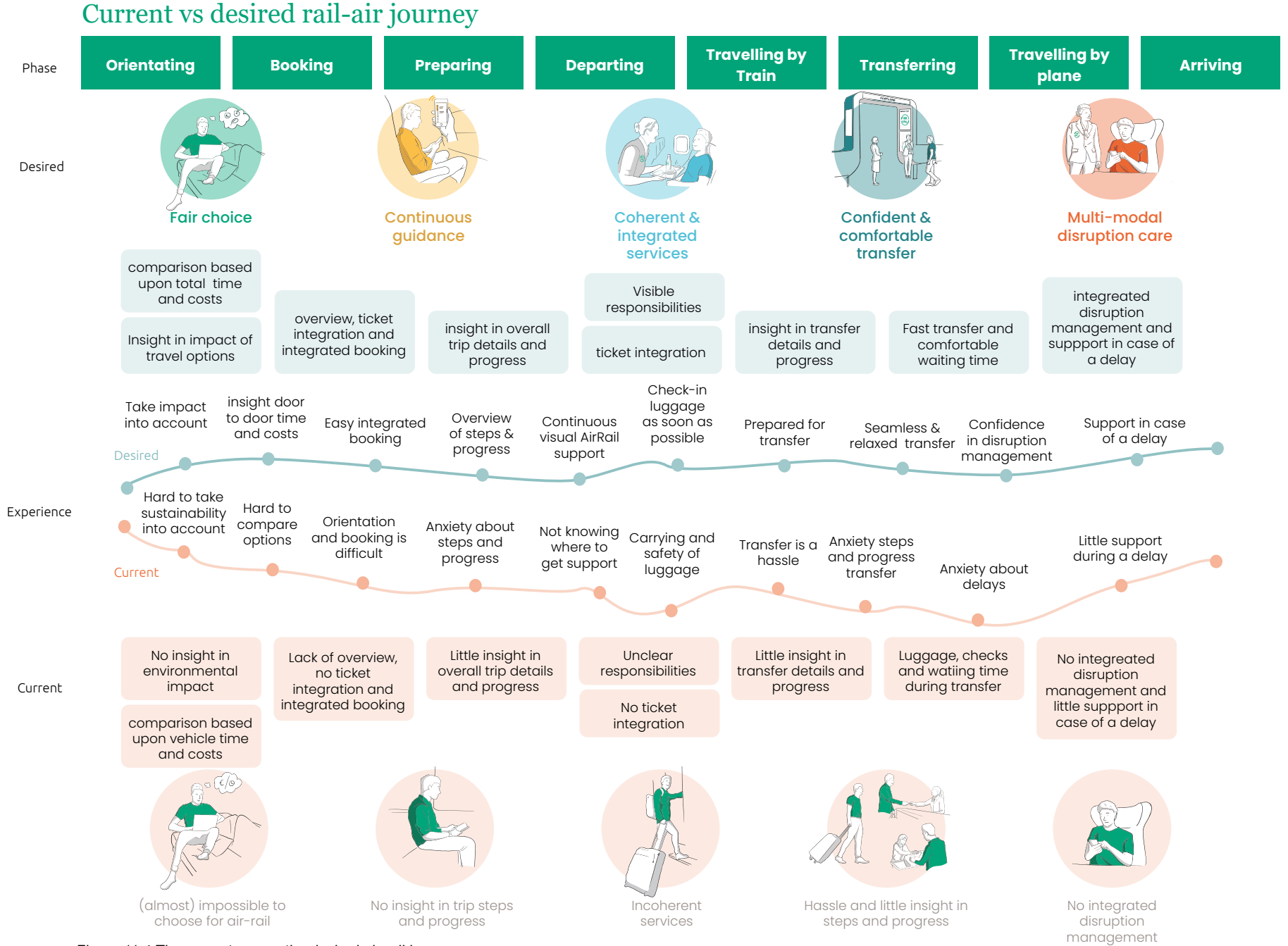
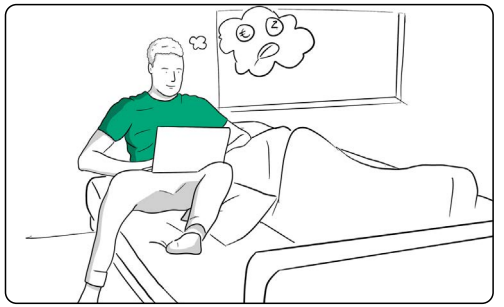


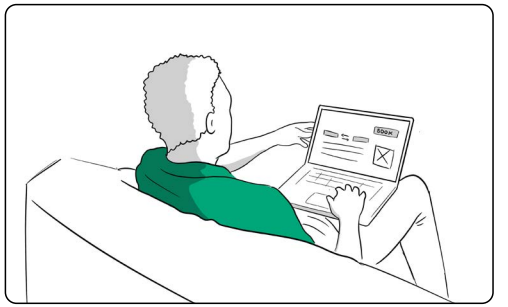
Figure 11.4 The current versus the desired air-rail journey.

11.5 Scenario

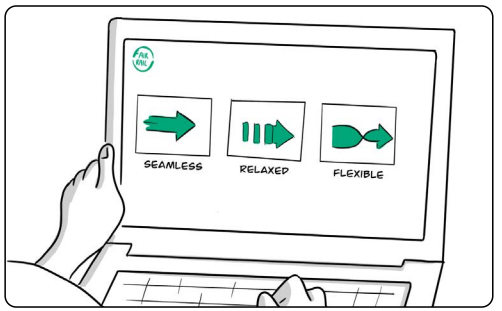
The experience with the AirRail Alliance is visualized in a scenario.(Interaction Design Foundation, 2020). This scenario tells as story of how travellers could interact with the service.



Tim lives in Paris and is planning a trip to New York. He checks Tripscanner for the available travel options. Here he can easily compare options based on total travel time, costs and environmental impact.

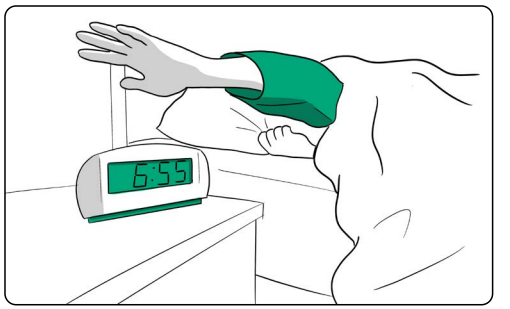


He checks out an AirRail Alliance option via Schiphol. He feels confident to choose for trip after checking the steps, timing, service and support. He feels like AirRail an upgrade with the fastlane and lounge acces.

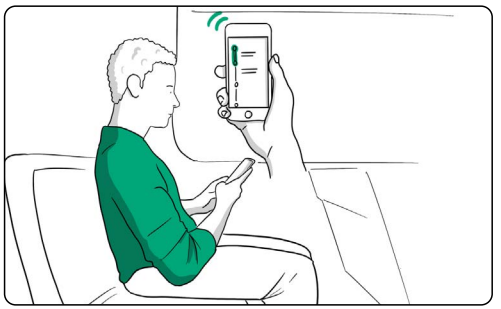


While booking, Tim chooses the transfer time. He picks the relaxed option, since he likes to hang around the airport for a bit and drink a coffee. Most importantly he wants to take it easy and be sure he won't miss his flight.

It's a couple days before the trip and Tim receives a notification to check in for his trip. He easiliy checks in via the app for the whole journey. After this, he receives one QR code he can use during the trip for the train and plane.



Departure day! It's early in the morning and Tim gets up and ready for his trip to New York.



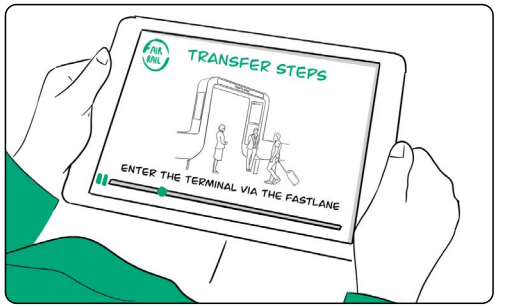
While sitting in the bus to the train station, Tim checks the trip details and status on the app. He sees what steps he needs to take next and at which platform his train to Schiphol will depart.

Tim arrived at the train station and navigates to the luggage drop off. Here he can easily check in his luggage for his AirRail trip by himself. When he is done, he feels relieved.

Tim boarded the train and found his seat. Staff of the international train is providing him with breakfast. Now his journey has really begun!

Tim checks the entertainment platform of AirRail. He starts to watch a movie that is just released.

He receives a message that the trains is delayed and that his flight is rebooked. He asks stuff with the AirRail logo if this is correct, the staff checks it for him and confirms.



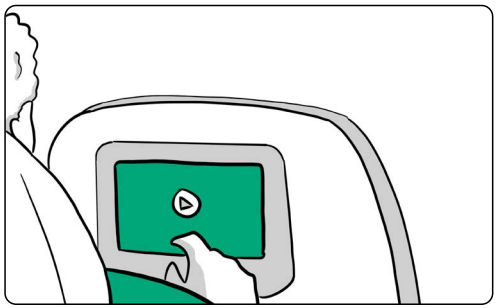
Tim is about to arrive at Schiphol. He receives a notification of the AirRail transfer video. He watches the video which lead him through transfer steps.

At Schiphol, Tim navigates to the fastlane and enters the terminal quickly. He has some spare time so he decides to check out the AirRail Lounge.

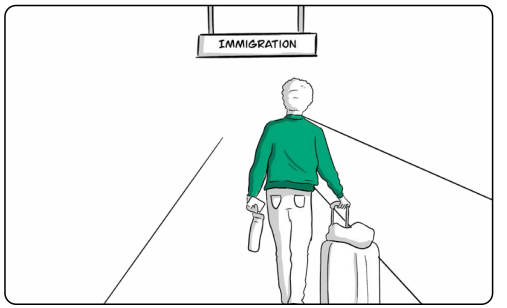
Within the AirRail lounge, he reads his book and enjoys a free coffee. After a while he receives a notification that it's time to go.

Tim boarded the plane and found his seat. He receives a notification of the AirRail track&trace system, his lugagge is also on the plane.

In the plane, he receives his lunch. He feels comfortable and in good hands.



He opens the AirRail entertainment platform and he continues the movie he started in the train.



He arrives at New York airport, collects his bags at the luggage belt and leaves the airport. Time to enjoy New York!

11.6 Implementation

To be able to implement the service, the different elements of the design need to be developed in detail. The design consists of multiple components which cannot all be implemented tomorrow. Therefore, the development and implementation of those components is structured and prioritised. To do this, a strategic roadmap is created (Almqvist, 2018). The roadmap visualises the steps and planning of implementing the AirRail alliance by 2030, see figure 11.5. This creates a clear overview of how the service could be implemented by 2030, to realize the mission of the project: Create air-rail journeys that can compete with air-air journeys, creating an unified and assured air-rail experience, to stimulate travellers to make a more sustainable choice.

11.6.1 Roadmap for implementation of AirRail

The roadmap is separated into three horizons of three years, over a total period of nine years. The AirRail alliance should be fully implemented by the year of 2030. The roadmap is visualized in figure 11.5.

Roadmap elements

The roadmap consists of different elements that can be categorized in four categories.

Service

Service elements of the AirRail Alliance.

User access

Elements that influence the experience of the service for the international air-rail traveller.

Collaboration

Collaboration that is needed between stakeholders to realize the service.

Measures

Measures that have to be taken to realize the service, for example price or policy measures.

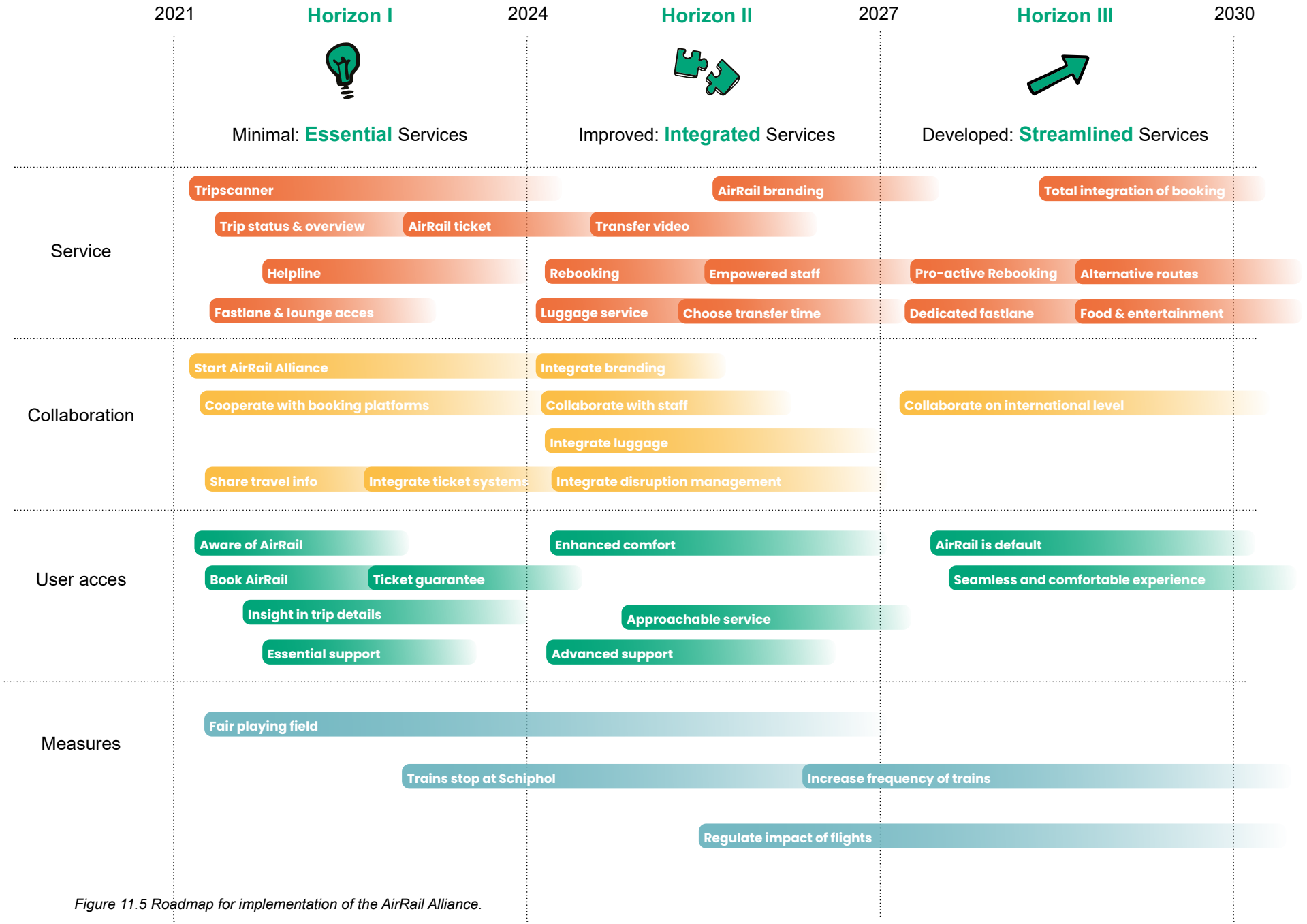


Figure 11.5 Roadmap for implementation of the AirRail Alliance.

Horizon I, Minimal:
Essential services (2024)
Stimulate & Assure

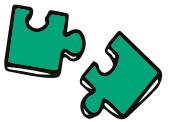
The first horizon is the minimal horizon in which the essential services should be implemented. Most important aspects should be arranged. This horizon is essential, since these aspects determine if AirRail could be an option to consider in the first place.

Travellers should be aware of AirRail and should be able to find and book the AirRail travel option. Travellers are stimulated by enhancing comfort and make AirRail appear like an upgrade due to access to fast lanes and lounges. Essential assurance is provided due to app integration, ticket guarantee, integration of ticketing and minimal support by a helpline.

In terms of collaboration, this horizon asks for making important steps in collaboration between stakeholders. A start has to be made with opening up the system, share travel information and start to integrate systems.

Finally, an important measure is to create attractive pricing. This has to be arranged, since costs is the decisive factor. If not, this could still overrule all other interventions.

Horizon II, Improved:
Integrated services (2027)
Assure & unify



The second horizon is focusing on integration of the air and rail services, to develop the AirRail Alliance to an unified service. Travellers will feel more assured about the trip due to integration of the services.

Luggage, branding and disruption management are integrated to unify the services,. Staff of both rail and air will work together and will get empowered. Due to integration of luggage, the transfer times can become shorter and travellers can start choosing for a seamless transfer. These elements provide travellers with more comfort. Moreover, it could really enhance assurance within the AirRail journey.

In terms of collaboration, this horizon is a challenge. The focus has to be on total integration between the train operators and airlines. Systems have to be put together to integrate disruption management and luggage services. Additionally, empowered staff and AirRail branding asks for willingness to adjust stakeholders' own services.

Measures regarding stops and frequency of trains should be taken. Trains should stop at Schiphol and the frequency of trains should increase to be able to ensure short and seamless transfers.

Horizon III, Developed:
Streamlined services (2030)
Unify

The final horizon is focusing on developing AirRail towards a streamlined service. In this phase, the AirRail service is operating and more and more travellers are going to make the choice for AirRail.

This asks for enhanced infrastructure such as dedicated AirRail fastlane. Additionally, due to optimized integration of systems on a broader scope, proactive rebooking is possible and emergency alternatives can be offered to travellers.

In this phase, trains and planes are totally integrated in the booking platforms, illuminating the differences. For the user this means that AirRail could become the standard and is a total competitive option compared to multi-leg flights.

In terms of collaboration, this asks for a broader collaboration on an EU level, together with different train operators, airports and booking platforms. In the end measures should be taken at this point to regulate the impact of flights, since this is crucial when AirRail increases and flights should be substituted. Additionally, pricing and the network should be optimized to be able to really make AirRail the default.

11.6.2 Main Challenges implementation

During the concept evaluation, the barriers regarding implementation were discussed with stakeholders. Within this section the main insights are discussed.

Competition between stakeholders

The main barriers noticed by the stakeholders were caused by tensions between stakeholders and operational barriers. Tensions or the competitive relation between stakeholders could make it hard to implement several elements that should be present over the whole journey. For instance, the continuous branding could be a problem, since this branding require both train operators and airlines to cooperate and use the same branding.

Operational barriers

Operational barriers were mainly seen regarding luggage services and integration of systems. Luggage services are hard to implement since this is a logistic and operational challenge, especially if the luggage still has to be transported by the train.

Integration of systems

Barriers regarding integration of systems can make elements as integrated ticketing, check in and disruption management hard to implement. For this to succeed, the systems of both the aviation sector and the rail sector have to work together, handle the same standards and allow to exchange information constantly.

Measures

The extra measures can be a challenge. Especially prices and limiting the amount of flights are a challenge since these measures are diametrically opposite to how the market currently operates. Therefore, these measures ask for collaboration on an international level.

11.7 Final design evaluation

To evaluate the final design, the design was presented and discussed during a knowledge sharing session with partners of the Seamless Personal Mobility Lab.

Representatives of MRDH, DOVA, RET, 9292, the Ministry of Infrastructure and Water Management and Translink participated in the session. In figure 10.6 an impression of the session is shown. In a 10-minute presentation the user experience of the final design was presented with the use of a storyboard. The service design vision was explained according to the vision elements.

To collect a wide range of feedback in a relatively short amount of time, the partners filled in a survey at the end of the session. The survey consisted questions like '*How would you describe the AirRail Alliance?'* and '*What advice would you give to implement the service?*' The session was concluded with some time for questions and discussion. The main insights resulting from the session are discussed in the following section.

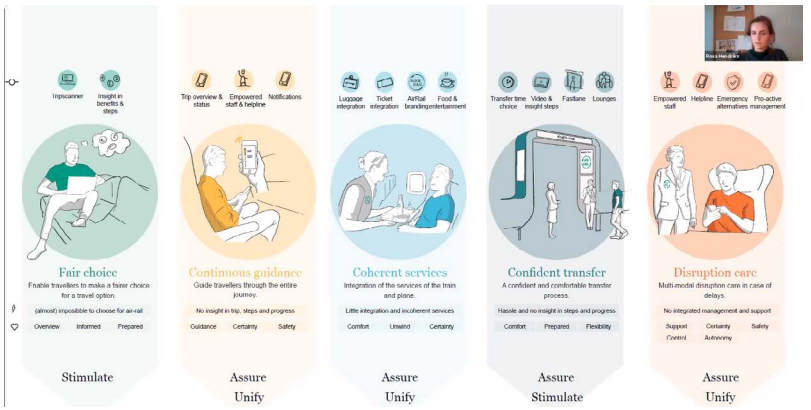


Figure 11.6 Impression of evaluation session.

Results

Project deliverables

The partners describe the AirRail Alliance as an integrated service that is complete, user-friendly and carefree.

An integrated service that makes it possible to make combined train and air travel easier - Representative of MRDH

Unburdening multimodal transport. A complete travel product that offers quality (from start to finish). - Representative of DOVA

The partners especially experienced the seamless aspect of the AirRail Alliance as positive. In addition, partners argued that the support and guidance of the service that eliminates the uncertainty of the traveller.

The seamless aspect and the combination of modalities. The integrated approach in terms of transferring and insight in the trip - Representative of DOVA

If something is wrong, there is one party you can approach. "You are never alone" It eliminates the traveller's uncertainty and is offering and stimulating more sustainable alternatives. – Representative of Ministry of infrastructure and water management

Furthermore, partners argued focus of the project on the perspective and needs of the traveller is very valuable, since this prevents getting stuck on all kinds of operational barriers.

Nice mindset and inspiring vision. It is a design based on the needs of the travellers, not deterring operational obstacles.- Representative of DOVA

Recommendations

The suggestions and feedback of the partners resulted in four main recommendations for the project. Firstly, the time and costs aspect of the project should be explored in more detail, since these are mostly very important factors for travellers.

Are they also willing to pay for it? or do they still choose a low-cost alternative and take a sandwich? - Representative of MRDH

Additionally, the partners argued that it is valuable to make use of existing services. In this way the service is easier to implement.

Above all, combine what is already there and provide good service if the switch does not work. Keep it flexible. – Representative of Translink

Furthermore, the partners noticed that the design is not only applicable for train and plane journeys, but could also be applied to other modalities and even seen as a general vision for the public transport.

For me this is also applicable in the development of BRT in the Netherlands, in conjunction with public transport / bicycle sharing / car sharing / etc.- Representative of DOVA

Finally, the user centered approach was seen as very valuable. This should be continued and the service should be developed further according to the user needs.

Design, implement, request and adjust continuously regarding the travellers' feedback. - Representative of MRDH

Conclusion

The goal of the service come across clearly. The vision and service design were interpreted as 'seamless', 'complete', 'integrated' and 'unburden'. Terms that fit the design goal of the project well. The partners experienced the service as unified, complete and integrated. Additionally, the partners feel like the service provides guidance and support to make travellers feel assured. Finally the partners argued that the air-rail option can become a competitive alternative to the multi-leg flight.

The main challenge for the AirRail Alliance noticed by the partners are the costs. The costs benefit ratio should be researched further. In addition the willingness of travellers to pay for services. In the end costs are a decisive factor for travellers and can therefore influence the success of the service greatly.

11.8 Conclusion

The AirRail Alliance aims to unify air and rail, stimulate travellers to choose for air-rail and assure travellers about a smooth course of the air-rail journey.

The AirRail Alliance aims to stimulate international air-rail travellers to choose for air-rail journeys instead of multi-leg flights, by creating a fair choice, a comfortable transfer and coherent services.

The AirRail alliance integrates services, provides continuous guidance and manages disruptions throughout the entire journey. Consequently, the traveller experiences this collaboration between train operators and airlines as a coherent and unified journey.

Ultimately, because of continuous guidance, support and integrated disruption management, travellers feel that nothing can go wrong, they feel assured.

When the AirRail Alliance is implemented according to the strategic roadmap, the service can be implemented by 2030. According to the roadmap, the essential services should be implemented by 2024, the service should be integrated by 2027 and the service should be streamlined by 2030.

12

In this chapter

Conclusion

This chapter draws and discusses the conclusion of the project. In addition, it discusses the limitations and recommendations of the project.

12.1 Conclusion

The goal of the project was to create a design vision for plane-train journeys, that facilitates in creating a seamless travel experience between planes and international trains within Europe. To create this design vision research was conducted and insights were gathered. These insights were used in the design phase to develop the design vision for air-rail journeys in 2030. The project focused on making the following vision reality: A world where travelling has little impact on the environment.

The research phase showed that international trains and flights are not well integrated, which makes the system hard to access, results in an incoherent service and creates an uncertain travel experience. This negatively influences the choice for a more sustainable alternative than the air-air journey. To overcome this problem, the goal of the design phase was to design an unified air-rail service that stimulates travellers to choose for air-rail journeys and is aligned with the traveller needs. The design should create an enjoyable air-rail experience which makes international air-rail travellers feel assured.

These insights resulted in the service design vision of the AirRail Alliance. The AirRail Alliance stimulates international air-rail travellers to choose for air-rail journeys instead of multi-leg flights, by providing a fair choice and coherent services. Additionally, international air-rail travellers feel assured by continuous guidance, a confident and comfortable transfer and multi-modal disruption care. Finally, international trans and flights are unified due to coherent services, continuous guidance and multi-modal disruption care.

The strategic roadmap could realize the ambitious scenario. This means each day around 12.000 air-rail travellers will travel with the AirRail Alliance, which will lead to the substitution of 63.000 flights on a yearly basis.

To conclude, the AirRail Alliance creates air-rail journeys that can compete with air-air journeys, by creating an unified and assured air-rail experience. AirRail stimulates travellers to make a more sustainable choice. Ultimately this contributes to a world where travelling has little impact on the environment.

12.2 Discussion

Targeting the personas

The project focused on the six defined air-rail personas. However, most of the aspects of the final design seem especially useful for the personas that are less experienced and confident, thus the vulnerable rookie and certainty seeker. Furthermore, when more and more travellers start using AirRail, travellers will get more experienced. The design will change accordingly and should focus less on guidance and support.

Qualitative research

To come to rich insights, the project is mainly based upon qualitative research. However, the researcher could have biased the results by interpretation, this could have influenced the final design.

Air-rail vs rail-air

The project focused both on air-rail and rail-air journeys. Despite that, the research participants were mainly European rail-air passengers, with as a result a final design which is detailed according to the rail-air journey. While most of the aspects are interchangeable between the rail-air and air-rail journey, there will be aspects that differ as well. The main aspect that needs some more attention is the integration of luggage service, since luggage services differ because of immigration restrictions.

The potential

An important nuance that has to be made towards the potential of air-rail journeys concerns competitive hubs in Europe. It is not unlikely that travellers will start to choose other airports over Schiphol, if these airports are easier or faster to reach by international or even domestic trains. Additionally, the potential of air-rail is based upon a situation with the current modalities. If new modalities will arise, such as the hyperloop, it might change the future scenarios. Finally, the sector expects that it will keep on growing, even though we are still in the current pandemic which might change the travel behaviour of travellers.

Implementation

The implementation of the service involves challenges. One of these challenges is the collaboration between stakeholders. The collaboration

is difficult because the stakeholders are competitors and work differently. Additionally, operational barriers concerning integration of services exist, for example the luggage service. Finally, the success of the AirRail Alliance also depends on complex factors on which the key stakeholders have little impact. Especially the creation of a fair playing field for the rail and aviation sector seems a challenge.

Feasibility

The integration of systems is the main challenge concerning feasibility. The service elements are easy to implement in the rail or aviation sector. However, the real challenge is the integration of elements in both sectors. For example, to create one ticket for the air-rail journey, the ticket systems of the rail and aviation sector should be integrated and should be able to recognize the ticket. To create integrated disruption care, disruption management of the train and plane should be integrated and the staff in the plane and train should be informed or even empowered to help travellers.

Sustainability

The main goal of the project was to reduce the impact of travelling. The project focused on realizing the ambitious scenario, which could lead to substitution of a substantial amount of flights. On the level of the traveller, it can be argued that a more sustainable travel option is realized. However, due the conflicting interest and the existing substitution paradox, the actual positive impact of air-rail on a wider scale could be doubted.

12.3 Limitations

Complexity of international train travel

Increasing international train travel is a quite complex process. There are many obstacles that hinder international train travel, like the infrastructure of the HSL network or difficulties between countries and train operators. These obstacles were acknowledged but are also challenged, however not all of these obstacles could be solved within the scope of this project.

Focus on user experience

The user was the focus of the project. This means that the needs of the user are priority in the design of the AirRail Alliance. The project involved multiple stakeholders; therefore also stakeholder needs were taken into account, however these were not leading. Furthermore, since the project focused on the user experience of the design, the aspects regarding business and technology are less dominant in the project research and results.

Executing field research

Finally, conducting field research was nearly impossible due to the current pandemic. Especially, doing field research in the restricted areas, planes, trains or other airports was impossible. Therefore, almost the entire project was executed remotely with the use of online tools. Research activities, interviews, presentations and evaluations were held online. This made it harder to empathise with the context and evaluate whether the service fits into this context.

12.4 Recommendations

Set priorities

The concept consists of multiple elements, however it is important to focus on solving the main barriers first. Travellers should be aware about air-rail and able to book air-rail. Additionally, travellers should feel assured about the booking and during the journey, by appropriate ticket guarantee and disruption management. These elements are key to make air-rail an option to consider in the first place.

Detail, develop and test the service

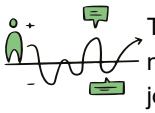
The AirRail Alliance is still conceptual and the service touchpoints should be developed and detailed further. A prototype should be tested within the travel context, ideally with a variety of travellers including all personas. When the service will be developed further, more detailed insights could be gathered about the service. This will create insight if the service really addresses the needs of the users.

Make use of existing infrastructure and services

For multiple aspects of the AirRail Alliance, existing services and infrastructure such as the lounges, food services and fast lanes should be used. These aspects of the concept could be in synergy with existing elements within the trains, train stations, airports and planes. The investments could be limited and the service is easier to implement.

Keep it user-centered

This project puts the user in the centre of the process. To make air-rail a success, this user-centered mind-set should remain. Otherwise air-rail could get stuck on stakeholders' interests and operational barriers. In the end, if the user experience doesn't address the needs of the travellers, air-rail will not be a success. Thinking from the user's perspective and start interventions from there, will make air-rail an attractive option. In the end, this will also lead to accomplish stakeholder goals and interests.



Focus on the entire journey

The transfer is an important moment in the journey, but this is not the only moment that is important for the traveller. The entire journey counts to create an air-rail experience that fits the user's needs. Especially orientation and booking is important to stimulate travellers to choose for air-rail. Additionally the traveller must feel assured during the entire journey, not only during the transfer.

Quantify the personas

The personas are based upon qualitative research. However, little is known about the distribution of these personas among the international air-rail travellers. Therefor, the personas could be quantified. This way, the share of each persona of the total travellers is determined. This can help to steer the service in the right direction.

Develop the service in synergy with OD rail travellers

The amount of air-rail travellers will be relatively small compared to OD travellers. Therefore, the air-rail journey should be developed in synergy with the OD journey of rail travellers. This means that interventions should not obstruct these group of travellers and ideally also make the service of international train travel better.

Watch ticket pricing

It is important to keep in mind that the ticket price is the main decisive factor for choosing a modality. If the air-rail service becomes expensive due to the implementation of the AirRail Alliance, this could obstruct the success. Consequently, the business model of air-rail should be researched in more detail, especially how the different service elements could be viable. An aspect to consider is the willingness of travellers to pay for extra services, such as luggage or flexibility. In the end, the difference between the ticket prices of flights and trains are key. If tickets of flights are cheaper, it will be hard to make air-rail into a success.

Create insight in the effect on the network

One of the reasons that seems to obstruct the motivation for air-rail, is the uncertain effect on the international network. This international network is the fundament of the sector, therefor it

is essential for the motivation of air-rail that this effect becomes clearer. The competition of other airport hubs and the willingness of travellers to go on air-rail journeys could be researched further.

Collaborate to integrate the rail and aviation sector

Integration between the rail and aviation sector is fundamental for the air-rail service. Therefor, collaboration between the key stakeholders is essential to make the service a success. Collaboration is the foundation for creating a unified journey, assuring travellers by integration of services and stimulating by collaboration in ticketing and booking. Integration of rail and aviation systems regarding ticketing, booking, trip details and disruption management is the most important step to make.

Overcome the substitution paradox

The substitution paradox seems to obstruct air-rail to be a sustainable measure. To overcome the paradox, extra regulation is needed. Two recommendations are given to contribute to the positive impact of substitution.

1. Regulate regarding impact, not on numbers of flights

Currently, there is a ‘flights limit’. There are no more than 500.000 flights allowed at Schiphol. So, substitution of short distance to long distance flights is allowed. Instead of this a limit could be created that is based upon the environmental impact. When the limit is based upon the impact flights have, it is no longer possible to swap short distance flights for long distance flights, since this will increase the overall impact.

2. Regulate on an international level

Regulations will only work if they are created on an international level. When only the Netherlands will regulate the impact of the aviation sector, other airports will grow instead. Therefore, international regulations are key to really overcome the environmental impact.

In the end, these two measures are complex and require effort of all stakeholders involved. Ultimately, international cooperation is fundamental to address this challenge.

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Appendices

A. Project brief

B. Sensitizing Booklet

C. Analysis roles and interests air-rail stakeholders

D. Analysis needs, barriers and requirements surrounding the choice for air-rail

E. Benchmark

F. Analysis types of travellers and the personas

G. Description user needs

H. Analysis moment of truths personas

I. Creative session results

J. User stories ideation phase

K. Overview of final ideas

L. Air-rail concept,

M. Concept evaluation results

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