



REDESIGNING THE DEBOARDING EXPERIENCE



// Master Thesis by Claudia Spaargaren //
// MSc. Design for Interaction // November 2018 //



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Author
Claudia Spaargaren
Student number 4326776
cspaargarenc@gmail.com

Supervisors TU Delft
Prof. dr. P. Vink (Peter) - Chair
MSc. S.R.. Dehli (Silje) - Mentor

Supervisor Brussels Airlines
MSc. Y. Buys (Yorick)

 **TU Delft**
Delft University of Technology
Faculty Industrial Design Engineering
Landbergstraat 15, 2628 CE
Delft, Netherlands

 **brussels
airlines**
Department Ground Operations
B.house - Airport Building 26 - Ringbaan
1831 Diegem, Belgium

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In front of you lies my thesis, which describes my final project to obtain my master degree of the master Design for Interaction at the Delft University of Technology. I got the opportunity to do this project at Brussels Airlines in Belgium.

My graduation project started not as planned, but I think it couldn't have been a better fit. I enjoyed being able to bring all of my favourite parts of design together with an extensive research, putting the passenger in the centre of the process, coming up with a concept and do a user test. Next to this it was also an inspiring experience, being able to see everything behind the scenes of an airline. I could however not have done it without the help of many others within Brussels Airlines, TU Delft and outside of it.

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Claudia

EXECUTIVE SUMMARY

You are almost at your holiday destination. The 'fasten your seatbelt' sign just turned on and the plane started descending. After landing it is time to get out of this confined space, but all the other passengers are thinking the same thing. Everyone stands in the aisle, trying to get their hand luggage out of the overhead bin and exit the plane at the same time. Arriving at the gate you feel relieved you are out and can really start your holiday. The deboarding experience is not the best experience of flying. And seeing it from the perspective of the airline, the delays caused by this process are increasing.

To investigate this issue a project was executed at Brussels Airlines. A research observing the deboarding of 28 flights showed the causes for blocks in the passenger flow going out of the plane. Four out of five are related to the hand luggage people bring. An A-B test with 16 passengers shows taking away the trolleys can save up to 80% of the deboarding time. Therefore, five concepts are proposed to make the deboarding smoother by changing the behaviour of people regarding hand luggage. The proposed concepts vary from informing people about the process of deboarding, having a new boarding & deboarding strategy based on the luggage people bring, convince people to bring less hand luggage giving direct feedback on their luggage at the airport, setting up a sharing community at every destination and the last concept focusses on educating people about the consequences of hand luggage in a game. The last concept is delivered as a final concept and explained more detailed.

The concept called 'The luggage games' is a smartphone application passengers can play before they fly. It includes three different mini-games, related to 3 parts of the passenger journey while flying which include hand luggage. The passenger gets positive feedback when packing light and making sure the plane is boarded and deboarded smoothly with hand luggage. Negative feedback will be given when too much hand luggage is on board, informing the passenger about consequences of the hand luggage on operations and with direct consequence on the flying experience. This way people can learn what the consequences are of bringing a lot of hand luggage and make them more aware the next time they pack their bag for inside the cabin. This solution will therefore inform the passengers, nudging them towards taking less hand luggage in a fun way instead of simply banning the hand luggage from the plane as a rule set by the airline.

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1 INTRODUCTION

This chapter gives an introduction of the project. The chapter makes the context of the project clear. Starting with a description of the assignment given by the company, the design process, a short introduction of the company for whom the assignment was executed and the main stakeholders involved in the project.



More and more people are travelling by plane. According to an estimation of the European Commission European flights will increase from 9.4 million flight-movements in 2011 to 25 million in 2050 (Kallas et al., 2011). The industry is therefore figuring out how to make this expansion possible, one factor which could help towards this goal is to shorten the time an airplane is on the ground. The time between the arrival of the plane and the departure of the next flight is called the turn around time (TAT). For an airline it is best if this time is as short as possible, a minute a plane is not flying is a minute not making money. At Brussels Airlines a minimum of 40 minutes is scheduled for the turn around.

The plane has a timeslot in which it needs to do a turn around which includes multiple processes (see Fig. 1.1). People and their hand luggage need to deboard, the luggage needs to be de unloaded, the plane needs to be cleaned, empty trolleys need to be taken off, new trolleys need to be loaded, the plane needs to be refuelled, people need to board and the new luggage need to be loaded. Since many different processes and different parties need to come together in this short timeslot every process step can cause a delay and can cause the plane to lose its timeslot.

Especially the passengers getting off and getting on the plane is part of the critical path, other processes are dependent from these processes (for instance cleaning, refuelling and catering can only be done after all passengers are deboarded).

Over the last years research has been conducted into the boarding process, creating faster boarding methods like the Steffen method (Steffen, 2008) and widening the aisle with retractable seats in the European PASSME project (PASSME, 2017). The deboarding process in comparison has gotten less attention. Therefore this project will focus on the deboarding of passengers.

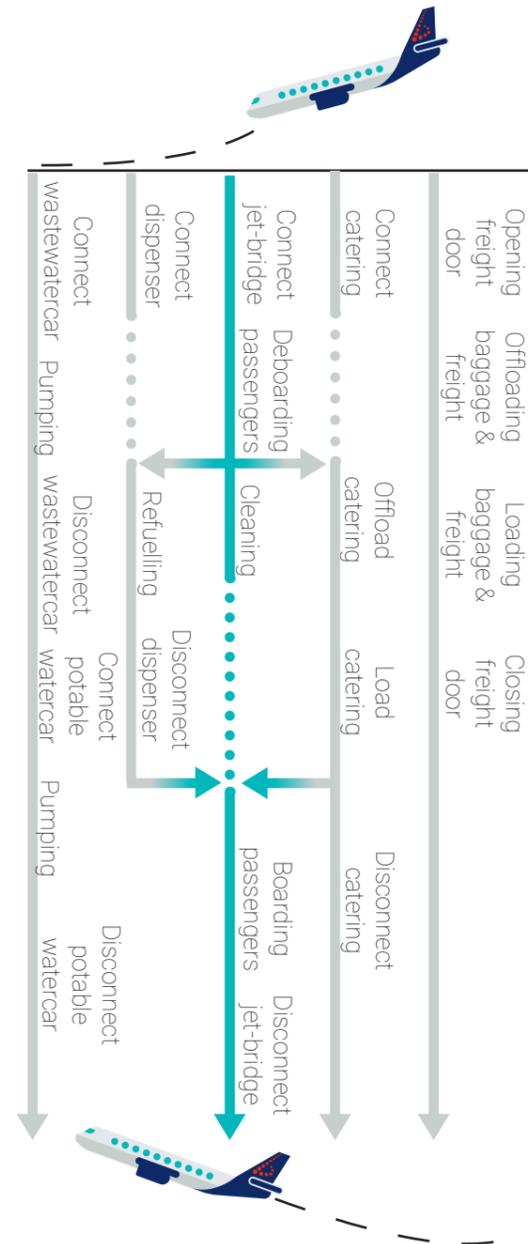


Figure 1.1: Image of turn around process. (Based on Horstmeier & de Haan, 2001)

ASSIGNMENT

The assignment of the project is described as follows: Develop a design intervention which will make the deboarding process of a narrow body aircraft more efficient for the airline and simultaneously a better user experience for the passenger. Starting point will be the current situation and through iterations and testing in context a solution will be developed. Since Brussels Airlines only flies with narrow body airplanes on short haul destination, the assignment will focus on short haul operations.

In figure 1.2 an overview of the different phases of a deboarding process is shown. Since deboarding is more than literally stepping out of the plane the visual shows the process before this moment as well.

When the passenger acts according to the given guidelines he or she should start gathering items, standing and walking after the FSB light is turned off. In reality this gathering, standing and walking already happens before the FSB light is off (sometimes even while the plane is still moving). Therefore for this project the deboarding is starting from the arrival at the gate until the passenger leaving the plane (with a dotted line before the arrival of the plane since some people even start earlier).

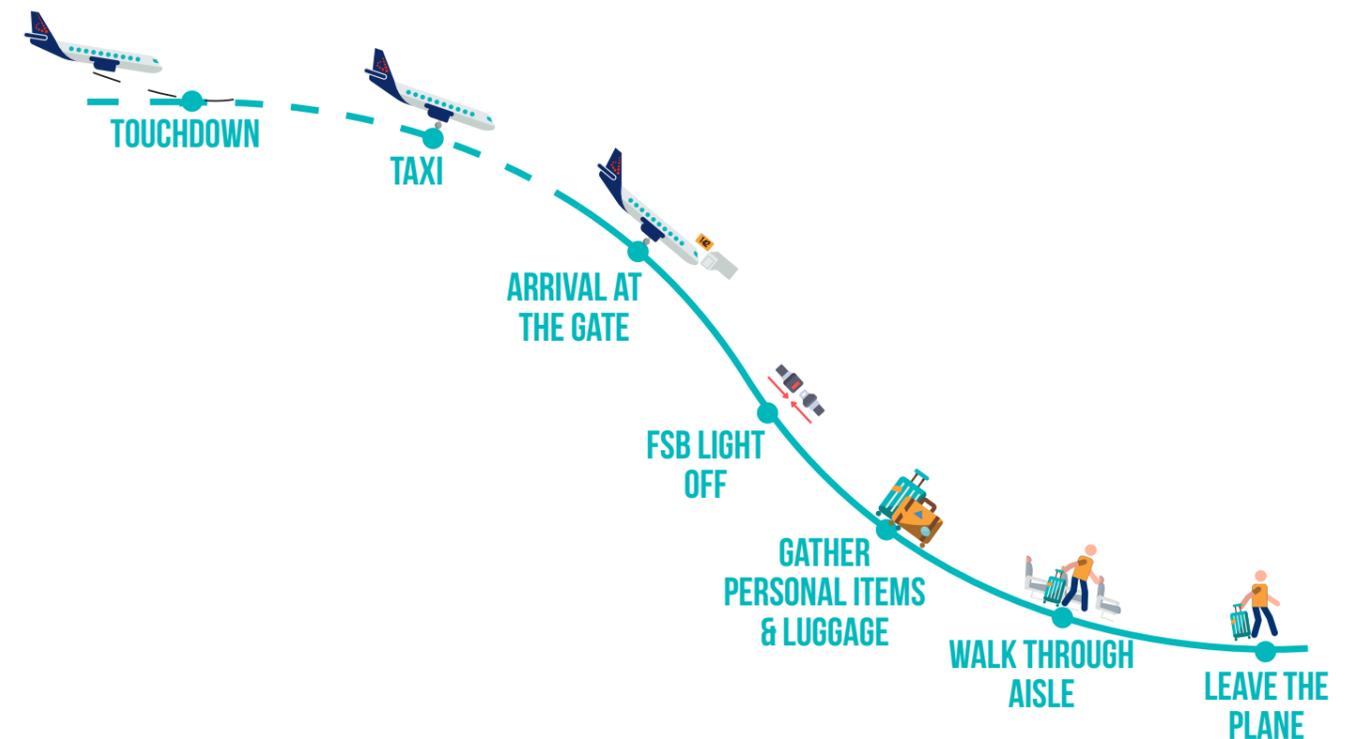


Figure 1.2: The deboarding process phases over a time line, from the passenger perspective.

DESIGN PROCESS

During the project the Double Diamond approach (Design Council, 2005) was used. This approach is a general description of the design process in which the project is divided into four stages. The report will also be ordered in the same four stages.

Discover

In the discover phase the starting point is the problem, or in this case the assignment given by Brussels Airlines. Through research the subject, context and problem are analysed, to get as many insights as possible. A literature review, analysis of company data and an explorative research into the real life situation were executed to gain the insights.

Define

The second phase has as its main goal to find the focus, the scope of the project. Defining what the most important insights are to come to a design brief. This design brief contains the different design opportunities, the design goal and interaction vision. Next to the scope of the project also the insights into the user are made clear in persona's and customer journeys. The define phase gives guidance for the next phases and helps to validate the end design if it is really solving the problem.

Develop

In the develop phase the goal is again to get a broader view. Get as many possible solutions as possible. Through quantity an overview of possibilities is found after which concept development helps to also add quality. Different creative sessions were held to find as many solution spaces as possible.

Deliver

The last phase is about finding a solution that will actually solve the problem. Through prototyping and a user test the concept can be validated. Which will conclude in a concept, which is not a fully developed product.

Figure 1.3 shows a visualisation of the process, including the methods used in the different phases.

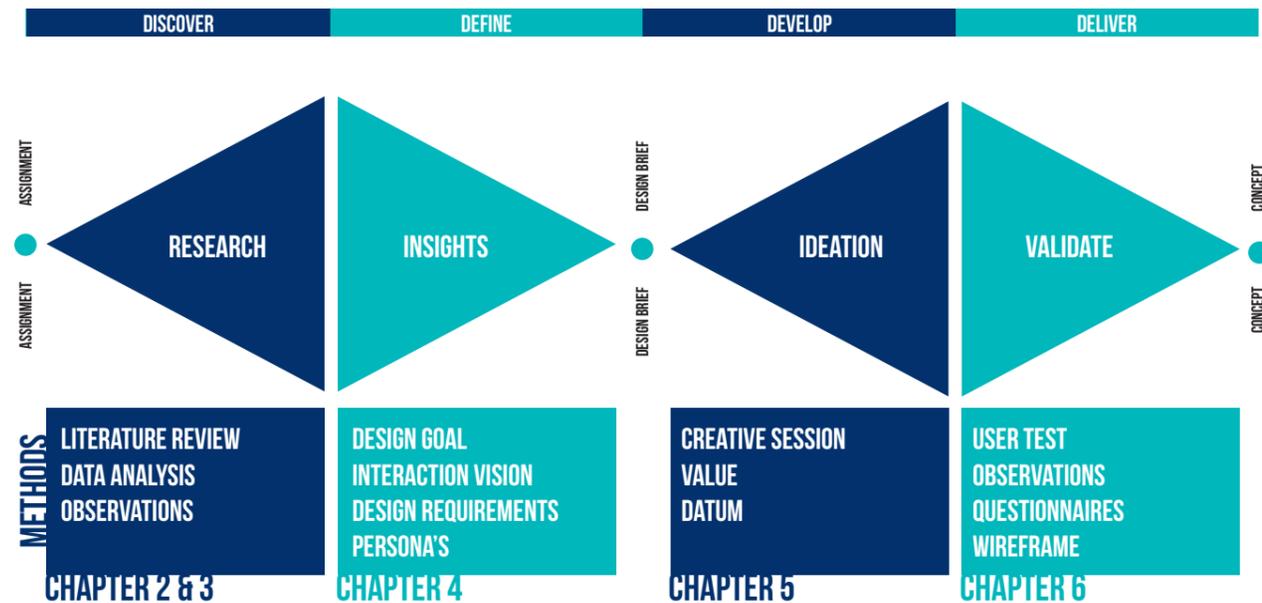


Figure 1.3: An overview of the design process.

BRUSSELS AIRLINES

Brussels Airlines originated from SN Brussels Airlines, which was founded in 2002 to connect Brussels with as many destinations as possible and to recreate job opportunities in the sector after the bankruptcy of the national airline Sabena (1923 - 2001). Many people who worked for Sabena were able to bring their knowledge and expertise to SN Brussels Airlines. In 2007 SN Brussels Airlines merged with another Belgian airline, Virgin express. From that moment the airline was called Brussels Airlines. The abbreviation SN was a leftover from Sabena, SN was the IATA code used by this airline and is still used by Brussels Airlines.

Lufthansa group & Eurowings group

In 2008 Lufthansa announced they were going to buy a minority share of 45% of Brussels Airlines. In 2016 the other 55% was also acquired by Lufthansa. This makes Brussels Airlines part of the Lufthansa group. The Lufthansa group also includes the airlines Lufthansa, Eurowings, Swiss and Austrian Airlines. Brussels Airlines will mostly join forces with Eurowings, being the point-to-point airlines with expertise in both short haul and long haul destinations.

Fleet

Brussels Airlines has a fleet of 55 aircraft's, made up of 5 different types.

- 4x A330-200 capacity of 262 passengers
- 6x A330-300 capacity of 288 passengers
- 22x A319 capacity of 141 passengers*
- 16x A320 capacity of 180 passengers*
- 4x SSJ100 with a capacity of 98 passengers*

* Since the class configuration is flexible on these airplanes the actual capacity varies per flight.

The A319, A320 and SSJ100 are all narrow-body airplanes, which are used for the short haul operations. The SSJ100 is mostly used for destinations with smaller airports. The A320 has 5 special designed aircraft's, which are called the 'Belgium icons'. The tails of these are shown in figure 1.4.

Product

Brussels Airlines offers passengers four different product fares on short haul destinations: Bizz & Class, Flex & Fast, Light & Relax and Check & Go (ordered from most expensive to the most inexpensive fare). The four different product fares differ in flexibility, comfort, service & amount of luggage you can bring.



Figure 1.4: The tails of the Belgium Icons of Brussels Airlines. Aerosmurf, Amare, Magritte, Rackham and Trident. (© Brussels Airlines)

STAKEHOLDERS

The project has different stakeholders. Figure 1.5 shows the main stakeholders of the project, with the stakeholders with a more direct link closer to the middle. Also included are the benefits the stakeholders can get out of making the deboarding more efficient with a user centric approach.

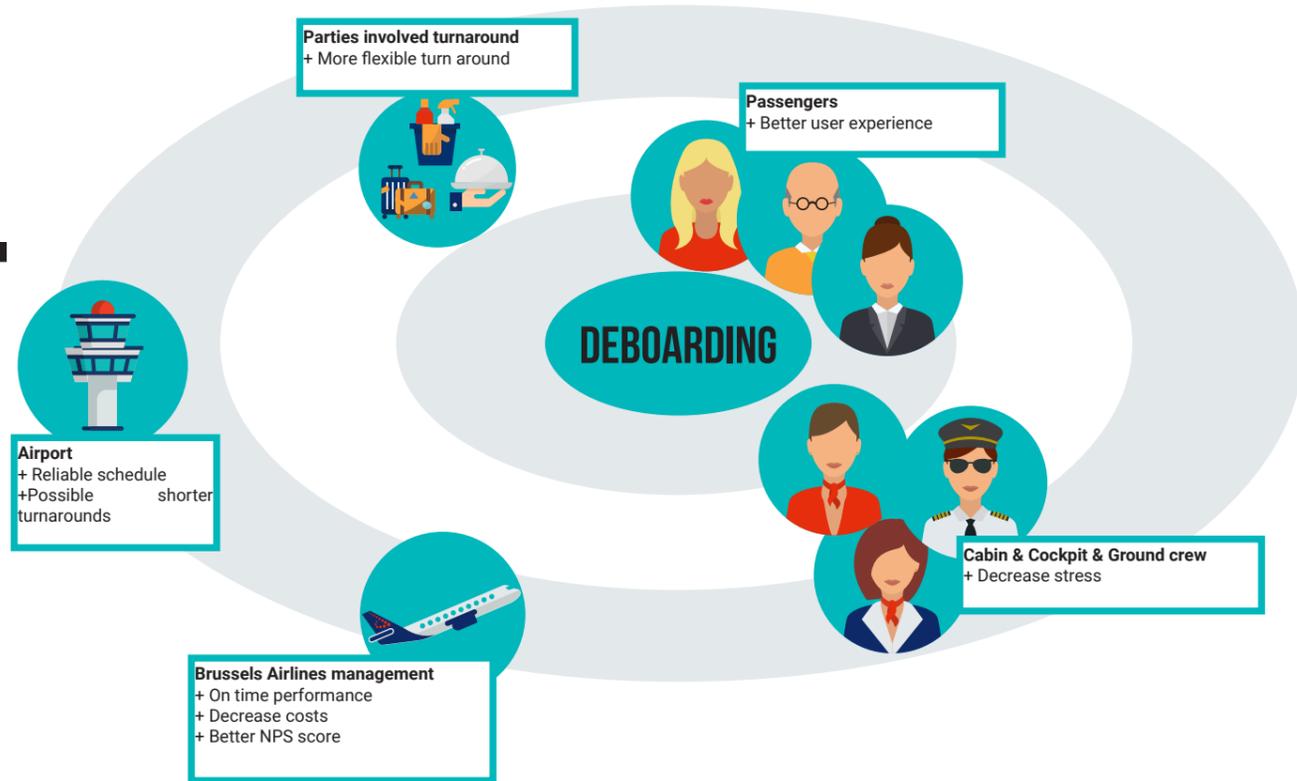


Figure 1.5: Stakeholders of the project.



2 DISCOVER I

DEBOARDING IN THEORY

To understand the processes surrounding deboarding and see what research is already done on the topic of 'deboarding' a literature review was executed. Next to the literature review also company data on delays have been studied to find possible trends.

LITERATURE REVIEW

METHOD

A literature study has been conducted by searching for scientific papers on Google Scholar using the search words 'deboarding' or 'de-planing'. Also 'disembarking' was searched, but did not give extra results. Papers classified as relevant to deboarding of an airplane were also used to find new papers in the references.

RESULTS

As seen in figure 1.1 on page 12 the boarding and deboarding of passengers are processes which influence and are influenced by other processes. Only after deboarding the cleaning, catering and fuel process can proceed. Boarding can only start when these processes are completed. Therefore Steiner et al. (2009) states the (de)boarding process is part of the critical path of the turn around of an airplane. When you win time in these processes, you will also decrease the time of the total turn around process (up to a certain extent).

The deboarding process is not examined as extensive as boarding. According to Wald et al. (2014) a reason for this is that passengers deboard faster then they board an airplane. A quick train of thought suggests it will therefore be easier to win time in the boarding process. Wald et al. (2014) thinks decreasing deboarding time could be a (hidden) opportunity for airlines.

Deboarding strategies

In the present situation people deboard an airplane randomly, everyone can stand up first and in theory leave the plane first. This makes the process chaotic and unpredictable. A structured deboarding strategy (i.e. people leave the plane in a specific order) could make the process more efficient and decrease the deboarding time.

On the next page an overview of different deboarding strategies. This overview is based on multiple researches (Yuan et al., 2007; Li & Mehta, 2007; Qiang et al., 2017; Wald et al., 2014; Qiang et al., 2016; Zhao et al., 2007; Miura et al., 2016). The majority of the research is based on a computer simulation of boarding backwards, assuming the deboarding strategy that matches the boarding strategy in theory is the same but backwards to simulate the effect.

Li & Mehta (2007) rise the argument the airlines have less control over the behaviour of the passengers in comparison to boarding. Therefore the very complex strategies will be hard(er) to implement. Especially the reverse pyramid strategy asks of a lot of operational organisation & discipline of the passenger.

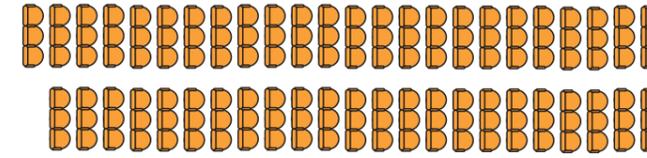


Figure 2.1: Random deboarding

Random (Fig 2.1)

People deboard at random, with the person who stands first in the aisle and the people more at the front of the plane deboard first until everyone got their chance. Airlines use this method and therefore this is used as the starting point to measure other strategies.

Random deboarding with a high load factor is perceived shorter by passengers than actual time (Miura et al, 2016)



Figure 2.2 Deboarding per row

Row (Fig. 2.2)

People deboard according to the row they sit, front row first up until the last row.

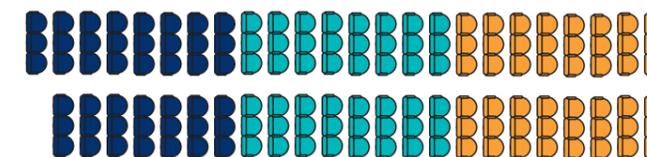


Figure 2.3: Block deboarding

Block & Front to back (Fig. 2.3)

With block deboarding the plane seats are divided in 3 groups and people deboard in these groups, first the front rows, back rows and middle rows. Front to back boarding is similar to block deboarding, except the order is different with first the front rows, then middle rows and last the back rows.

Block is perceived longer by passengers than actual time (Miura et al, 2016)

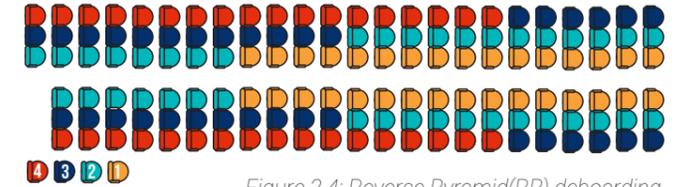


Figure 2.4: Reverse Pyramid(RP) deboarding

Reverse Pyramid (Fig. 2.4)

It follows the order first the aisle, middle and window seats, however in a diagonal order (making a pyramid form)

According to Qiang et al (2016) in combination with RP boarding fastest combined process.



Figure 2.5: Luggage distribution control (LDC)

Luggage distribution control (Fig. 2.5)

Based on the amount and size of the luggage the passenger gets a seat assigned, with the most luggage in the back of the plane and the light packed passengers in the front. This boarding method also affects the deboarding, in combination with inside out deboarding.

Theoretical strategy of Yuan et al (2007), who states it saves 3 min on boarding and also 3 min on deboarding.



Figure 2.6: Inside out deboarding

Inside out (Fig. 2.6)

People deboard per 'column', which means first the aisle seats deboard, then the middle seats and finally the window seats.



Figure 2.7: Marked with yellow the place where deboarding occurs in the context of the entire journey of the passenger.

To have a good experience on a flight is important for the passenger, but also for the airline this should be an important factor. Vink, Bazley, Kamp and Blok (2012) found a relation between the comfort experienced by the passenger and the likelihood the passenger would fly again with the same airline. With the high amount of competitors in the aviation industry, the comfort could be an argument which can convince passengers to fly with your airline.

Bouwens et al. (2017) studied the levels of comfort during the passenger journey of the flight, showing significant high peaks of comfort after settling in and starting to taxi and secondly when arriving at the airport. The research does not go in-depth into the deboarding process, since it only shows the moment of taxi and arrival at airport. Low peaks of comfort are found stowing away luggage during boarding and during cruising.

Passenger perspective

The first part of the literature review focussed mostly on the operational side of deboarding. The passenger however is also affected by the process of deboarding. In the overall journey of a passenger deboarding is only a small part (Fig. 2.7), but it could also has an impact on the entire journey.

Lewis et al. (2016) showed that VE's (virtual environment) can distract passengers from their discomfort in some cases and for a short period of time. Also Hiemstra-van Maastrigt (2015) showed people can be distracted from their lack of comfort activities. If discomfort can be taken away by distraction of non-physical things, comfort is more than only the physical environment.

Therefore the mental side of flying should also be taken into account. Overall travelling by plane is a stressful experience for passengers, which is shown in figure 2.8. The figure shows the journey of a passenger and the stress levels the passenger experiences. Although not in red the arrival and deboarding areas do cause stress with passengers.

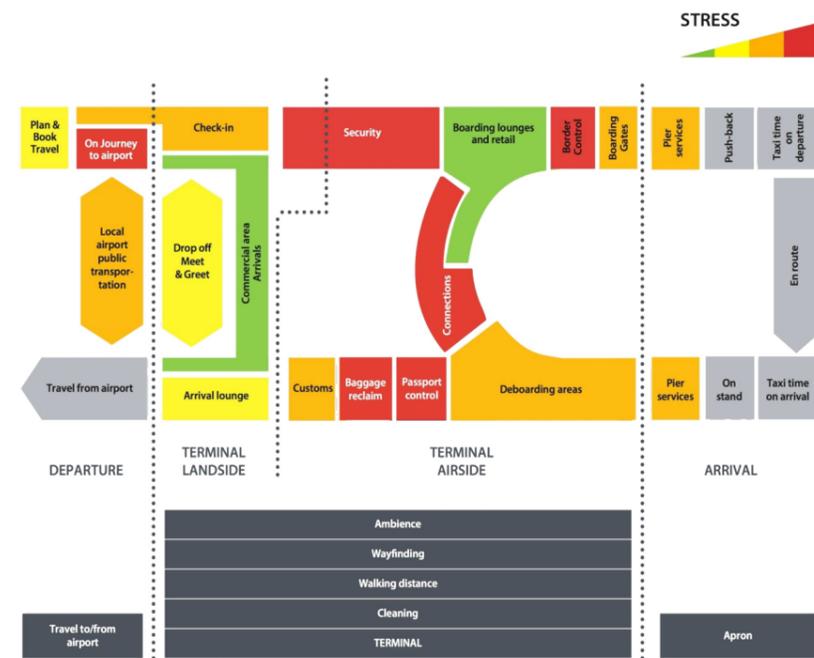


Figure 2.8: Stress-chart of the passenger journey (Airport Council International Europe (2014))

Deboarding is often only mentioned as a side note to the research about boarding or the entire journey. Mapping out the deboarding as extensive as the boarding process has not been done yet.

TRENDS COMPANY DATA

The literature showed the context of deboarding in general. To see the impact of deboarding (delays) for Brussels Airlines specific a data analysis has been done.

METHOD

When a flight of Brussels Airlines has a delay of 3 minutes or more the reason is documented by the cockpit and the ground handler. They give the delay a delay code and in most cases a short description. To see if there are trends in the delays of Brussels Airlines regarding deboarding, delay data is analysed of the company using the "Spotfire delay dashboard" (which shows all delay data of Brussels Airlines) and excel. The delay data is first filtered on the (de)boarding (combining both boarding & deboarding) delay code and exported to excel. After this the data is filtered based on the short description to see if the code is used for boarding or deboarding.

RESULTS

In the first half year of 2018 already more delays are reported caused by boarding/deboarding of passengers in comparison with the whole year of 2017. This is the case for both 15+ minutes delays (meaning missing the time slot to depart) as for the delays between 3 to 15 minutes delays. Another thing which stands out it the amount of delays because of deboarding/boarding per airplane type. Out of the total approx. 40000 flights until July 5th, 50% was an A319 flight and 25% was an A320 flight, however almost 80% of the 15+minutes delays because of (de)boarding are reported on the A320 flights.

Looking more closely into the description of each reported delay out of all reported 15+ delays because of (de)boarding, 35% are reported because of deboarding, 35% do not have a clear description, 25% are because of boarding and the last 5% are on other airplanes (not A319 or A320). Looking at the 3-15 minute delay reports 15% are caused by deboarding, 25% do not have a clear description, 60% are reported for boarding. Showing a big difference between the 15+ min and 3-15 min delays.

Excluding the reports which are about boarding, the destinations Málaga, Madrid, Tel Aviv and Rome have the most delays because of deboarding. Excluding the reports which are about boarding for the reported delays under 15 minutes Geneva, Málaga and a shared third place for Rome, Madrid and Lisbon have the most delays because of deboarding.

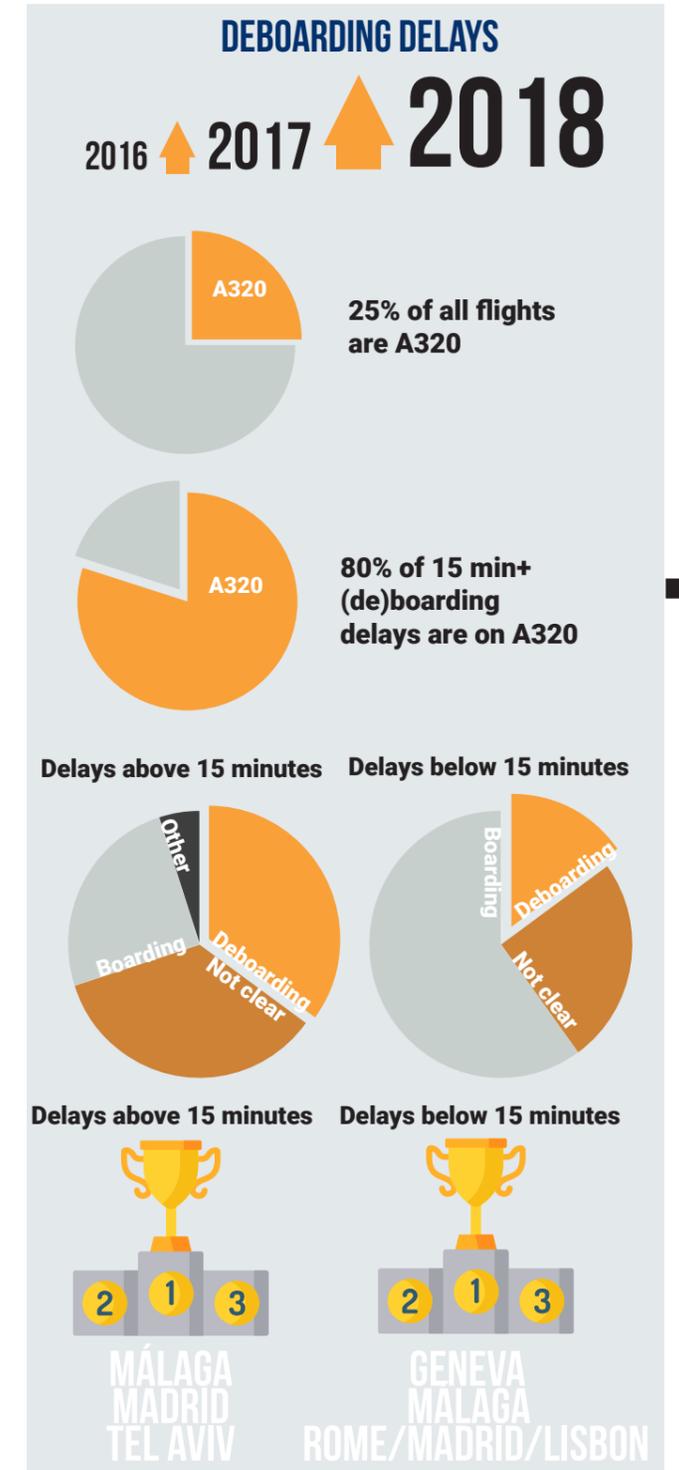


Figure 2.9: Visual of the main findings from the company data

DISCUSSION & CONCLUSION

The goal of the discover in theory was to find out what was already known about deboarding, to find out what the context is of deboarding and what problems may already been known.

The literature review showed deboarding has not been researched as extensive as boarding (Wald et al., 2014), there are however already some scientific papers written about deboarding. Most of them are more of a side-note to the main topic; boarding. By reversing the boarding strategy or a simulation the deboarding is also mentioned.

The papers give interesting alternative deboarding strategies. The simulations suggest minutes can be saved on the deboarding times in comparison with the 'random' deboarding. Especially deboarding people in columns (aisle, middle, window seats) seems a strategy which could decrease the deboarding time. Also the Luggage Distribution Control system has the potential of taking of minutes of the boarding and the deboarding times.

Another interesting fact is that the papers are mostly based on computer simulations, not real life tests. The human behaviour during deboarding is not taken into account (e.g. groups travelling together, retrieval of luggage). Therefore it seems like there is a big potential in doing a research in the real life situation and look into the behaviour of passengers.

Next to the insights into new deboarding strategies, some insights are gathered about the passenger experience. It shows passengers experience a lot of stress during their journey, and the deboarding process is no exception. Next to the stress also comfort is an important factor for the passenger, which has a relation with the likelihood to choose an airline. Therefore it is important for the project to keep in mind the stress & comfort levels during the deboarding and how the concept can contribute in lowering the stress and increasing the comfort of the passenger.

Next to the literature, the company data showed (de) boarding gives more and more delays. The specific cause of this trend can not be concluded from the data itself. It does show it would be interesting to look into the topic. Especially flights executed with an A320 aircraft type seem to have issues with the deboarding. Since the fleet of Brussels Airlines only is growing towards a bigger segment of A320's, this can cause bigger problems in future operations.

The delay data of Brussels Airlines is based at the moment on the input of people, the cockpit and ground personnel have to give input for the system. Therefore the reason for delay is not always black & white and is in some cases interpretable in different ways.

Next to this there is a one delay code for delays because of boarding & deboarding, whereas these are different processes. In most cases the short description gives an insight if the delay was caused by boarding or deboarding, but this was not clear for all reported delays. The data therefore only give a guideline there is an increase of delays because of deboarding. More research is needed to find out if this is the case, why this increase happening and what is actually the cause of the deboarding delays.

Combining all these insights deboarding is from both an operational side and the passenger side a process which has room for improvement. The analysis also show more information about the deboarding process is valuable to get to the root of the issues surrounding deboarding and how to possibly solve them, while also keeping the passenger in mind.

3 DISCOVER II

DEBOARDING IN PRACTICE

The literature review showed most studies have been done into boarding, and deboarding is often done more as a side-note to boarding. Also most literature about deboarding is based on computer simulations. Therefore a more explorative research approach has been chosen to learn more about the deboarding process and the human behaviour during deboarding. How does this work in reality? What are the factors that influence this process?



METHOD

To learn more about the deboarding process an observational research is conducted flying with 14 different flights (starting at the crew center of Brussels Airlines, to the plane, boarding, flying, and deboarding).

After analysing the delay data multiple destinations came forward on which a delay because of deboarding occurs more often. Based on the data the following selection criteria were used to select flights: destinations on which delays because of deboarding occurred more often, aircraft type (both Airbus A319 and A320) and flights on which it was possible to do a rotation (back and forth to Brussels).

With these selection criteria the following flights were observed (*the flights marked in bold are on an A320 airplane, the flights in regular typeface on an A319*):

- | | | | |
|-----|-----------------|---|-----------------|
| 1. | Brussels | - | Madrid * |
| 2. | Madrid | - | Brussels |
| 3. | Brussels | - | Málaga |
| 4. | Málaga | - | Brussels |
| 5. | Brussels | - | Madrid |
| 6. | Madrid | - | Brussels |
| 7. | Brussels | - | Lisbon |
| 8. | Lisbon | - | Brussels |
| 9. | Brussels | - | Porto |
| 10. | Porto | - | Brussels |
| 11. | Brussels | - | Nice |
| 12. | Nice | - | Brussels |
| 13. | Brussels | - | Faro |
| 14. | Faro | - | Brussels |

* Flight excluded from results, used as a pilot test to find the best way of observing and documenting.

During the deboarding of each flight the deboarding time was measured with a stopwatch on a smart phone. The following milestones of deboarding were measured:

1. Touchdown aircraft – start of timer
2. Aircraft arrival at gate (stand still)
3. First passenger to stand
4. FSB-light off
5. Plane door open
6. First passenger leaving the plane
7. Last passenger leaving the plane

Next to the time measurement every irregularity of the passenger stream going out of the aircraft was observed to see why the stream was held up and the location of the block. These observations were described in a notebook using a floor-plan of the aircraft. Figure 3.1 shows the two different floor-plans used for the observations.

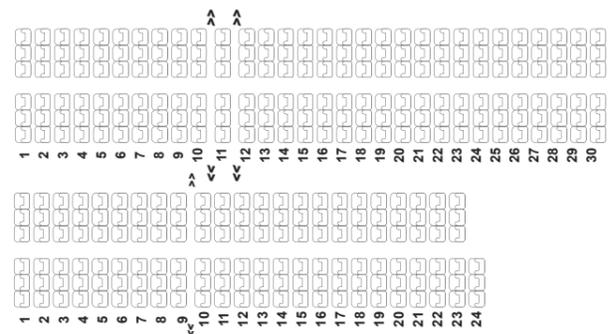


Figure 3.1: Floor-plans of the A320 (above) and the A319 (underneath) used during observations.

During flights the place of observing was determined by the availability of a place for the researcher. Figure 3.2 shows the different placements of observation, with most observations done from the front galley or front row.

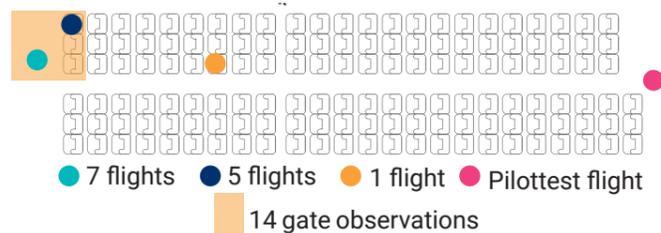


Figure 3.2: Place researcher during observation

OBSERVATIONS AT GATE BRUSSELS AIRPORT

After the 14 flights especially more data on the reasons for blocks was still needed. Therefore a different (more efficient) strategy was applied. The different approach was observing the deboarding only after the door opens, by entering the plane after the door opens and observe only this part of deboarding. For this second observation the same 6 flights were observed for 3 days (with exception of Nice and Vienna, which did not fly all 3 days), a total of 14 flights. (*The flights marked in bold are on an A320 airplane, the flights in regular typeface on an A319*)

1. Nice scheduled arrival 10:00 LT
2. Vienna scheduled arrival 11:05 LT
3. **Málaga scheduled arrival 12:25 LT**
4. **London scheduled arrival 13:15 LT**
5. Madrid scheduled arrival 14:55 LT
6. **Porto scheduled arrival 16:10 LT**

These flights were chosen to have both the Airbus A319 and A320 in the set, different kind of destination (holiday/business) and to have at least one hour in between (to ensure timely arrival at the next gate even with small delays of previous flights).

For these observations the same method was used for time measurement (except starting stopwatch when airplane arrives at the gate instead of touchdown) and collect data on the irregularities of the passenger stream as the observations during flight.

All observations were done from the front galley or the first row, depending on availability of space in the front row (see figure 3.2).

To get an impression of the observational research a picture collage has been included in appendix B.



Figure 3.3: Overview of the observed flights flying & the observed flights at the gates of Brussels Airport

TIME MEASUREMENTS

In total 28 flights were observed. 14 concerned the entire flight and 14 only after the door opens at the gate of Brussels Airport. The results of the time measurements of the 28 flights can be found in table 1. None of the flights had a delay caused by deboarding or boarding.

The average deboarding time per passenger on the A319 flights was 3,26 seconds per passenger and for the A320 the average was 3,34 seconds per passenger.

The fastest deboarding times on the A319 are of flight BRU-LIS (7) with 2,64 seconds per passenger, LIS-BRU(8) with 2,69 seconds per passenger and NCE-BRU (24) with 2,68 seconds per passenger.

The fastest deboarding times on the A320 are 2,55 seconds per passenger (OPO-BRU, flight 10), 2,56 seconds per passenger (LHR-BRU, flight 17) and 2,62 seconds per passenger (AGP-BRU, flight 16)
The slowest deboarding time is on the A319 flight 20 VIE-BRU with 4,67 seconds per passenger. And on a A320 flight 11 BRU-NCE with 4,42 seconds per passenger. Approximately 2 second difference with the fastest deboarding time. To illustrate, if both the slowest & fastest flights would have been at full capacity this would be a difference of approximately 5 minutes.

There does not seem to be a direct relation between the amount of observed blocks and the deboarding time.

Table 1: Results of time measurements during flights. Flight 1 excluded because of pilot test, flight 6 is excluded because of technical issues. *2 door deboarding, excluded from A320 average.

	Flight	Till door open	Till first pax out	Till last pax out	Sec/pax	Blocks	Pax
A319	2 MAD-BRU	03:24	00:20	06:59	4,41	6	95/141
	3 BRU-AGP	08:00	00:20	07:40	3,43	8	134/141
	4 AGP-BRU	04:25	00:10	06:41	3,18	9	126/141
	5 BRU-MAD	03:33	00:09	07:08	3,15	11	136/141
	7 BRU-LIS	02:20	00:11	06:01	2,64	12	137/141
	8 LIS-BRU	02:01	00:31	05:20	2,69	12	119/141
	15 VIE-BRU	02:21	00:17	04:33	3,03	11	90/141
	18 MAD-BRU	02:40	00:16	06:43	2,92	12	138/141
	20 VIE-BRU	02:22	00:15	07:19	4,67	9	94/141
	22 MAD-BRU	03:41	00:18	06:27	2,88	15	134/141
	24 NCE-BRU	-	-	05:56	2,68	12	133/141
	25 AGP-BRU	02:35	00:15	06:45	2,87	13	141/141
	27 MAD-BRU	09:52	00:15	08:28	3,85	17	132/141
	Average A319	03:56	00:16	06:36	3,26	11	
A320	9 BRU-OPO	02:30	00:16	09:42	3,27	11	178/180
	10 OPO-BRU	03:11	00:14	07:06	2,55	9	167/180
	11 BRU-NCE	02:01	00:20	12:10	4,42	17	165/180
	12 NCE-BRU	04:23	00:18	10:30	3,58	11	176/180
	13 BRU-FAO	01:51	00:05	04:05	1,47*	6	167/180
	14 FAO-BRU	07:39	00:10	10:42	3,36	13	177/180
	16 AGP-BRU	02:08	01:15	07:34	2,62	14	173/180
	17 LHR-BRU	04:37	00:15	07:35	2,56	22	178/180
	19 OPO-BRU	03:58	00:43	11:55	4,16	17	172/180
	21 LHR-BRU	03:59	00:15	06:14	2,79	18	134/180
	23 OPO-BRU	02:00	00:33	08:09	2,88	14	170/180
	26 LHR-BRU	03:01	00:17	09:26	3,89	19	167/180
	28 OPO-BRU	03:35	00:20	11:33	4,05	18	171/180
	Average A320	03:27	00:23	08:58	3,34	15	

SLOWEST DEBOARDING
FASTEST DEBOARDING

PASSENGER BEHAVIOUR

During the 14 flights which were observed in full the behaviour of passengers between landing and the actual deboarding of the plane was also observed. The following more general findings were made during these observations:

- During the taxi many seatbelts are already taken off (while the FSB light is still on). And after people notice other people taking it off they copy the behaviour.
- During the taxi the chef de cabin needs to make an announcement to stay seated during the taxi, especially during the longer taxis this is needed to ensure people stay seated.
- Sometimes the chef de cabin makes an announcement for connecting passengers, giving information about what gate they arrive, what gate their next flight leaves and when the boarding starts. This is done to inform people and to give them some piece of mind.
- After the plane stands still, but before the FSB light is turned off many people already stand up. The aisle is already full before the light is turned off.
- People do stay seated till the FSB light is turned off when the flight or landing did not happen as it usually does (for instance when the plane did a go around during landing or there was bad weather).
- When the aisle is full other people wait while seated or stand (uncomfortably) in their row. However when it takes a long time before the door opens more and more people squeeze into the aisle making it more crowded.
- Also when more time passes by more people choose to no longer wait sitting down but stand up in their aisle, taking a uncomfortable position while waiting.
- Also the passengers on the last six rows (approximately) are standing from the start without movement and are often the last to leave the plane.

- Passengers do not process and/or acknowledge all information given to them in the aircraft, for instance during a boarding announcement given by the crew to stow smaller items underneath the seat in front of the passenger instead of the overhead bin you can see passengers putting their coat or handbag in the overhead bin.

PASSENGER FLOW DISRUPTIONS

The reasons for disruptions in the passenger stream are clustered in three different kind of blocks (the flow stops) and two different reasons for slowing down the flow. The most occurring reason for blocking the stream is retrieving the luggage from the overhead bin (Fig.3.4). Not everyone can easily access the bin, but also very big or heavy luggage items make it hard to get the luggage out of the bin. Retrieving luggage stowed in the overhead bin behind the seat (Fig. 3.5) does not occur that often, but does give a bigger disruption in the passenger flow. And as a last block giving priority to a person (Fig. 3.6) still sitting/hanging in their row seems a social action to do, however it does keep up the stream since this person still needs to get out & retrieve their luggage.

The last two disruptions of the stream do not block, but only slow down the stream. People with reduced mobility (PRM) and elderly (Fig. 3.7) have a harder time walking through the aisle. The second reason are people with little kids or with big/clumsy luggage (Fig. 3.8). For this last category it seems hard to manoeuvre through the aisle. People with a lot or big luggage get stuck behind a chair or seem confused to how to get all the luggage through the narrow aisle. Little children are allowed the same luggage items, therefore the parent often walks with multiple trolleys or the little child walks with a very large trolley (in comparison with himself).

The results of all observed disruptions in the passenger stream disembarking of the 28 observed flights can be found in figure 3.9 on the next page, for these results flight 1 is excluded since it was used as a pilot test. Appendix C has all raw data about the blocks and shows blocks for separate flights.

A total of 189 disruptions of the passenger flow were observed on the A320 flights and 154 disruptions on the A319 flights. With both aircraft types the blocks because of a person retrieving luggage from the overhead bin occurs the most. And also for both aircraft types slow walkers because of big/many luggage items and/or children are the second most occurring reason for disruptions of the stream. With both the A319 flights and the A320 flights the most disruptions of the passenger stream occur between row 3 and 10. For A320 this is 45% of all blocks and for the A319 even 60%.



Figure 3.4: Passenger retrieving luggage from overhead bin, causing a block of the stream.

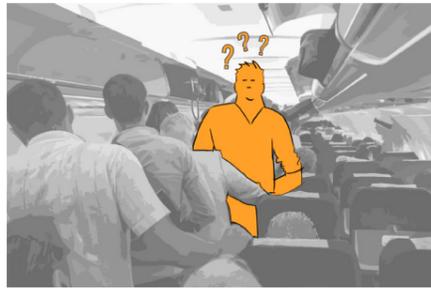


Figure 3.5: Passenger trying to go against the stream to retrieve luggage behind seat.



Figure 3.6: Passenger giving priority to a person in front of them to get out of their row.



Figure 3.7: Elderly walking slow through the aisle, slowing down the stream



Figure 3.8: A passenger with a child, slowing down the stream.

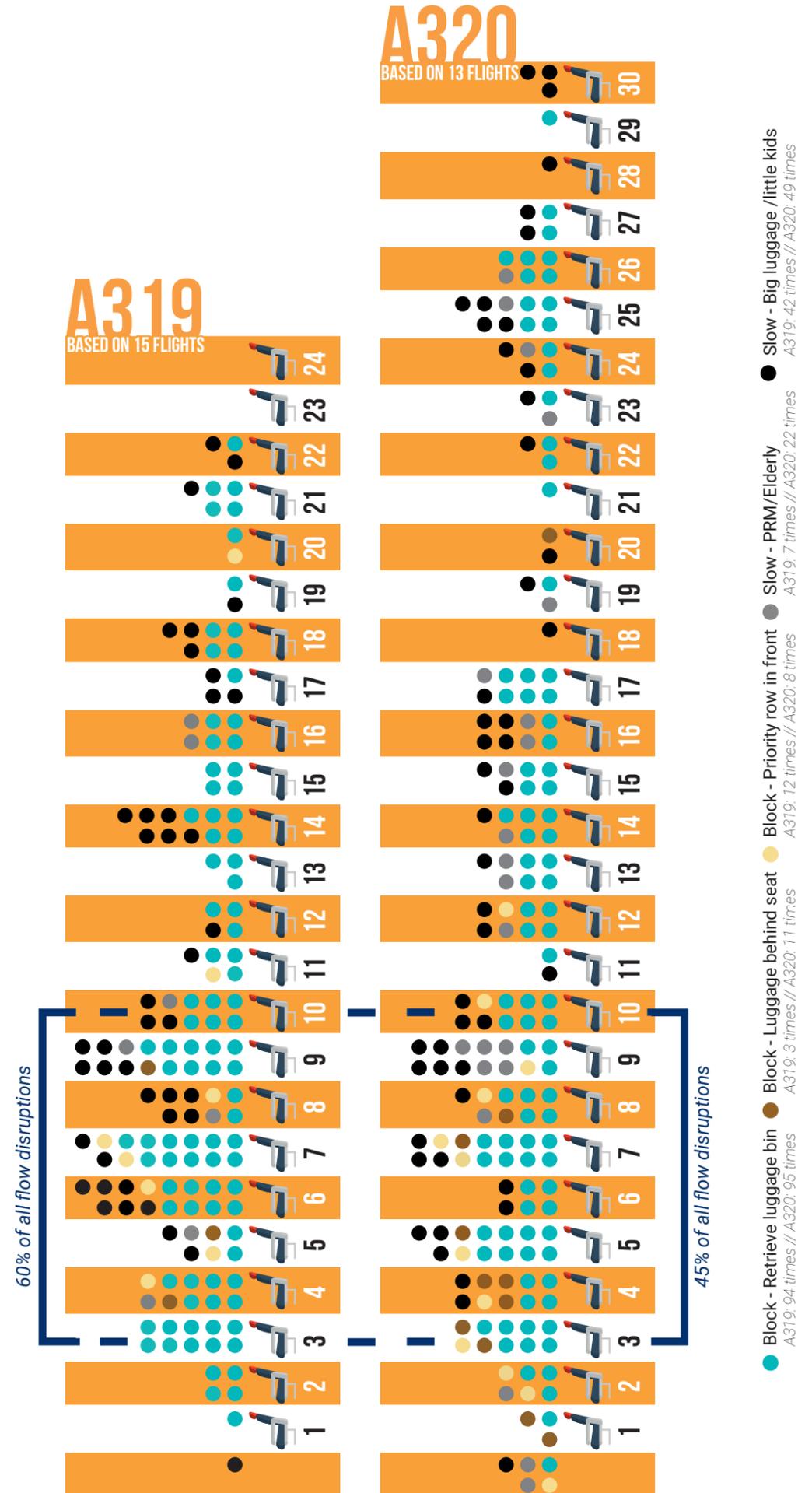


Figure 3.9: Results of all observations, every dot is an observed disruption during one of the 28 flights. A total of 189 disruptions on the A320 and a total of 154 on the A319.

DISCUSSION & CONCLUSION

The observations made clear there is room for improvement on the, now random, deboarding. Since the most optimal way of deboarding would be if there is a constant stream of passengers leaving the plane, without gaps in between passengers, every block or disruption of the stream is a potential improvement to make the deboarding more efficient.

The disruptions can mainly be brought back to a couple of bottlenecks: Luggage (too many, too big, too heavy to easily handle), the aisle (too narrow to manoeuvre and to hold all passengers), the overhead bin (hard to reach, not enough space) and the door (only so many people can exit the plane at the same time). The problems with overhead bin, aisle and the door are however also caused or at least related to the luggage (for instance without luggage walking through the aisle would not be an issue for the average passenger)

The literature also showed potential in implementing a new deboarding strategy. Instead of a random deboarding a structured deboarding. The challenge here would mostly lie with the behaviour of passengers. The observations showed passengers do not process and/or acknowledge all information that is given to them, they seem impatient to leave the plane and they do not always 'listen' to guidelines such as the FSB light.

Therefore the research (see Fig. 3.10) shows two main potential design opportunities. First to solve the disruptions of the passenger stream by solving the bottlenecks of luggage, aisle, overhead bin and/or door. Especially in row 3 till 10 the problems seem to pile up, however the question would be if these are solved specifically if the problem would simply move further back in the aisle.

The second would be to develop a design intervention which would make the passengers follow (and actually listen) to a structured deboarding strategy.

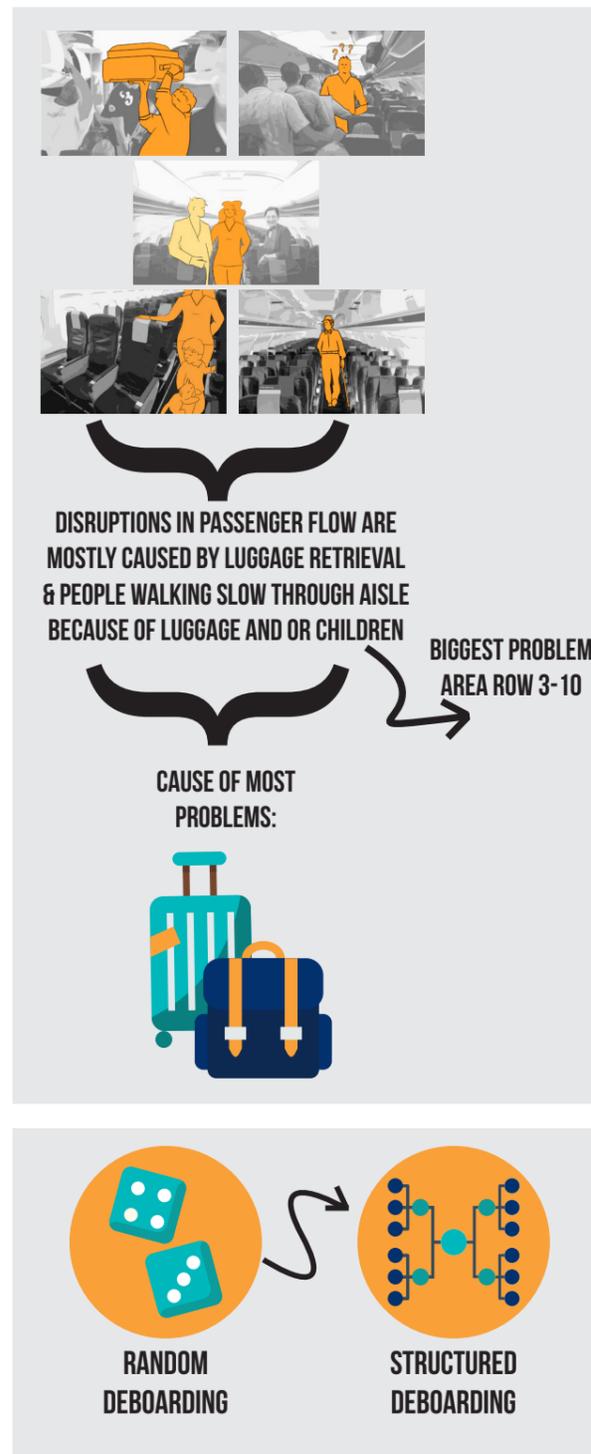


Figure 3.10: Summary of main findings discover phase.

The observational research is executed in the months July & August, the peak holiday season. This audience is very different to the audience in for instance October. In the winter months there are more business travellers who only travel with their trolley & laptop bag so they don't have to wait at the baggage retrieval and in the winter another luggage item comes into play, the winter coat. People do not want to stow this underneath their seat so this takes up bin space. The research could therefore show different results when done outside the summer season. This is also something the delay data of Brussels Airlines suggest, since at the start of this year more delays because of (de)boarding were reported in comparison with the summer months.

The time measurements showed a 2 seconds per passenger difference between the slowest deboarding and the fastest. However none of the (next) flights were reported delayed because of deboarding. This means that even the slowest deboarding did not give problems during these flights. More research could show how much this difference would be on the flights which actually cause a delay because of deboarding.

During the observations the place of observation was dependent on the availability of an observation spot. During the first 14 observations (flying with the flights) the research was dependent if the researcher had to sit on the jump seat in the front galley, the jump seat in the back galley, a cabin (passenger) seat or a jump-seat in the cockpit. Since the passengers stand before the FSB light is turned off there was no room to change location and therefore the placement of the researcher during flight was also the observation placement. During the observations it became apparent that the best place to see the aisle and what happens is at in the first row (business class seats), since the view is clear towards the entire aisle (front, middle & back). In the back galley the view is the most limited, since you only see the people standing in the aisle in the back and no movements. More towards the middle it is hard to keep track of the entire aisle. When sitting in the cockpit the first part of the deboarding is not observable, this mostly had an impact on observing the behaviour of the passengers before the door opens.

To understand the blocks in passenger flow not only the reason for the block was documented, but also the location of the block (i.e. row numbers used to define the location in the aisle). Some rows were easily determined, these could be seen in one glance (e.g. the front row, back row, the emergency exit rows). The other rows had to be quickly counted, to determine the location. Therefore it could be some of the blocks may differ a row because of a miscount. The observations happened in short timespan and therefore it was necessary to quickly locate a block.

4 DEFINE

The discover phase showed potential improvements in the deboarding process. In this chapter an overview of the insights from the direct users of the process and the scope of the project will be set. The scope will be formulated by defining which design goal is aimed for in the project and what requirements there are.



THE PASSENGER

Different kind of people use an airplane for transportation and also with different purposes. The design intervention should be usable for all the different kind of passengers, since in the deboarding there is no possibility to only address a part of the passengers. Brussels Airlines executed a large passenger study to form and define in total 5 passenger profiles. Based on the data of this research 5 persona's were created for this project (figure 4.1), each representing one of the passenger profiles.

Although they all have different needs, there are some similarities. Two frustrations are found with all different passenger profiles: the waiting times and the uncertainty delays will give them. Especially clear communication and transparency are preferred by the different passengers.

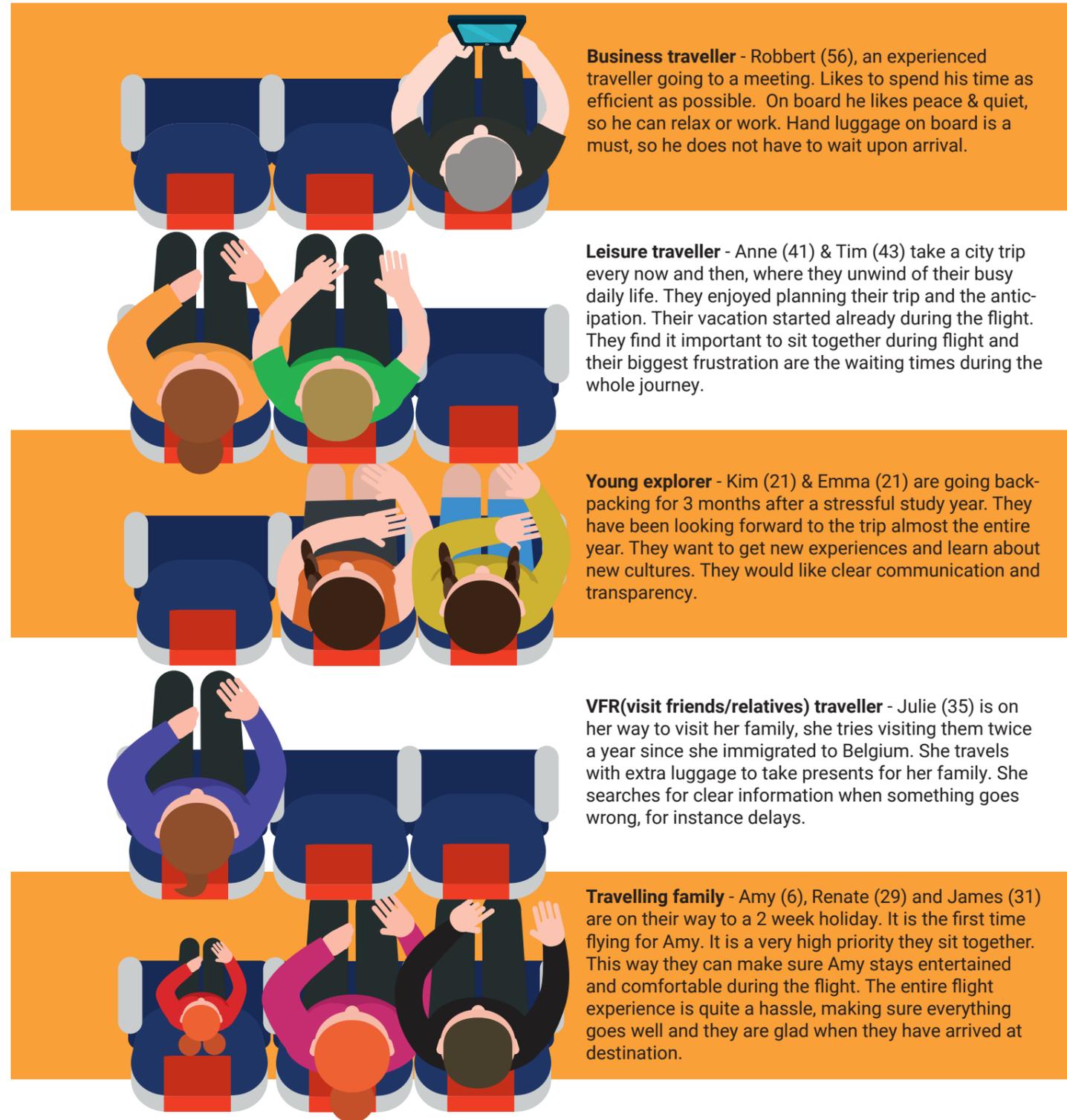


Figure 4.1: Five different persona's based on different passenger profiles. On most flights a mix of all these passengers will be present.

DESIGN OPPORTUNITIES

The starting point of the project was to develop a design intervention which will make the deboarding process of a narrow body aircraft more efficient for the airline and simultaneously a better user experience for the passenger.

The discover phase showed two main issues standing in the way of an efficient deboarding. First the hand luggage of the passengers and second the behaviour of passengers during deboarding. The chaotic way of deboarding in combination with the hand luggage cause blockages in the passenger flow going out of the plane. People feel impatient, uncomfortable and frustrated because of the process and the other passengers behaviour. Based on this discovery two design opportunities have emerged.

- 1) To make passengers understand and follow up on a structured deboarding method.
- 2) To make deboarding the plane easier for the passenger by taking away difficulties concerning their luggage.

Since the two design opportunities ask for different approaches and it should fit in the time span of the graduation project a choice had to be made. The second opportunity is chosen to ideate, prototype & test. This opportunity is chosen for two reasons. First luggage is a major issue for the airline, but also for the passenger and a solution could possibly also have a positive effect on other processes. And next to this the process already feels complicated, adding the structured deboarding has the pitfall of only making it more complicated for the passenger & crew. When the luggage issues are already simplified, it would be interesting to take a look at a different deboarding strategy.

DESIGN GOAL

The design goal is to make deboarding with hand luggage more smooth for passengers.

The context of the project is inside the cabin of an airplane, where there is limited space and people take multiple luggage items per passenger on board in the cabin. The amount, weight and size of the luggage make it hard to retrieve it from the overhead bin and get out of the plane. Because of the narrow aisle of the plane the passengers cause blocks or are slowing down the other passengers getting out of the plane, making it an inefficient process.

The people involved in the situation are the passengers who are of mixed ages, experience level, travel purpose and personalities. They feel **stress, impatience and frustration**, because they want to get out of the plane as soon as possible and are held up by other passengers or their luggage. Also the cabin crew is present during the process, but do not influence the process since they also can not manoeuvre through the aisle.

The desired situation should be implementing a design intervention which will ensure passengers can retrieve their luggage, walk through the aisle and walk out of the door without being held up by their luggage. Making it **relaxed, effortless, and giving the passengers a feeling of being in control.**

DESIGN PARAMETERS

Based on the discover phase, the passenger study and conversations with the company problem owner design parameters are formulated.

Efficiency

As described in the original assignment the deboarding should become more efficient, which in this project is translated to decreasing the deboarding time. To be able to compare different flights (with different passengers loads) this is adapted to decreasing the deboarding time per passenger.

Short term

As seen in the company data the delays because of deboarding are increasing. Since it is a problem of the present, which seems to increase the solution should aim for a short term effect.

No physical changes in the cabin

The problem owner has one restriction to the solutions: the solution should not include a change in the cabin. A change in the cabin needs years of development and getting approved in terms of safety and regulations. This restriction is therefore in line with the previous parameter to aim for a short term solution.

Technical feasibility

The solution would be technical feasible. Not only should the technology be available, the solution needs to be developed quick (see also parameter short term).

Operations

The solution should fit within the operations of the airline, the operations can not be stopped for a certain time period to implement new solutions. It can not interfere with current operations and should be executable and implementable in the current operations.

Part of turn around

Should not interfere with other processes in the turn around (e.g. catering, cleaning)

Revenue management

Brussels Airlines is an airline, therefore it needs to make a profit. The solution should therefore not decrease the revenue.

Part of flying journey

The solution should not move the problem to a previous or next stage of the process. For instance by solving the problem in deboarding, but creating the problem with the baggage reclaim.

Customer experience

The customer experience should not be negatively influenced by the solution. Brussels Airlines uses a system NPS-score to measure the customer experience, it is based on a questionnaire and the scores the passenger gives after a flight. The solution should not have a negative influence on this score, and preferably have a positive influence (wish).

Different passengers

As shown earlier in this chapter, there are different passengers with different purposes of flying and characteristics. The solution should aim to include multiple passenger profiles and not only focus on a single passenger profile. Deboarding is a group effort, therefore focussing on one passenger profile will not solve the issues of deboarding.

Clear communication & transparency

The passenger study of Brussels Airlines made clear no matter what kind of passenger is travelling, they wish for more transparency and clear communication. Uncertainty is one of their biggest frustrations. Therefore the solution should aim to communicate clearly and transparent.

Crew needs

The deboarding process has more than 1 user, also crew is effected by the deboarding. The needs of crew should therefore also be taken into account. The crew should not get extra stress or pressure because of the solution.

Touchpoints

During the passenger journey the first touchpoint with some passengers is at the gate, during boarding and the last touchpoint is often already directly after deboarding. Expanding the touchpoints with passengers would be interesting for the airline, to strengthen brand presence and differentiating with competitors.

5 DEVELOP

The discover phase showed the different bottlenecks of the deboarding process and in the define phase the scope of the project is set. The next phase is the develop phase in which through ideation as many solutions as possible are found. This chapter shows the ideation process and a first selection resulting in five concepts and finally the selection of one concept to test and develop further.

To get a broad view on the possible solutions for the design goal four creative sessions were held which all gave a different view on the problem. The first creative sessions was with different stakeholders within Brussels Airlines. Combing the knowledge of the departments gave insights in the problem from the perspective of each of the involved stakeholder and solutions which are based on experience and knowledge in the aviation industry. The other creative sessions are held with Industrial Design Engineering students following the course Creative Facilitation. These groups do not have prior knowledge of the aviation industry or the problem itself, therefore have a fresh perspective on the issue at hand. A short description of each session will be given in this chapter.

CREATIVE SESSION BRUSSELS AIRLINES

The session was held in the offices of Brussels Airlines with one participant of each of the following departments: Passenger Services, Cabin Crew, Customer Experience and Ground Procedures. The session was done in two parts. First an individual dynamic brainwrite, with five different "how to"(H2) questions the participants got to brainstorm on each H2 question for 5 minutes and then rotate to a next question. The H2 questions were "H2 move easier through the aisle with hand luggage?", "H2 convince passengers to take less hand luggage?", "H2 make it easier to retrieve hand luggage from the overhead bin?", "H2 take away stress from passenger during deboarding?" and "H2 get passengers faster out of a plane?". After this the more general H2 question was formulated as "H2 make deboarding with hand luggage more smooth for passengers?". With different 'trigger cards' new solution spaces were explored (e.g. what if there is no overhead bin, what if you could start all over with organizing the cabin, how would Disney solve the deboarding, how to make deboarding slower, what if passengers need to collaborate or how could you reward or punish them?). From all the ideas the participants got to select their favourite, most realistic and most surprising idea. Using the voting system everyone could individually express their opinion, while also keeping the less obvious ideas on the table. The voting system also gave a first impression what the experts would find suitable solutions. See Appendix D for the outcome of the creative session.

CREATIVE SESSIONS IDE STUDENTS

In total three groups held a session on the topic of deboarding. A mix of different master specialities was present in all three groups. Two groups were all with Dutch nationality and the third group was a mix of different nationalities. To get as many ideas as possible - *said by Tassoul (2009) you need quantity to get quality in brainstorm sessions* - the groups all had a different approach. The third group focussed on how to persuade people to take less hand luggage whilst the other two groups took a more broader approach, first doing a more elaborate problem analysis through a guided fantasy or an enactment (see figure 5.1) of the deboarding and from there formulate their problem statement.

After all four sessions the ideas were all put together and clustered. A clear separation could be made between solutions which persuaded the passenger to take less hand luggage, persuading the passenger to check in their hand luggage, giving the passenger a different state of mind (e.g. less stress) and last to change the way luggage/people get out of the plane. In Appendix D an overview of all ideas in this re-clustering can be seen



Figure 5.1: Impression of a creative session with IDE students, sitting close together with a narrow aisle in the middle to immerse themselves in the situation.

Going through all ideas a first selection was made for five concepts. Many of the ideas are put aside because of the fact it would involve a change in the cabin of the aircraft. Changing the cabin would be a long and difficult path to follow, which could end up taking 10, 20 or more years to develop, because of safety regulations and the many parties involved. Since the deboarding is a problem of the present it was decided to go for a solution which would not involve a change in the cabin of the aircraft.

Secondly the ideas which would not improve the efficiency of deboarding or even make it slower are also left out of the selection. Last the ideas which would be more leading towards a structured deboarding were also put aside. As explained in the design brief, the structured deboarding is an interesting assignment to do further research into, but for this project is outside the scope.

After all ideas which included cabin changes, slower deboarding and structured deboarding were taken out five concept were left standing. These are:

- > Concept 1: b.prepared
- > Concept 2: Light travel priority
- > Concept 3: Interactive luggage wall
- > Concept 4: Holiday share
- > Concept 5: The luggage games

The five different concepts are very different from each other and also have different touchpoints in the customer journey when flying. Figure 5.2 shows where all concepts would meet the passenger. On the following pages the different concepts will be explained.

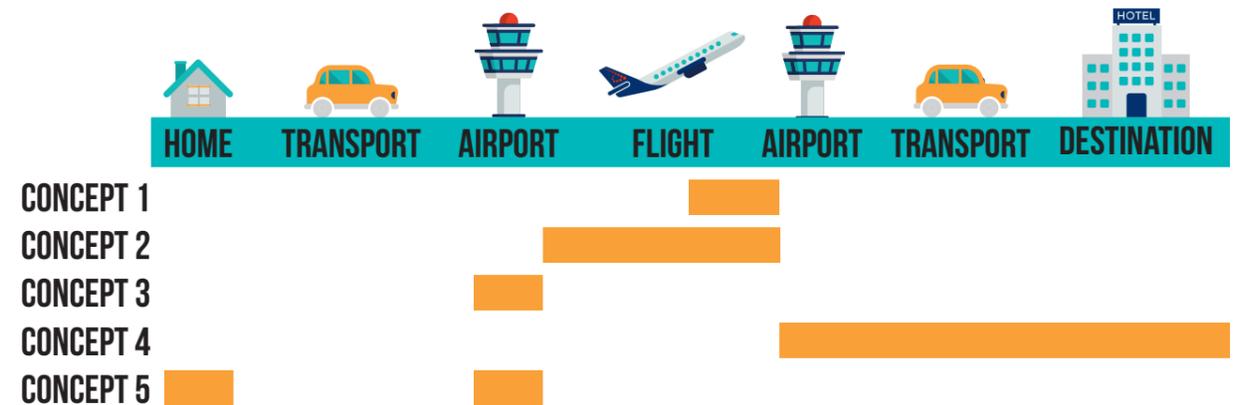


Figure 5.2: The five different concepts placed in the customer journey of the passenger.

CONCEPT 1 B. PREPARED

In the last stages of the flight the passengers can create their personal deboarding plan. The deboarding plan will inform them about where they need to go, how to get there and how much time they have. The concept aims to inform the passengers and thereby take away the doubt, insecurity and stress caused by the unknown situation of making a transfer to another flight or getting to their final destination through the airport.

This concept aims at changing the state of mind of the passengers during deboarding, creating a different mindset with the effect of a less chaotic deboarding in which the passengers might become less ego centric and more at ease. A visual of the concept can be found in figure 5.3.

The data on which gate you need to go and when you arrive are the two data sources that would need to be real time, or at least be updatable during the flight.

As long as there is no Wi-Fi on board of the SN flights, a work around can be found via a blue tooth solution, a printer or other analogue solution. In the ideal situation this would however come in via Wi-Fi directly to the device of the passenger, so the passenger himself is in control of the situation and to what extend he wants the information.



Figure 5.3: Visual of concept 1, smartphone app b.prepared with your personal deboarding plan.

VALUE

ADVANTAGES

- > Has a passenger centric focus, concentrating on the user experience of the passengers during the deboarding.
- > Could be developed and implemented short term (if Wi-fi on board), without interfering with current processes.
- > Takes away uncertainty & stress of the passenger
- > Would not ask more of operational side of deboarding
- > Would not give the crew extra tasks

LIMITATIONS

- > The concept needs real time data, at the moment the airplanes of Brussels Airlines do not have Wi-fi during flight.
- > The hand luggage is not limited, therefore similar problems will still occur with regards to the hand luggage. Which does not mean the deboarding time will not be affected.
- > The concept is a digital solution, still not all passengers are in possession of a device which could display the personal deboarding plan.

UNIQUE ELEMENT

Differentiating the airline with better communication & transparency, as seen in the passenger study one of the top wishes of the passengers.

CONCEPT 2 LIGHT TRAVEL PRIORITY

The concept is to position the passengers according to the amount of hand luggage they have with them to fly. The people with a lot of hand luggage get a seat in the back, the passengers who are travelling light get a seat in the front (see fig. 5.5). Next to the new seating arrangement the people with less or no hand luggage get a priority boarding (see fig. 5.4), and because they sit in the front they automatically also get a priority deboarding. Making travelling without hand luggage easier and faster for the passenger and simultaneously as said by Yuan et al (2007) the boarding and deboarding time shorter because of the new distribution of the passengers and their hand luggage.

This would mean people do not get a seat assigned during booking or even before arriving at the airport. The seating could be free seating (just sit down the first empty seat you see) or assigning the seat at the gate.

Another option would be to ask how much hand luggage someone expects to take during the booking process (or making and arranging the passengers accordingly. This would ask a lot of the gate agent to check if people actually bring the amount of hand luggage they said they would bring.

VALUE

ADVANTAGES

- > The passenger is rewarded for travelling with less hand luggage by boarding first and automatic also deboarding first (since the people in the front deboard earlier in comparison with the people in the back), giving the passengers an incentive to take less hand luggage.
- > The boarding & deboarding should become more efficient.

LIMITATIONS

- > Will make the boarding process and tasks of gate agents different to the current situation, depending on how the concept is developed further this could mean more demanding tasks.
- > Can not sell seat selection, which is now an ancillary which increases revenue.
- > Will make the boarding process operationally more difficult, moving the seat assignment to the gate and checking the luggage more extensively at the gate.
- > Groups travelling together (or families with kids) can be separated by this system, which is important for some passenger groups (see persona's chapter 4)

UNIQUE ELEMENT

Makes the dealing with luggage more transparent and fair*, people will no longer feel they are treated unfair because their luggage is taken away even if they only have a small bag.

**In the current situation at Brussels Airlines there is a first come first serve principle. The gate agents will count trolleys up to a certain quota (set amount which differs per aircraft type), after this number all items which do not fit under a seat will be labelled and put in the belly of the plane. Until this quota is reached the gate agents do not always check if the luggage fits the allowance. This creates situations in which the first passengers sometimes bring more than two items or items which are too big while people who are boarding later and did stick to the rules are 'punished'.*



Figure 5.4: Visual of concept 2, different priorities at the gate.

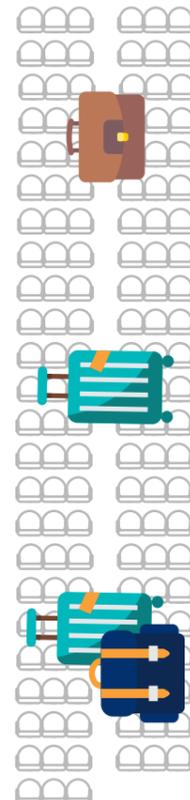


Figure 5.5: People with more hand luggage in the back, people with less in the front.

CONCEPT 3

INTERACTIVE LUGGAGE WALL

While walking through the terminal of the airport the passenger will encounter the interactive luggage wall. When the passenger has a little bit of hand luggage the interactive wall will react positively to the passenger. This means a visualisation of a happy crew member will be shown. If the passenger has multiple hand luggage items the wall will react negatively, showing a disappointed crew member. A visual representation of the concept is shown in figure 5.6.

The wall plays to the passengers emotions by giving positive feedback for good behaviour and more negative feedback when the passenger has unwanted behaviour.

Based on literature of Fogg (2009) about persuasive design, one of three motivators in human behaviour is social acceptance/rejection. The Interactive Luggage Wall can thereby have an impact on the motivation to take less hand luggage by addressing the need to avoid social rejection (i.e. of the crew but also other passengers around).

Fogg (2009) describes in total 3 motivators, next to social acceptance/rejection also pain/pleasure and hope/fear are motivators. The wall in addition could offer a reward or punishment (pain/pleasure) in the form of for instance a free drink or a fee. To address hope/fear a sort of lottery could also be implemented in the wall, offering an upgrade or an occasional downgrade.

The wall could potentially replace the sizewizer, but only if it would be mandatory to use the wall and if there is a form of feedback towards the gate what the result was of the wall. This way a task could be taken away from the gate agents.

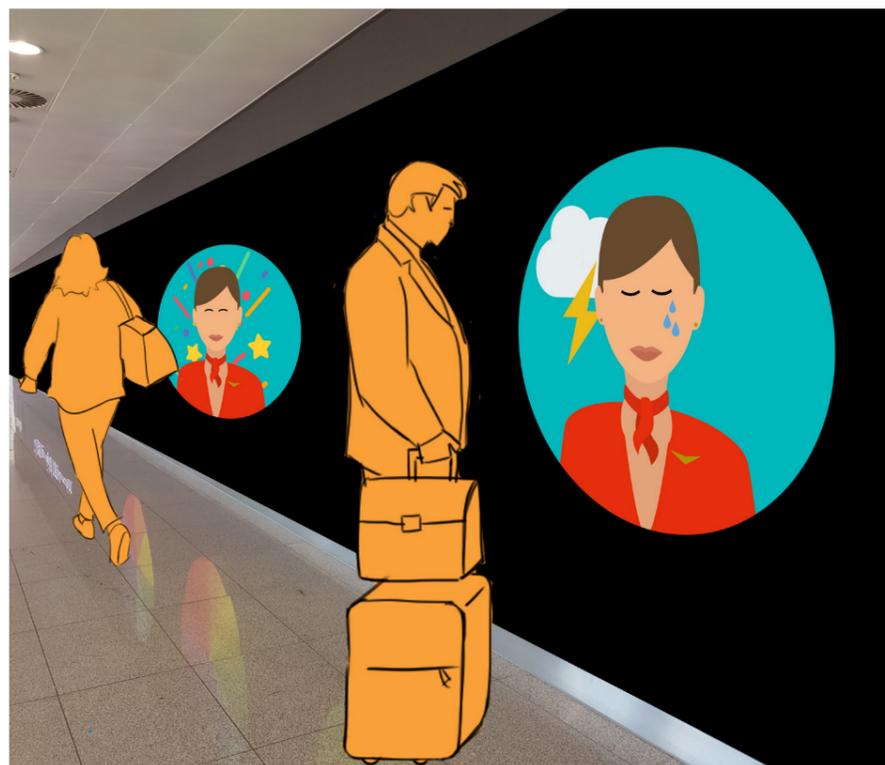


Figure 5.6: Visual of concept 3, the interactive wall shows feedback to the amount of luggage in the form of a cabin crew with a positive or negative emotion

VALUE

ADVANTAGES

- > The concept is more subtle in convincing people to bring less hand luggage in comparison with for example Ryanair who is going to forbid the trolleys. Making it a more passenger friendly solution
- > Potentially could take over the function of the current 'size wizer', taking away a task of the gate agent.

LIMITATIONS

- > Since the concept is more 'subtle', this could also mean (a group of) passengers will not react and thereby the concept will not have an effect.
- > Need to execute in collaboration with the airport(s), since the wall needs to be installed in a terminal.
- > When also including the downgrade or punishment this could have a negative effect on the user experience of the airline and thereby the brand image.

UNIQUE ELEMENT

People don't feel like they are being told or forbidden to take less hand luggage, since it will be their own choice to take less. Which will therefore not have a negative impact on the airline.

CONCEPT 4 HOLIDAY SHARE

How to persuade passengers to take less hand luggage? By providing the things they need at their destination! At every airport there is a 'Holiday Share' where you can borrow clothes, electronic device chargers, books etc. Everything you could wish for you can use during your time abroad and return when you are at the airport on your way back home. This way all this stuff does not even have to be transported by air. The first goal would of course be to only offer the things people normally bring in their hand luggage, but also the hold luggage could in the end be replaced by a shareable items community.

The name of the concept, holiday share, suggests the concept is only aiming at passengers with a leisure purpose to their journey. A business traveller has the first need to be fast and on time, therefore to make the concept also work for the business man it would be needed to implement a service to reserve the items beforehand and have a pick up point. Also for the leisure traveller reserving the items can be an interesting addition, this way the passenger is certain the items will be available he/she wants on their journey.



Figure 5.7: Visual of concept 4, the holiday share shop as part of the airport terminal

A similar service is already provided in the USA, called DUFL, which focusses on the frequent business traveller no longer needing to drag their luggage through the airport.

The passenger no longer feels insecure about the luggage, everything that could be in a lost suitcase is also available to borrow at destination. It even makes your own stuff more safe at home, you can not lose your phone charger or anything you also still need after your holiday.

The concept also fits in the trend of the sharing community, with nowadays the options to share cars, bikes and even time-share a house.

The service could be provided by Brussels Airlines themselves, however they would need partners (such as the airports, providers). Another possibility is to start a start-up or find a start-up to collaborate with.



Figure 5.8: Visualisation of the sharing system, arriving at the airport, gathering your items, enjoy your holidays, return it and fly back

VALUE

ADVANTAGES

- > Limits the amount of hand luggage on board
- > Fits in the trend of a shared economy, attracting specific passengers with this mindset to the airline.
- > New opportunity to make revenue when Brussels Airlines is the one offering this service (or to partner up and get a share).

LIMITATIONS

- > Will have a long(er) acceptance time.
- > Mostly the younger traveller will be open to the concept (at the start)

UNIQUE ELEMENT

Could differentiate the airline from other airlines, by not just forbidding or limiting the hand luggage with rules and regulations, but providing a service to make the passenger as comfortable and easy as possible on their trip. Also expanding the presence of the airline in the lives of the passenger not only during the journey towards the destination, but at destination itself.

CONCEPT 5 THE LUGGAGE GAMES

In a fun way making passengers aware of the hand luggage and how to deal with it. Making them think what they actually need, what they really need on board, what are the consequences of a lot of hand luggage. The luggage games would be most effective if the passenger already comes in contact with it at home, so it can influence the hand luggage they bring on their next flight. However at the (departure) airport there is also a window of opportunity, between the moment passengers passed the security and they need to board there is some time to kill where you could get the attention of the passenger to participate in the luggage games. This second option would not have an immediate effect on the hand luggage on the next flight, but could influence future travels of the passenger.

In the visual below (fig. 5.9) some examples are given of (mini) games, all have the hand luggage as a main theme. The first one shows what you would need, which gives an opportunity to educate about what you actually need (e.g. afterwards you could even give a pack list with things you REALLY need in your hand luggage), the second mini game let's people think about the size and amount of hand luggage by swiping left or right to accept luggage on the plane. As feedback at the end of the game you could show the effect of allowing too much on board. The third game shows a memory style game, where the passenger has to remember where the luggage is stowed. The last screen shows an example of a feedback screen, showing a consequence of hand luggage nowadays, a plane has a delay because of the hand luggage.

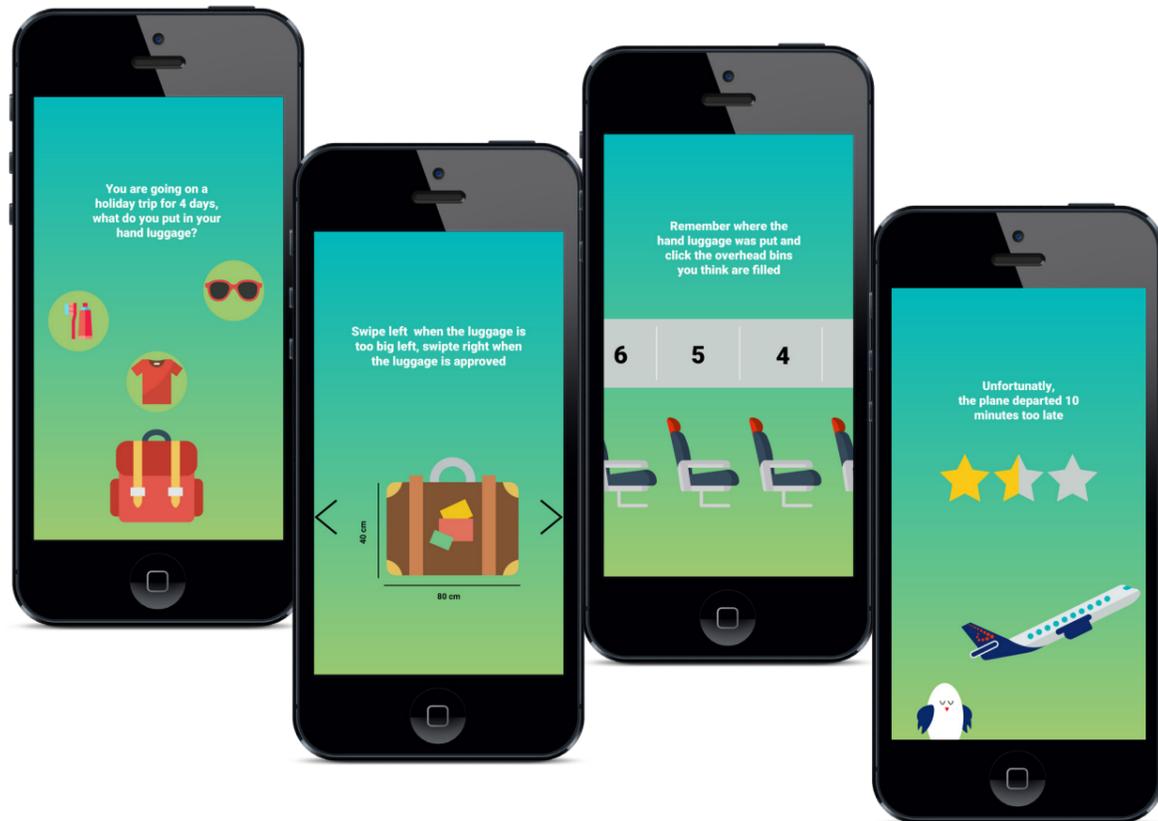


Figure 5.9: Visual examples of the concept 'The luggage games', showing a feedback screen and 3 game ideas.

VALUE

ADVANTAGES

- > Can be developed and implemented on the short term, without interfering with current operations.
- > Could be offered on multiple touchpoints in the customer journey, at home but also at the airport (e.g. similar to the 'airport games' currently at Brussels Airport, see fig. 5.10)
- > Has the possibility of decreasing the amount of hand luggage
- > Passenger gets better informed about the consequences of hand luggage, giving them more understanding of operations.

LIMITATIONS

- > The smartphone application is a digital solutions, thereby not reaching all passenger groups (e.g. elderly without access to digital devices).

UNIQUE ELEMENT

People don't feel like they are being told or forbidden to take less hand luggage, since it will be their own choice to take less. Which will therefore not have a negative impact on the airline. And also gives more transparency to the passengers why flights can be delayed because of hand luggage.



Figure 5.10: Picture taken at Brussels Airport, an installation called 'airport games' which can be played by passengers in the gate while they wait.

The observational research into the deboarding (described in chapter 3) showed multiple reasons for an inefficient deboarding process. Most of these reasons were related to the hand luggage, especially the trolleys in the overhead bin. Therefore 4 out of 5 concepts described in this chapter aim to decrease the amount of luggage. The question 'What would the actual effect be of less hand luggage on the deboarding?' rises. Therefore a test has been conducted to test what the effect is of less hand luggage on both the deboarding time and the user experience.

METHOD

A group of 16 people is asked to board and deboard the TU Delft test airplane (see fig. 5.11) two times. The first time the participants have a trolley and a personal item (e.g. a handbag or backpack). The trolleys are filled with a bag of potting soil of 3,5 kg, making all the filled trolleys between 5 and 6 kg each. The second time the participants only have a personal item. The total boarding time is measured starting the first person crossing a mark set in the cabin until the last person sits down in their seat. The deboarding time is measured starting from the first person standing up until the last person crossing the mark (see fig. 5.12 for the test setup), this time is based on the video footage. After each boarding & deboarding round the participants got a questionnaire. The questionnaires asked the participant to rate their experience of the two boardings and the two deboardings on a scale of 1 to 5. The participants are asked to rate their experience in terms of:

- Stress(1) - No stress (5)
- Rushed (1) - Not rushed (5)
- Negative (1) - Positive (5)
- Difficult (1) - Positive (5)
- Slow (1) - Fast (5)
- Confusing (1) - Clear (5)
- A lot of effort (1) - Effortless (5)
- Not in control over situation (1) - In control (5)

Next to these eight recurring questions the participants are also asked four questions to compare the two boardings & deboardings, after both boarding & deboarding rounds. In these questions they are asked which (de)boarding they preferred, why they preferred it, what went wrong in the other (de)boarding and what would improve their (de)boarding experience. All materials used during the test can be found in appendix F.

Participants

In total 16 participants were asked to board and deboard the plane. They were between 23 and 70 years of age. 14 out of 16 participants was female and 2 male. All had some experience with flying, varying between flying less then once a year, once a year to maximum twice a year.



Figure 5.11: Picture of the cabin of the TU Delft test plane.

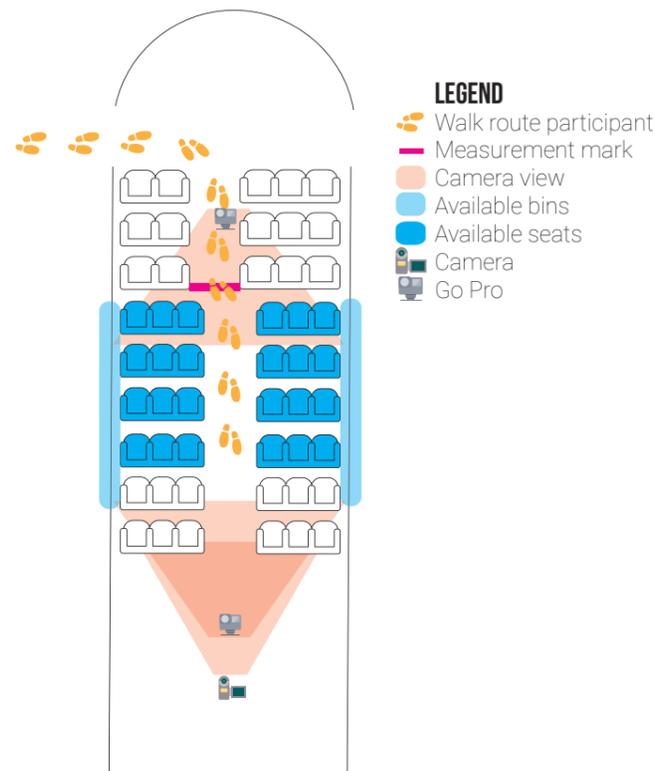


Figure 5.12: Test set-up, a top-view of the airplane including where the camera's were situated.

RESULTS

Table 2 shows the results of the time measurements during the two boarding rounds. It shows a difference between boarding round 1 (trolley & personal item) and boarding round 2 of 2 minutes and 2 seconds, a 42% decrease in time. Also the deboarding times are compared, these are found in table 3. The difference between the two deboarding times is 2 minutes and 19 seconds, an 80% decrease.

Table 2: Results time measurements boarding 1 (trolley & personal item) and boarding 2 (personal item)

	Time	Time per passenger
Boarding 1	04:51:52 min	18:15 sec
Boarding 2	02:49:58 min	10:37 sec
Difference	02:01:54 min	07:37 sec

Table 3: Results time measurements deboarding 1 (trolley & personal item) and deboarding 2 (personal item)

	Time	Time per passenger
Deboarding 1	02:54:13 min	10:53 sec
Deboarding 2	00:34:58 min	02:11 sec
Difference	02:19:15 min	08:42 sec

Next to the time measurements results, also data was gathered about the passenger experience. All the data gathered from the questionnaires can be found in appendix G. To compare the two boarding rounds and the two deboarding rounds statistical tests have been conducted to see if there is a significant difference between them. Table 4 shows the results of the statistical tests, for the variables which have a normal distribution a paired t-test has been executed and for the variables which are not normally distributed a wilcoxon signed rank test has been done.

The boarding shows a significant better experience in terms of being more positive, easy, fast, clear and effortless. The feeling of stress, rushed and being in control do show a more positive rating with boarding 1, with a rushed feeling showing a significant difference.

The deboarding shows a significant better experience for deboarding 2 in terms of being easy, fast, clear and effortless. The feeling of being in control over the situation did increase with deboarding 2, but not significantly. Stress and rushed are scored higher with boarding 1, with a rushed feeling showing a significant difference.

Table 4: Results user experience statistical tests boarding. Outcome reported with t are paired t-tests and outcome reported with z are wilcoxon signed rank tests

	Outcome	Significance (2-tailed)
Stress - No stress	z = -1,611	p=0,107
Rushed - Not rushed	z = -1,026	p=0,305
Negative - Positive	t(15) = -5,000	p=0,000
Difficult - Easy	z = -2,926	p=0,003
Slow - Fast	t(15) = -6,983	p=0,000
Confusing - Clear	t(15) = -6,484	p=0,000
Effort - Effortless	t(15) = -3,337	p=0,004
Not in control - In control	t(15) = -1,732	p=0,104

Table 5: Results user experience statistical tests deboarding. Outcome reported with t are paired t-tests and outcome reported with z are wilcoxon signed rank tests

	Outcome	Significance (2-tailed)
Stress - No stress	t(15) = 1,447	p=0,168
Rushed - Not rushed	t(15) = 2,360	p=0,032
Negative - Positive	t(15) = -1,815	p=0,089
Difficult - Easy	z = -2,048	p=0,041
Slow - Fast	z = -3,108	p=0,002
Confusing - Clear	t(15) = -3,437	p=0,004
Effort - Effortless	t(15) = -2,546	p=0,022
Not in control - In control	t(15) = -2,076	p=0,055

Comparing the two boarding and the two deboarding rounds 14 out of 16 participants prefer the boarding without trolley. When asked why participants say there was less hassle (N=8), no blocked aisle (N=2), less chaos (N=2), less waiting time (N=1) and you do not need to go against stream to find an empty bin space (N=1). The two passengers which preferred the boarding with hand luggage both experienced less waiting time during this round.

15 out of 16 participants prefer the deboarding without trolley. The reasons given are less chaos (N=5), less hassle (N=2), less waiting time (N=5) and not going against stream to retrieve luggage (N=2). The participant which preferred deboarding round 1 said the round was more relaxed, the second one felt very rushed because everyone was getting out fast.

SELECTION

CONCLUSION

At the start of this paragraph the question 'What is the effect of less hand luggage be on the deboarding time?' was raised. The test showed taking away all trolleys will decrease the deboarding time, as well as the boarding time. Which means decreasing luggage will have an effect on the deboarding time and could make the deboarding more efficient.

Next to this the test also showed the effect on the user experience of taking away all trolleys from the flight. Decreasing the amount of luggage would make the deboarding easier, more clear, take less effort and experienced as faster. The feeling of being in control, stressed and rushed are not positively influenced by the decrease of luggage.

During the boarding all the user experience scales are rated more positively with the boarding without the trolleys. The results showed a significant difference for being more positive, easier, experienced faster, more clear and to take less effort.

Therefore taking away the trolleys, or at least decrease the amount of hand luggage will have a positive effect on both efficiency of boarding and deboarding as well as a positive effect on the user experience during (de) boarding.

DISCUSSION

The test results show a positive outcome to decreasing the amount of hand luggage. The test did have some limitations, which are described further in this paragraph.

The test was setup in a way all participants had a trolley or no one had a trolley. In reality now the majority has a trolley, but not all passengers. And also in the future not all trolleys will probably be gone from the cabin but a part of it. Therefore these are two extremes of the situation, which means this does not translate one on one to reality when hand luggage is decreased.

The test shows a large decrease of time needed per boarding and deboarding. These results are however only based on one group of 16 participants, the test should be repeated multiple times to make more definite conclusions.

Especially the deboarding time has decreased a lot. With both rounds the introduction given to the participants mentioned they should take into account they needed to catch a transfer, taxi or train. This part of the introduction was not processed or heard by all participants in the first round. This probably had an effect on the time it took to deboard, but also on the user experience questionnaire. Explaining partly why the user experience rated worse for deboarding 2 when looking at stressed and rushed.

Further testing should be executed to find if these results are consistent and can be translated to the population and not only for a singular test. It would be advisable to have a larger group per test, more rows filled, to stay closer to the real situation.

The five concepts showed and explained earlier in this chapter mostly aim to limit the amount of hand luggage, with the exception of concept 1 (b.prepared) which focusses on informing the passenger. They are all quite different. Some are short term other more long term, some are operationally harder to implement in comparison with others. Therefore the DATUM method is used to compare the different concepts, based on the design parameters of chapter 4. In the DATUM method one concept is used as 'DATUM' and the others are compared to this concept judging it as better (+), the same (s) or worse (-). By choosing the different concept as DATUM, all concepts can be compared to each other.

First concept 1, b.prepared, is chosen to compare with the other concepts. The parameters of chapter 4 are used, only the 'No physical changes are made in the cabin' parameter is excluded, since this parameter was already used to come to a selection of 5 concept earlier in this chapter. The DATUM shows especially concept 5 'The luggage games' scores high in comparison with concept b.prepared. See table 6 for the outcome.

Therefore a second DATUM was made, using the luggage games as the concept to compare the others with. The comparison shows the other concepts score lower. The outcome of this DATUM is showed in table 7.

After this comparison is done the five concepts are also presented to the problem owner. The problem owner indicates a preference for The Luggage Games and Holiday Share, however sees the disadvantage of Holiday Share it being a more long term solution.

Based on both the DATUM comparison and the conversation with the problem owner 'The Luggage Games' is developed more elaborate in the next chapter.

Table 6: DATUM table 1, comparing b.prepared with the four other concepts. += scores better, - = scores worse, s = scores the same.

	B.prepared	Light travel priority	Interactive Luggage wall	Holiday share	The luggage games
Efficiency	+	+	+	+	+
Short term	-	s	-	s	s
Technical feasibility	+	+	+	+	+
Operations	-	s	s	s	s
Effect turn around	s	s	s	s	s
Revenue management	-	s	+	s	s
Effect other processes	+	+	+	+	+
Customer experience	-	-	s	s	s
Different passengers	+	+	s	+	+
Clear & transparant	s	s	-	s	s
Crew needs	-	+	s	s	s
Touchpoints	-	-	+	+	+
Sum	-2	3	3	5	5

Table 7: DATUM table 2, comparing The luggage games with the four other concepts. += scores better, - = scores worse, s = scores the same.

	B.prepared	Light travel priority	Interactive Luggage wall	Holiday share	The luggage games
Efficiency	-	s	s	s	
Short term	s	-	s	-	
Technical feasibility	-	s	s	s	
Operations	s	-	s	s	
Effect turn around	s	s	s	s	
Revenue management	s	-	s	+	
Effect other processes	-	s	s	s	
Customer experience	s	-	-	s	
Different passengers	-	s	s	-	
Clear & transparant	s	s	s	-	
Crew needs	s	-	+	s	
Touchpoints	-	-	-	+	
Sum	-5	-6	-1	-1	

DISCUSSION & CONCLUSION

The develop phase has the goal to diverge and come up with a big variance of ideas to solve the issues described in the discover and define chapters.

To achieve the goal of diverging in total four creative sessions gave input for a big pile of ideas. To get a good overview of all these ideas all sessions were re-clustered into one big overview. The clusters were easily found; solutions which persuaded the passenger to take less hand luggage, persuading the passenger to check in their hand luggage, giving the passenger a different state of mind (e.g. less stress) and last to change the way luggage/people get out of the plane. To make a first selection, the first step to converge and focus again, the ideas which include a change in the cabin and structured deboarding were excluded. Keeping five ideas in the running to develop into concepts.

Although not intended beforehand 4 out of 5 concepts aim to convince passengers to take less hand luggage into the cabin. To ensure if this is the right direction a deboarding AB-test was executed, to see what the effect actually is of less hand luggage on the deboarding. The test showed clear potential to improve the customer experience and to decrease the deboarding time.

A second converging step was taken through the selection method 'DATUM'. Comparing the five concepts based on the design parameters showed "The Luggage Games" is best fitting these parameters. Therefore in the following chapter this concept will be developed more detailed and prototyped.

A clear direction was found during the project, to work towards one concept. The other concepts should however not be dismissed immediately. This concept was the best fit for this specific project with the set parameters. Especially the concept "Holiday Share" is a direction which could be interesting as long term vision. "The Luggage Games" would then be a short term solution to already convince passengers to take less hand luggage, to work towards the goal of providing a shared economy based service as "Holiday Share".

The deboarding AB test was a good first test, especially to have a first verification decreasing the hand luggage will have a positive effect. A more substantial conclusion would be needed to develop for instance a long term vision as "Holiday Share". The AB-test should therefore be repeated multiple times and by preference with a bigger group of participants.

6 DELIVER

After learning about the context of the assignment (discover chapters), defining the scope of the design project (define chapter) and coming up with concepts for the issue at hand it is time to deliver. This chapter will show the final concept design, an expert view on the concept, an evaluation of the concept testing if it fits the design brief, a roadmap for implementation ending with a conclusion and discussion section and recommendations.



FINAL CONCEPT

In the previous chapter different concepts were proposed. The concept 'The luggage games' was chosen as a final concept. 'The luggage games' aims to make people think about their hand luggage, especially the amount people bring, so in the future people will take less hand luggage with them. The game is also a more fun and user friendly alternative to a strict solution such as decreasing the luggage allowance (which is done by Ryanair starting from November 2018). This chapter will describe the concept more in detail.

GAMIFICATION THEORY

Gamification entails using game elements or game mechanisms in a non-game situation or environment. Applying it can also achieve behaviour change, which is called Persuasive Game Design by Visch et al. (2013). The paper describes a theoretical model for persuasive game design (PGD), which can be seen in figure 6.1. Gamification of a real world situation with game elements in a game world you can achieve behaviour change through an intended transfer effect. In the case of this project where passengers are bringing the luggage they feel entitled to and not what they actually need the gamification consists of challenging the passenger in different quick and easy to play mini-games. By giving direct feedback on their achievements in the game world about the consequences of hand luggage on operations the intended transfer effect is to increase the awareness of consequences of hand luggage on the flying experience of passengers. Therefore in the future the passenger can over think if these consequences are worth having as many luggage as possible or to strive for light packing hand luggage.

LOOK & FEEL

The game uses the elements of the house-style of Brussels Airlines. The gradient backgrounds, bird character(s) and colours are used in all internal and external communication of Brussels Airlines. Also in the current smartphone application for the boarding passes and flight information this house style is applied. By adapting the look & feel of the game to the Brussels Airlines application it can be integrated in the existing application and it will be recognizable as a game provided by the brand Brussels Airlines.

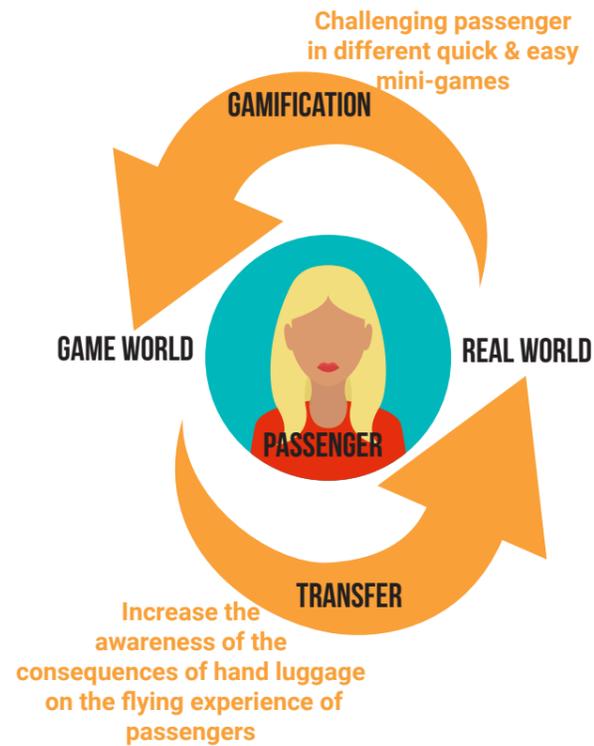


Figure 6.1: Visual based on Persuasive game design(PGD) model of Visch et al. (2013).

THE 3 MINI GAMES

In total three different mini games are included in the game. All three games are based on different parts of the passenger journey where the luggage plays a role. First packing your bag (see figure 6.2), the preparation towards your flight and the start of the luggage. The second game is based on the boarding process (see figure 6.3). During the boarding process luggage is reviewed by the gate agents of Brussels Airlines if they meet the luggage allowance. Luggage can be labelled and taken away by the gate agents when the luggage is too large, when the passenger has too many items or when they expect the overhead bins are already full on the flight. This process costs time and can cause delays if a lot of luggage has to be labelled and checked-in.

The third game is based on the deboarding (see figure 6.4). During the deboarding people have to search for their hand luggage, gather it and walk with it through the small aisle of the cabin. Because of the amount, size or weight of the luggage deboarding takes more time and can therefore also cause delays.

Passengers are often not aware delays can be caused by luggage. A plane is delayed because of a slow process at the gate, or the flight is delayed because of the large amount of hand luggage taken by passengers.

GAME ELEMENTS

To ensure motivation and engagement more game mechanisms are included in 'The luggage games'.

The passenger can see 3 different leaderboards, to compare it's own achievement to others. The first is with all playing passengers, the second with friends (they would need to connect their social media) and the third is people from their next flight. Figure 6.4 shows the leaderboard, with 3 tabs on top.

Another motivator is a badge system. Here the user can earn different kind of badges (for instant a badge for earning a perfect score on one of the games). This gives the user a goal to strive for and an extra reward for the 'right' behaviour.

The leaderboard and badges could be linked to real life rewards. Once a month if you are first on the leaderboard your Loops are doubled on the next flight.



Figure 6.2: The first mini-game the passenger is asked to pack the things they need for a 2 week holiday in their hand luggage.



Figure 6.3: In the second game the passenger is asked to help the gate agents assess the hand luggage for a flight, either approving it or disapproving it.

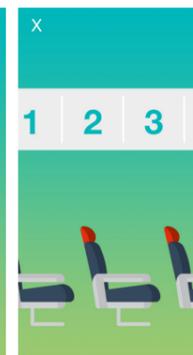


Figure 6.4: The third game has 2 stages. In the first stage the passenger gets 10 seconds to remember in which bins luggage is stowed. In the second stage they have to find the stowed luggage.

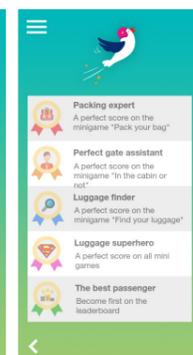
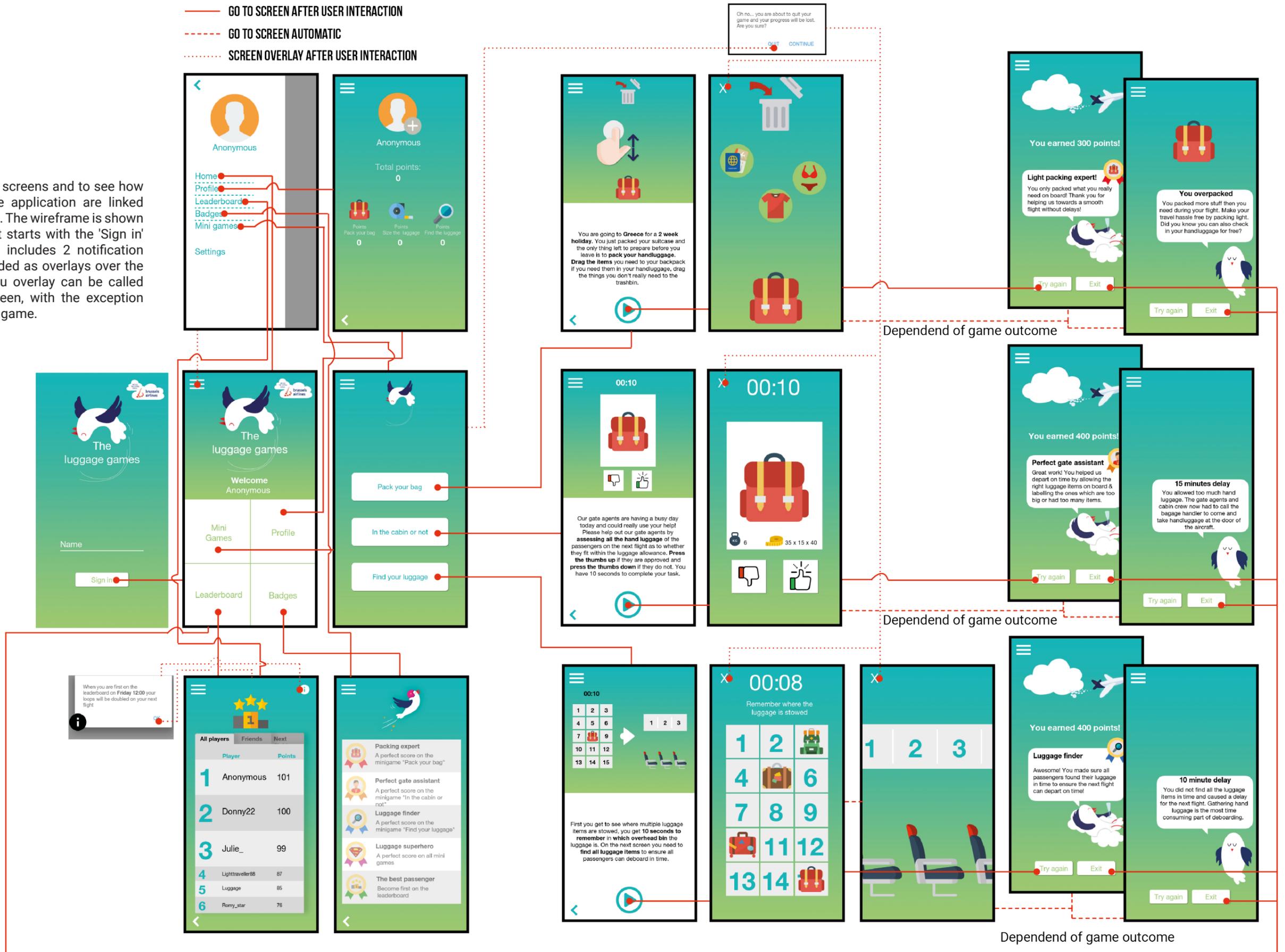


Figure 6.5: Left: the leaderboard, showing the user can compare his/her results on 3 different levels. On different badges the user can earn by doing a good job. Reinforcing the 'right' behaviour.

WIREFRAME

To get an overview of all the screens and to see how the different screens of the application are linked together a wireframe is made. The wireframe is shown on this and the next page. It starts with the 'Sign in' screen. The wireframe also includes 2 notification messages, which will be loaded as overlays over the original screen. Also a menu overlay can be called upon on (almost) every screen, with the exception when the user is in an actual game.

-  MENU AS OVERLAY
-  GO TO PREVIOUS SCREEN
-  GO TO SCREEN AFTER USER INTERACTION
-  GO TO SCREEN AUTOMATIC
-  SCREEN OVERLAY AFTER USER INTERACTION



On the previous pages the final concept was developed further and explained. As one of the final steps for the concept it is important to relate the concept back to the scope set earlier in the project. Therefore the concept will be evaluated based on the assignment, the design goal and the design parameters.

ASSIGNMENT

At the start of the project the following assignment was formulated:

"Develop a **design intervention** which will make the deboarding process of a **narrow body aircraft more efficient** for the airline and simultaneously a **better user experience** for the passenger."

"The luggage games" intends to make passengers more aware of the consequences of taking (a lot of) hand luggage, which has the ultimate goal to let people think about their behaviour. During the project it was not tested if this effect is achieved with the current concept, however it was tested what the effect is of less hand luggage. The test showed potentially 80% of the deboarding time could be decreased, by limiting the trolleys in the cabin. Also the user experience was significantly better when deboarding without less hand luggage. Further testing is needed to measure the effect the concept will have on the amount of hand luggage, this will be described more elaborate in the recommendations.

DESIGN GOAL

After the context of the assignment was made clear through discovery of theory and practice the project was focussed on the following design goal:

"The design goal is to make deboarding with hand luggage more smooth for passengers.

The desired situation should be implementing a design intervention which will ensure passengers can retrieve their luggage, walk through the aisle and walk out of the door without being held up by their luggage. Making it **relaxed, effortless, and giving the passengers a feeling of being in control.**"

During the observational research it became clear the amount, (high) weight and/or size of hand luggage makes it difficult to retrieve the luggage and to walk through the aisle. Decreasing the amount should therefore make this easier and take less effort.

During the deboarding test 15 out of 16 passengers preferred the deboarding with only a personal item. They also rated the customer experience higher. The feeling of being in control is higher, it takes less effort, it was more clear, perceived faster and easier. Passengers were not more relaxed in the test. Decreasing the hand luggage therefore has the potential of improving the user experience and make the deboarding process more smooth.

Since this is all based on one deboarding test it is important more data is collected about the topic.

DESIGN PARAMETERS

Next to the design goal also 13 design parameters were defined, these were based on all insights from the discovery phase and conversations with the problem owner.

Efficiency

The deboarding time per passenger should decrease. The deboarding test there is a potential of 80% decrease of time per passenger when only deboarding with a personal item.

Short term

"The Luggage Games" is a short term solution. It is not dependant on ongoing operations or other projects. It will still need some steps before it can be implemented. Steps such as: another design iteration to further develop the concept, research the effect of the game on the passenger, developing & making the real application (not prototype), marketing plan and implementation plan. When given priority this should be feasible within one year.

No physical changes in the cabin

The concept does not need any changes in the cabin. It can be used by the passenger on their own smart device or made available at the airport terminal.

Technical feasibility

Brussels Airlines has the knowledge and people in house to develop the concept, since they already have a smartphone application. The concept could also be done in collaboration with partner airline Eurowings which founded a digital company to improve the flying experience of passengers.

Operations

The solution is not dependant of current operations. The current operations will also not be influenced by the implementation of "The Luggage Games". After implementation and when the effect of less hand luggage started the operations surrounding luggage can be optimized.

Part of turn around

The game does not interfere with other processes in the turn around, such as cleaning or catering.

Revenue management

The game does not directly impact the revenues of Brussels Airlines. It will probably not increase the sells of hold luggage and will also not generate a new form of ancillary.

Part of flying journey

"The Luggage Games" does not influence other processes in the flying journey. When the amount of hand luggage decreases it could however also have a positive effect on other processes (e.g. boarding).

Customer experience

As shown in the user test decreasing the amount of hand luggage has the potential of increasing the passenger experience.

Different passengers

The application is available for a large group of passengers (i.e. leisure, business or others), however will probably not reach all. For instance elderly who are not digitally engaged. This could be solved by investigating the possibilities of providing the Luggage Games at the airport on a different platform.

Clear communication & transparency

The passengers are better informed about the processes behind the scenes and why delays can occur. They will not increase the transparency real time, for instance why their flight is delayed that day.

Crew needs

The luggage games does not directly effect the crew.

Touchpoints

The game can be introduced on multiple touchpoints and has the potential of creating new touchpoint(s) in between de existing touchpoints booking and boarding.

DISCUSSION & CONCLUSION

The final concept "The Luggage Games" is the result of this project. The game aims to use persuasive game design to make passengers more aware of the consequences their hand luggage has on their own flight experience and on the operations behind the scenes. With the intended effect people will over think their behaviour and adjust it to take less hand luggage.

A user test with 16 passengers shows decreasing the amount of hand luggage will make the deboarding more efficient and simultaneously a better user experience. Thereby the concept of "The Luggage Games" meets the assignment to develop a design intervention which will make the deboarding process of a narrow body aircraft more efficient for the airline and simultaneously a better user experience for the passenger.

Next to the assignment the concept also achieves the design goal to make the deboarding more smooth by making it effortless and giving the passengers the feeling of being in control (based on results of the user test). However making the passengers more relaxed is not yet achieved.

Since "The Luggage games" are still in a early conceptual state, the evaluation of the design parameters is done based on the deboarding user test and the assumptions of the researcher. The assumptions are based on gathered knowledge during the project about the company and the operations.

The get more definite insights and make the concept ready for implementation multiple steps still need to be taken. An extra design iteration on the concept, testing the usability of the application, testing the effect of the game on the actual amount of hand luggage are some examples to be named (see also the recommendations on page 72).

RECOMMENDATIONS

During the project choices had to be made to scope and focus on specific directions. However, during the course of the project interesting opportunities were discovered, but not (yet) developed or investigated further. Therefore in this chapter recommendations on some of these interesting opportunities which could be looked into or could use some extra research.

CONCEPT ITERATIONS

"The luggage games" is developed more elaborate in comparison to the other four proposed concepts. However the concept needs more iterations before it can be developed for implementation. The following parts of the design need an extra step of design or research:

Framing

The concept will only have an effect if the passenger will use it. To make this happen, the framing of the concept is key. The passenger needs to know what they get out of using the app. By presenting different ways of framing the application to the user a quick user test can give insights into the best framing.

Touchpoints

Next to explaining to the passenger why they should use the app, the best moment of approaching the passenger is also important. What is the best moment to introduce the app? Are multiple touchpoints possible and beneficial? Possible touchpoints could be before booking in the inspiration phase, directly after booking, a week before flight (before packing), at the airport before departure or provide the app after people had a delay (when they are possibly more impressionable by the information).

Feedback

The concept now has a positive feedback and negative feedback screen for each game. An extra iteration could be made on this as well. Testing if the passenger would want more factual information, more elaborate information or maybe movies behind the scenes (for example showing the process of the ground handler putting the surplus of luggage in hold at the last moment). Since the feedback loop is an essential part of making people more aware of the consequences of hand luggage it is important to get this right.

Group dynamics vs. individual

The games are now focussed on the individual, whereas the problem surrounding the hand luggage and flying in general is a group effort. If you pack light, but all the other passengers don't the problems won't go away. Therefore the game could be translated more towards this. For instance by actually filling a plane in the game with the current players, making an leaderboard more focussed on a group, giving feedback on the group performance or only showing the leaderboard with the people you are flying with instead of the now general leaderboard with all players.

Rewards

An incentive to play the games could be by giving a rewards. For instance by 1) giving a free drink, discount or loops when downloading and playing the game, 2) donating to a good cause when people use the game and 3) rewarding the best player(s). A more elaborate research is needed what kind of rewards work good for the passenger and the airline to achieve the goal of decreasing the amount of luggage.

The above mentioned iterations are based on a consultation with persuasive game design researcher dr. V.T. Visch which made clear there is already a good base with the current concept, but the above points could make the concept stronger and therefore have a bigger chance of success.

USER TESTING

During the project it is decided to put the focus on researching the effect of hand luggage on deboarding. A user test is also needed to find out if 'The Luggage Games' has the aimed effect. Will people actually be more aware of the consequences of hand luggage? And will it convince them to bring less hand luggage? When the concept is further developed (see the previous paragraph) a new interactive prototype could be tested with passengers in the terminal and an interview. The next step would be a beta test with actual passengers after they booked their flight and see how many download/use the application and follow up during their flight how much hand luggage they brought with hem.

EFFECT HAND LUGGAGE ON DEBOARDING

During the project a test has been conducted to see the effect of less hand luggage on deboarding, both the time and the user experience. To get more reliable data and concrete trends more research is needed in this direction.

OTHER CONCEPTS

Besides 'The Luggage Games' four other concepts were proposed. Especially the sharing community 'Holiday Share' is worth looking into further to see if it has potential. The concept would be a long term solution, but could solve many of the issues of today with (hand)luggage.

STRUCTURED DEBOARDING

The literature shows an interesting opportunity to look into a structured deboarding. The simulations show minutes could be taken of the deboarding time. Which structured deboarding would be best fitting and how to make the passengers listen and follow up on a new structured deboarding would both need attention. Although there would be many challenges to make it work in a passenger friendly way (e.g. groups or families travelling together) and also make it operationally easy to do for all crew involved. The structured deboarding also came back in the ideation phase and during the deboarding test as suggestions of the participants how their experience could be improved.

GLOSSARY

TAT	Turn around time
SN	Brussels Airlines
LCC	Low cost carrier
OTP	On time performance
PAX	Passenger
PRM	Person with reduced mobility
ETA	Estimated time of arrival
ATA	Actual time of arrival
ETD	Estimated time of departure
ATD	Actual time of departure
NPS	Net promoter score
AEA	15+ minutes delay
ATC	Air traffic control
IATA	International Air Transport Association
LH	Long haul
SH	Short haul
FSB light	Fasten seat belt light
LT	Local time
HB/HL	Hand baggage / Hand luggage
VFR	Visiting Friends or Family

BRU	Brussels Airport, Belgium
MAD	Madrid Barajas Airport, Spain
AGP	Malaga - Costa del ol Airport, Spain
LIS	Lisbon Portela Airport, Portugal
VIE	Vienna International Airport, Austria
NCE	Nice - Cote D'azur Airport, France
OPO	Francisco De Sá Carneiro Airport (Porto), Portugal
FAO	Faro Airport, Portugal
LHR	Londen Heathrow Airport, United Kingdom

Landside	Area at airport before security
Airside	Area at airport after security
Gate	Area where passengers arrive after deboarding (and new passengers wait for next flight to board)
Hub	The home basis of an airline

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APPENDICES



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APPENDIX B - IMPRESSIONS OF RESEARCH

APPENDIX B - IMPRESSIONS OF RESEARCH



Seeing the Aerosmurf for the first time!



Refuelling at Charleroi & waiting for the thunderstorm to leave Brussels Airport.



Arriving with the crew bus for my next flight



Boarding the Amare



Inside of a Brussels Airlines aircraft.



The trolleys in the galley



The aircraft door, armed and ready for take off.



The jump-seat, my home during the observation flights.



But sometimes, sitting in the cabin and seeing the amazing view

88

89



This napkin put a smile on my face



Enjoying the perks of Business class! Being spoiled by the cabin crew.



My first cockpit experience, landing in Málaga



And my second cockpit experience, flying to Nice!

APPENDIX B - IMPRESSIONS OF RESEARCH

APPENDIX C - RAW DATA DEBOARDING OBSERVATIONS

Overview of all observed blocks on A320, first the 7 flights at the gate, second the flights researcher flew with entire flight and last (yellow) the two combined.

Overall at gate (7 flights)																																
Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
Block - Luggage Behind seat	0	2	0	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Block - Retrieve luggage bin	1	1	3	7	3	6	2	4	3	1	4	1	4	2	3	3	2	4	0	0	0	1	1	1	1	3	2	2	0	1	0	66
Slow - PRM or elderly	1	0	0	0	0	0	0	0	1	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	8
Slow - Big luggage/kids	1	0	0	0	0	3	1	2	1	4	2	1	2	1	0	2	3	1	0	1	0	0	0	1	1	2	0	1	0	0	3	33
Block - Social	0	0	2	1	0	0	0	2	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Total	3	3	5	9	5	9	3	9	6	9	7	2	7	4	4	5	5	5	0	1	0	1	1	2	2	5	3	3	0	1	122	

Overall flying (6 flights)																																
Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
Block - Luggage Behind seat	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
Block - Retrieve luggage bin	0	0	0	1	2	2	4	2	2	0	0	2	2	1	0	2	0	1	0	0	1	0	1	0	1	1	3	0	0	0	0	29
Slow - PRM or elderly	1	0	1	0	0	0	0	0	2	0	0	1	1	0	1	2	1	0	1	0	0	0	0	1	1	1	0	0	0	0	0	14
Slow - Big luggage/kids	0	0	0	0	2	0	1	1	0	1	1	0	0	0	1	0	1	0	1	0	1	0	1	0	1	2	0	1	1	0	0	16
Block - Social	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Total	2	0	1	1	5	4	3	5	3	5	3	0	1	3	3	2	3	3	1	2	2	0	2	1	3	4	3	1	1	0	67	

Overall flying+gate (7+6 flights)																																
Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
Block - Luggage Behind seat	0	2	0	2	3	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11
Block - Retrieve luggage bin	1	1	3	7	4	8	4	8	5	3	6	1	4	4	5	4	2	6	0	1	0	1	2	1	2	4	5	2	0	1	0	95
Slow - PRM or elderly	2	0	1	0	0	0	0	1	5	0	0	1	2	1	1	2	1	0	1	0	0	0	1	1	1	1	0	0	0	0	0	22
Slow - Big luggage/kids	1	0	0	0	2	3	2	3	1	5	3	1	2	1	1	2	4	1	1	1	1	0	1	1	2	4	0	2	1	0	3	49
Block - Social	1	0	2	1	1	1	0	2	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Total	5	3	6	10	10	13	6	14	9	14	10	2	8	7	7	8	8	1	3	2	1	3	3	5	9	6	4	1	1	3	189	

6 46% van alle blocks

Overview of all observed blocks on A319, first the 7 flights at the gate, second the flights researcher flew with entire flight and last (yellow) the two combined.

Overall at gate (7 flights)																												
Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total		
Block - Luggage Behind seat	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Block - Retrieve luggage bin	0	1	3	7	5	2	3	4	1	4	3	2	3	1	0	3	3	0	1	0	1	2	0	0	0	0	49	
Slow - PRM or elderly	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Slow - Big luggage/kids	0	0	0	0	0	2	6	2	4	4	3	0	0	0	4	0	0	2	3	1	0	1	0	0	0	0	32	
Block - Social	0	0	0	0	1	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5
Total	0	1	3	7	6	5	9	8	5	9	6	3	3	1	4	3	3	2	4	1	2	3	0	0	0	88		

Overall flying (8 flights)																											
Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	
Block - Luggage Behind seat	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Block - Retrieve luggage bin	0	0	1	3	2	0	5	7	1	5	3	1	0	2	5	1	1	1	3	1	0	2	1	0	0	0	45
Slow - PRM or elderly	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	6
Slow - Big luggage/kids	1	0	0	0	0	0	0	0	1	1	0	1	1	0	2	0	0	1	0	0	0	0	0	2	0	0	10
Block - Social	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Total	1	0	1	3	4	2	6	7	4	7	4	2	1	2	7	1	3	2	3	1	0	2	3	0	0	66	

Overall flying+gate (7+8 flights)																											
Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	
Block - Luggage Behind seat	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Block - Retrieve luggage bin	0	1	4	10	7	2	8	11	2	9	6	3	3	3	5	4	4	1	4	1	1	4	1	0	0	0	94
Slow - PRM or elderly	0	0	0	0	1	1	0	0	1	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	7
Slow - Big luggage/kids	1	0	0	0	0	2	6	2	5	5	3	1	1	0	6	0	0	3	3	1	0	1	2	0	0	42	
Block - Social	0	0	0	0	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Total	1	1	4	10	10	7	15	15	9	16	10	5	4	3	11	4	6	4	7	2	2	5	3	0	0	154	

6 60% van alle block

All time measurements of the observed flights. The top part is all A319 flights (PAX capacity of 141 PAX) and the bottom half are A320 flights (PAX capacity of 180). The flight numbers which are coloured red are observed at the gate and the black flight numbers are observed the entire flight. The light blue marked time of flight 13 is a 2-door deboarding time. The red marked times are the slowest deboarding times (flight 2, 20, 27, 11, 19, 28) and the green marked times are the fastest deboarding times (Flight 7, 8, 24, 10, 16, 17)

Nr.	Flight	Taxi	till door opens	til first pax out door	last pax out	sec/pax	Blocks	PAX
2	MAD-BRU		02:48	03:24	00:20	06:59	4,41	6 95/141
3	BRU-AGP		03:00	08:00	00:20	07:40	3,43	8 134/141
4	AGP-BRU		02:47	04:25	00:10	06:41	3,18	9 126/141
5	BRU-MAD		13:38	03:33	00:09	07:08	3,15	11 136/141
7	BRU-LIS		05:31	02:20	00:11	06:01	2,64	12 137/141
8	LIS-BRU		04:59	02:01	00:31	05:20	2,69	12 119/141
15	VIE-BRU			02:21	00:17	04:33	3,03	11 90/141
18	MAD-BRU			02:40	00:16	06:43	2,92	12 138/141
20	VIE-BRU			02:22	00:15	07:19	4,67	9 94/141
22	MAD-BRU			03:41	00:18	06:27	2,88	15 134/141
24	NCE-BRU					05:56	2,68	12 133/141
25	AGP-BRU			02:35	00:15	06:45	2,87	13 141/141
27	MAD-BRU			09:52	00:15	08:28	3,85	17 132/141
			05:27	03:56	00:16	06:36	3,26	11
9	BRU-OPO		02:30	02:30	00:16	09:42	3,27	11 178/180
10	OPO-BRU		03:42	03:11	00:14	07:06	2,55	9 167/180
11	BRU-NCE		04:02	02:01	00:20	12:10	4,42	17 165/180
12	NCE-BRU			04:23	00:18	10:30	3,58	11 176/180
13	BRU-FAO		06:30	01:51	00:05	04:05	1,47	6 167/180
14	FAO-BRU		04:45	07:39	00:10	10:42	3,36	13 177/180
16	AGP-BRU			02:08	01:15	07:34	2,62	14 173/180
17	LHR-BRU			04:37	00:15	07:35	2,56	22 178/180
19	OPO-BRU			03:58	00:43	11:55	4,16	17 172/180
21	LHR-BRU			03:59	00:15	06:14	2,79	18 134/180
23	OPO-BRU			02:00	00:33	08:09	2,88	14 170/180

2 MAD-BRU

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue					1*																					1
Yellow							2	1	3										4							4
Pink																										0
Purple																							1*			1
Green																										0
Total					1		1	1	1										1				1			6

3 BRU-AGP

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
Yellow		1	2				3	4+5																		5
Pink												6														1
Purple													1*	7												2
Green																										0
Total		1	1				1	2			1		1		1											8

4 AGP-BRU

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
Yellow			1	2			3+4				7															5
Pink											6															2
Purple										5												8				2
Green																							1*			0
Total		1	1				2	1	1		1											1	1			9

5 BRU-MAD

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue						5																				1
Yellow			8				1	2+3		4					6+7					9	10					9
Pink																										0
Purple																							11			1
Green																										0
Total			1		1	1	2	1		1					2						1	1	1			11

6 MAD-BRU

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
Yellow					5		1+2			3	4				8	6+7										8
Pink																										0
Purple																										0
Green																										0
Total			1		2		1	1		1	2															8

7 BRU-LIS

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
Yellow										5	3				7	10	11	9								6
Pink					8																					1
Purple	1*									2	6				4											4
Green						1																				1
Total	1				1	1				2	1	1			1	1	1	1	1							12

Block - Luggage Behind seat
 Block - Retrieve luggage bin
 Slow - PRM or elderly
 Slow - Big luggage/kids
 Block - Social

8 LIS BRU

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
Yellow										4+!	6			7	8				10			12	11			8
Pink										3									9							2
Purple																										0
Green						1			2																	2
Total						1			2	2	1			1	1			1	1			1	1			12

VIE 15

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
LB							1+2+3								8		10									5
Pink																										0
Purple									4	5		6+7										11	9+LB			6
Green																										0
Total						3		1	1	2				1		1	1	1								11

MAD 18

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
Yellow			1		2							11		7+8												5
Pink				9																						1
Purple								4	6	5		10														4
Green						3																		12		2
Total			1	1	2		1	1	1	2		2		2									1			12

VIE 20

Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Blue																										0
Yellow								1	4	2		9		8												5
Pink																										0
Purple									7	3	6	5														4
Green																										0
Total						1		2	1	1	1	2		1												9

APPENDIX E - CONSENT FORM (EMPTY)

INFORMED CONSENT

Dear participant,

Thank you for collaborating within this research. This experiment is about your experience of boarding and de-boarding. This study is part of my graduation project at Brussels Airlines which looks at how to enhance passenger experiences at with boarding & deboarding.

Procedure and Duration

This study is done to evaluate different aircraft (de)boarding scenarios. You will be asked to board and de-board the aircraft in different settings. After each boarding and de-boarding experience, you would be given a questionnaire to complete. This test will take approximately 30 to 45 minutes. We have installed several cameras and video cameras with microphones to record the process for further analysis.

Confidentiality

Upon completion of the study, your data will be merged with others who have completed the experiment. No identifying information is recorded during questionnaires so your responses will remain anonymous and will be used as a data set in published reports and presentation.

Risks and Benefit

There are no severe risks in these tests. There will be no direct benefit to you, but your participation is likely to help us design an improved future (de)boarding experience.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so. You may stop participating in the experiment at any time without giving any reason. Do inform the researcher of this, enabling us to destroy the data and exclude it from the results.

If you have any questions about any stage of the study, or if you wish to receive a report of the findings, please do not hesitate to contact us.

I have read the foregoing information, or it has been read to me. I consent voluntarily to be a participant in this study.

Do you also give consent for using the video footage of today in a video used for presentation purpose during my graduation ceremony and which will also be published at the TU Delft Repository? Yes/No

Name of Participant :

Signature of Participant :

Place, Date : Delft,

Signature of Researcher :

Many thanks for your collaboration!

Best regards,
Claudia Spaargaren (C.spaargaren-1@student.tudelft.nl)

TOESTEMMINGSVERKLARING FORMULIER (INFORMED CONSENT)

Geachte deelnemer,

Hartelijk dank voor uw medewerking aan het onderzoek over hoe u boarden ervaart (in- en uitstappen van het vliegtuig). Dit onderzoek maakt deel uit van mijn afstudeerproject bij Brussels Airlines, dat tot doel heeft om de passagiers ervaring tijdens tijdens boarding & deboarding te verbeteren.

Procedure en Duur

Het doel van deze studie is om verschillende (de)boarding scenarios te evalueren. U zult worden gevraagd om meerdere malen het vliegtuig in te stappen en weer uit te stappen. Na iedere keer instappen en iedere keer uitstappen krijgt u een vragenlijst om in te vullen. De test zal in totaal ongeveer 30 tot 45 minuten duren. We hebben verschillende foto- en videocamera's geïnstalleerd in het vliegtuig om het in- en uitstapproces te kunnen observeren voor verdere analyse.

Vertrouwelijkheid

Na voltooiing van de studie zullen uw gegevens worden samengevoegd met anderen die hebben deelgenomen aan het experiment. Uw gegevens blijven anoniem en de informatie is niet terug te leiden naar u.

Risico's en Baten

Er zijn geen ernstige risico's verbonden aan deelname aan dit onderzoek. Er is voor u geen direct voordeel, maar uw deelname kan ons helpen om uw boarding ervaring in de toekomst te verbeteren.

Vrijwillige deelname

Deelname aan dit onderzoek is geheel vrijwillig. U heeft het recht om op elk moment, zonder opgaaf van redenen, uw deelname aan dit onderzoek te beëindigen of uw gegevens te laten verwijderen. Laat u dit alstublieft tijdig en duidelijk weten aan de onderzoeker, zodat wij uw gegevens kunnen verwijderen.

Indien u vragen heeft over dit onderzoek, of als u een rapportage wilt ontvangen van de resultaten van deze studie, aarzel dan niet om met ons contact op te nemen.

Hierbij verklaar ik dat ik voorgaande informatie heb gelezen, of dat dit mij is voorgelezen. Mijn vragen zijn naar tevredenheid beantwoord en ik weet dat gegevens en resultaten alleen anoniem en vertrouwelijk aan derden bekend gemaakt zullen worden. Ik stem geheel vrijwillig in met deelname aan dit onderzoek.

Geef je ook toestemming voor het gebruik van het video materiaal van vandaag in een video gebruikt als presentatie middel tijdens mijn afstudeer ceremonie en welke ook wordt gepubliceerd op de TU Delft Repository?

Ja/Nee

Naam deelnemer :

Handtekening deelnemer :

Plaats, Datum : Delft,

Handtekening onderzoeker :

Hartelijk dank voor uw medewerking!

Met vriendelijke groeten,
Claudia Spaargaren (C.spaargaren-1@student.tudelft.nl)

APPENDIX F - MATERIALS USED DEBOARDING TEST

The materials used during the deboarding test (AB-test) to find the influence of hand luggage on the (de)boarding times.

Questionnaire given after round 1 of boarding & deboarding. The passengers had a personal item & a trolley

BOARDING 1 TU Delft

Participant nummer:

Stress	○ ○ ○ ○ ○	Geen stress	○ ○ ○ ○ ○
Gehaast	○ ○ ○ ○ ○	Niet gehaast	○ ○ ○ ○ ○
Negatief	○ ○ ○ ○ ○	Positief	○ ○ ○ ○ ○
Moeilijk	○ ○ ○ ○ ○	Makkelijk	○ ○ ○ ○ ○
Langzaam	○ ○ ○ ○ ○	Snel	○ ○ ○ ○ ○
Verwarrend	○ ○ ○ ○ ○	Duidelijk	○ ○ ○ ○ ○
Veel moeite	○ ○ ○ ○ ○	Geen moeite	○ ○ ○ ○ ○
Geen controle over situatie	○ ○ ○ ○ ○	Controle over situatie	○ ○ ○ ○ ○

Extra aantekeningen/opmerkingen

DE-BOARDING 1 TU Delft

Participant nummer:

Stress	○ ○ ○ ○ ○	Geen stress	○ ○ ○ ○ ○
Gehaast	○ ○ ○ ○ ○	Niet gehaast	○ ○ ○ ○ ○
Negatief	○ ○ ○ ○ ○	Positief	○ ○ ○ ○ ○
Moeilijk	○ ○ ○ ○ ○	Makkelijk	○ ○ ○ ○ ○
Langzaam	○ ○ ○ ○ ○	Snel	○ ○ ○ ○ ○
Verwarrend	○ ○ ○ ○ ○	Duidelijk	○ ○ ○ ○ ○
Veel moeite	○ ○ ○ ○ ○	Geen moeite	○ ○ ○ ○ ○
Geen controle over situatie	○ ○ ○ ○ ○	Controle over situatie	○ ○ ○ ○ ○

Extra aantekeningen/opmerkingen

Questionnaire given after round 2 of boarding & deboarding. The passengers had a personal item. Also on the back of this questionnaire questions to compare round 1 and round 2.

BOARDING 2 TU Delft

Participant nummer:

Stress	○ ○ ○ ○ ○	Geen stress	○ ○ ○ ○ ○
Gehaast	○ ○ ○ ○ ○	Niet gehaast	○ ○ ○ ○ ○
Negatief	○ ○ ○ ○ ○	Positief	○ ○ ○ ○ ○
Moeilijk	○ ○ ○ ○ ○	Makkelijk	○ ○ ○ ○ ○
Langzaam	○ ○ ○ ○ ○	Snel	○ ○ ○ ○ ○
Verwarrend	○ ○ ○ ○ ○	Duidelijk	○ ○ ○ ○ ○
Veel moeite	○ ○ ○ ○ ○	Geen moeite	○ ○ ○ ○ ○
Geen controle over situatie	○ ○ ○ ○ ○	Controle over situatie	○ ○ ○ ○ ○

Extra aantekeningen/opmerkingen

DE-BOARDING 2 TU Delft

Participant nummer:

Stress	○ ○ ○ ○ ○	Geen stress	○ ○ ○ ○ ○
Gehaast	○ ○ ○ ○ ○	Niet gehaast	○ ○ ○ ○ ○
Negatief	○ ○ ○ ○ ○	Positief	○ ○ ○ ○ ○
Moeilijk	○ ○ ○ ○ ○	Makkelijk	○ ○ ○ ○ ○
Langzaam	○ ○ ○ ○ ○	Snel	○ ○ ○ ○ ○
Verwarrend	○ ○ ○ ○ ○	Duidelijk	○ ○ ○ ○ ○
Veel moeite	○ ○ ○ ○ ○	Geen moeite	○ ○ ○ ○ ○
Geen controle over situatie	○ ○ ○ ○ ○	Controle over situatie	○ ○ ○ ○ ○

Extra aantekeningen/opmerkingen

BOARDING 2 TU Delft

Participant nummer:

Welke boarding was jouw beste ervaring?

Boarding 1 Boarding 2

Wat maakte deze boarding een betere ervaring?

Wat ging er fout bij de andere boarding?

Welke verandering zou je boarding verbeteren?

DE-BOARDING 2 TU Delft

Participant nummer:

Welke de-boarding was jouw beste ervaring?

De-boarding 1 De-boarding 2

Wat maakte deze de-boarding een betere ervaring?

Wat ging er mis bij de andere boarding?

Welke verandering zou je de-boarding verbeteren?

All participants had a fixed seat. In round 1 every participant had a different set as in round 2. This was done to minimize the learning effect during the two rounds.

Passenger name From
Madrid

Participant number To
Delft

Seat

Passenger name From
Delft

Participant number To
Madrid

Seat

APPENDIX G - RAW DATA DEBOARDING AB-TEST

Nr	B1-Stress	B1-Rushed	B1-Neg/Pos	B1-Diff/Easy	B1-Slow/Fast	B1-Confusing/Clear	B1-Effort	B1-Control	B2-Stress	B2-Rushed	B2-Neg/Pos	B2-Diff/Easy	B2-Slow/Fast	B2-Confusing/Clear	B2-Effort	B2-Control	Best_Boarding
1	5	5	3	3	4	2	4	2	5	5	3	3	4	4	5	4	2
2	2	1	2	3	3	2	4	4	4	5	5	5	5	4	4	4	2
3	5	5	3	3	3	4	4	4	5	5	5	5	5	5	5	5	2
4	4	3	2	3	4	2	3	3	2	4	4	4	5	3	4	4	2
5	4	3	3	2	2	2	3	2	5	4	4	5	5	5	5	3	2
6	4	4	3	2	2	3	2	2	5	5	4	4	4	5	5	5	2
7	4	4	4	5	4	2	3	3	3	3	3	5	4	5	5	5	1
8	3	2	4	4	4	2	4	5	5	4	5	4	4	5	4	4	2
9	4	3	2	4	4	2	4	2	4	3	4	3	3	4	4	3	2
10	4	5	4	3	3	3	3	2	5	4	4	5	5	5	5	3	2
11	5	5	3	5	5	2	5	5	5	5	5	5	5	5	5	5	2
12	2	5	2	2	2	2	2	2	2	5	3	3	4	3	4	4	2
13	5	4	4	4	5	5	5	5	5	1	5	5	5	5	5	5	2
14	5	5	3	4	4	4	4	4	5	5	5	5	5	5	5	4	2
15	5	3	3	2	2	2	2	3	4	4	4	4	4	4	4	4	2
17	5	5	3	3	3	3	3	5	5	5	5	5	5	3	3	5	1

Nr	D1-Stress	D1-Rushed	D1-Neg/Pos	D1-Diff/Easy	D1-Slow/Fast	D1-Confusing/Clear	D1-Effort	D1-Control	D2-Stress	D2-Rushed	D2-Neg/Pos	D2-Diff/Easy	D2-Slow/Fast	D2-Confusing/Clear	D2-Effort	D2-Control	Best_deboarding
1	5	5	3	3	5	2	3	2	5	3	3	3	3	3	3	3	1
2	4	4	4	3	3	4	4	4	4	4	4	4	5	5	5	5	2
3	5	5	4	3	3	3	4	4	2	3	2	1	3	4	4	3	2
4	4	4	4	3	3	3	3	2	2	2	2	3	4	3	4	2	2
5	3	3	3	3	3	1	2	1	3	3	5	5	5	5	5	3	2
6	5	4	3	2	2	3	3	3	5	4	5	5	5	5	5	5	2
7	4	4	3	3	3	4	3	3	2	3	3	4	4	3	4	3	2
8	5	2	5	5	5	4	5	5	3	2	5	5	5	5	5	5	2
9	3	2	2	4	4	2	3	4	3	2	3	3	3	4	4	2	2
10	3	2	4	2	4	3	4	2	3	3	2	3	3	4	3	3	2
11	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2
12	4	5	3	2	2	3	2	2	5	4	5	5	4	5	5	4	2
13	5	5	4	4	1	2	5	3	5	5	5	5	5	5	5	5	2
14	5	4	4	4	4	4	4	4	5	1	5	5	4	5	5	4	2
15	2	2	3	2	2	2	2	1	4	3	3	3	3	4	3	4	2
17	5	5	3	3	3	3	3	5	5	5	5	5	5	5	5	5	2