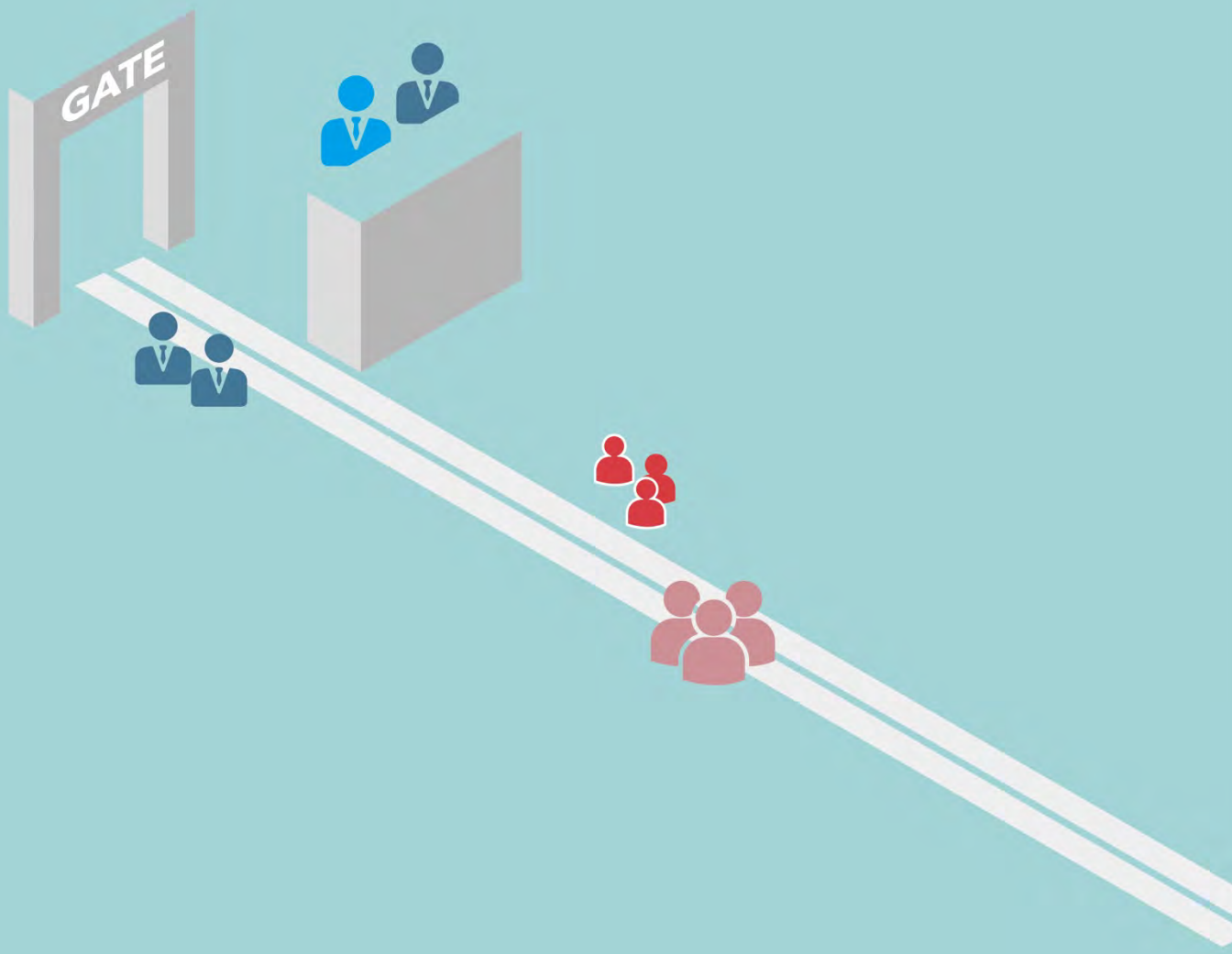
Boarding in the future

Design a roadmap and a digital product for the future boarding process



Master Graduation Thesis
by Qiong Wang

Msc Design for Interaction
Industrial Design Engineering
Delft University of Technology

Supervisory team
Henk Kuipers, chair
Margreet Beets, mentor

Company project from KLM
Supervised by
Hedwig Sietsma
Ocky Wiemeijer

Huge thanks to my tutors:
Henk Kuipers, Margreet Beets (TU Delft)
Hedwig Sietsma, Ocky Wiemeijer (KLM)

Special thanks to:
Rick van Cappellen (KLM)
Mala Bhagwandin (KLM)
Sanne Kempers (KLM)
Meeke Roet (KLM)
Jingyu Li
Can Yuan
All the participants

Executive Summary

This project has four phases: Research by explore the context and understand the stakeholders, Define the future vision and roadmap, Design a digital interface for the first horizon in the roadmap and lastly evaluation of the digital prototype.

In the research phase, multiple research methods were conducted. The research phase has two parts, understanding the process and understanding the user. To get a thorough understanding of the process, internal documents reading, observation and expert interviews were conducted. After these research activities, the first list of problems was made, based on my personal perceiving.
Afterwards, to understand how the stakeholders think about current process and tools, and also what is their desired future, more research was done with the three stakeholders: gate agents, managers and passengers. According to the results, the list of problems was revised adding the problems agents perceived. Besides the list of problems, a main problem was redefined for later design phase.

In the second phase, a vision in five years were come up with, with three horizons step by step. The vision was designed considering all the different visions from different stakeholders and aiming at solving the main problem from research phase. Based on the vision and trends analysis, a cocreation session was conducted with four students, to generate ideas in this scope. Later, the ideas were mapped and divided into three horizons according to the importance and feasibility.

The third phase started from looking deep into the first horizon in the roadmap. A design brief and a list of requirements were designed, under the context of the first horizon. Ideas were generated and finally two concepts were designed. After validating the two concepts with experts (two gate agents and a shiftleader), one concept was chosen for iteration. And iteration was made based on experts' feedback. Later on, a high-fidelity interactive prototype was made to describe the functions and to prepare the final user test.

The last phase is user test and evaluation. Five gate agents as well as two service agents were recruited randomly to the test. Due to technical limitation, participants were asked to pretend to work using the prototype and give feedback about the design. Based on the interviews and questionnaires, the data analysis was conducted. The result shows that agents rate a high score for the user experience of the new prototype. The prototype is regarded as supportive, proactive and in control in general.
Based on the feedback from the user test, improvements were made to finalize the design. Moreover, the conclusions were drawn for the whole project and recommendations were provided for the company.

Executive Summary 3

Chapter 1 Introduction 6

Chapter 2 Understanding current process 8

2.1 Methodology 9
2.2 Essence of Boarding 9
2.3 Complexity of boarding 11

2.3.1 Regular operations
2.3.2 Irregular disturbances
2.3.3 Overview of gate agents' workflow
2.3.4 Diverse workload
2.3.5 Problems of the process

2.4 Digital tools during boarding 20

2.4.1 Understanding tools
2.4.2 Tools analysis

2.5 Conclusions 25

Chapter 3 User research 27

3.1 Methodology 28

3.1.1 Research goal
3.1.2 Research methods

3.2 Results 30

3.2.1 Understanding the agents
3.2.2 Understand the business
3.2.3 Understand the passengers

3.3 Analysis 34

3.3.1 Needs of different stakeholders
3.3.2 Visions of different stakeholders
3.3.3 Problems cluster

3.4 Conclusions..... 39

Chapter 4 Future Vision..... 41

4.1 Trends analysis 42

4.2 Cocreation session 43
4.3 Vision and 3 Horizons..... 45
4.4 Technology 53
4.4.1 Data flow
4.4.2 Expert Validation
4.5 Conclusions 55

Chapter 5 Design Brief 57
5.1 Design goal 58
5.2 Design criteria 59

Chapter 6 Ideation and iteration 60
6.1 Ideation 61
6.2 Expert validation 64
6.3 Main functions 66
6.4 Conclusions 74

Chapter 7 User test 75
7.1 Procedure 76
7.2 Results 79
7.3 Discussion 84
7.4 Improvements 85

Chapter 8 Final Design 86

Chapter 9 Conclusion 94
9.1 Conclusions 95
9.2 Recommendations 96

Glossary

References

CHAPTER 1. Organizational Context

1.1 About KLM

Founded on October 7, 1919, KLM Royal Dutch Airlines is the oldest scheduled airline in the world still operating under its original name. Operating out of its home base in Amsterdam, the KLM Group served its global network with a fleet of 209 aircraft in 2018. KLM employs 33,000 people. In 2017, the KLM Group generated EUR 10 billion in revenue. Following the merger with Air Francein 2004, KLM has pursued the concept of one Air France-KLM Group, two airlines and three core activities (passengers, cargo and engineering & maintenance). Together with Air France, KLM plays a pioneering role in the European air transport industry ("KLM Company profile", 2019).

KLM vision

KLM has the ambition to become the most customer centric, innovative and efficient European network carrier. It takes on this challenge by putting the customer first with everything she does and by setting up her employees for success.To align ambitions for the desired customer experience with ambitions for the desired employee experience, a KLM compass is created and communicated thoroughly in every units (see Figure 1.1).

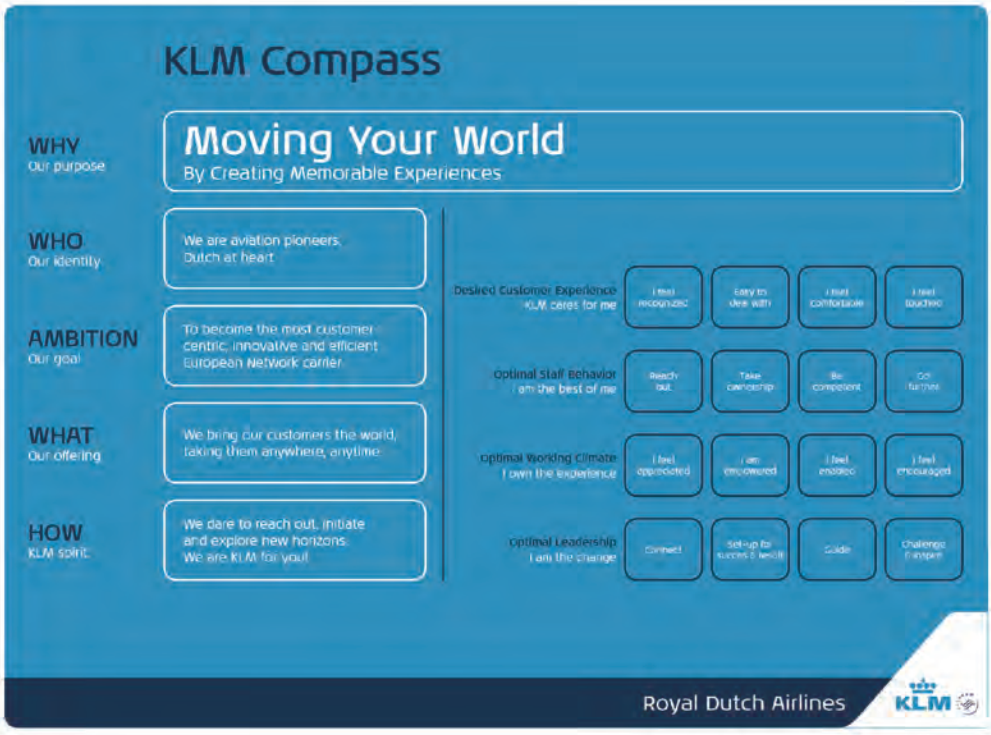


Figure 1.1 KLM compass

1.2 About Ground Services

Ground Services is responsible for all ground handling in Schiphol airport, including passengers, baggages and aircrafts. Ground Services consists of several divisions, and Passenger Services is
one of them. Ground Services has the only key performance indicator(KPI), which is the turnaround on time performance. Besides, there are some factors to be considered during the operation:

- safety;
- maximum baggages;
- maximum passengers;
- customer loyalty and experience;
- Productivity and costs.

1.3 Scope and Stakeholders

This project is mainly conducted in the context of Ground Services. It should be taken into consideration, to align with the goal of Ground Services, which is to help improve boarding on
time performance. As shown in figure 1.2 below, this project is assigned by boarding ICA, a unit under passenger services, and also works with X team and Appy2Help team. KLM X team has access to design and test quickly and iteratively in the real context. Appy2Help is an iPad app for all the ground staffs to help passengers look for information. It is widely used in current boarding process.
The other departments shown in the figures are other stakeholders related inside KLM.

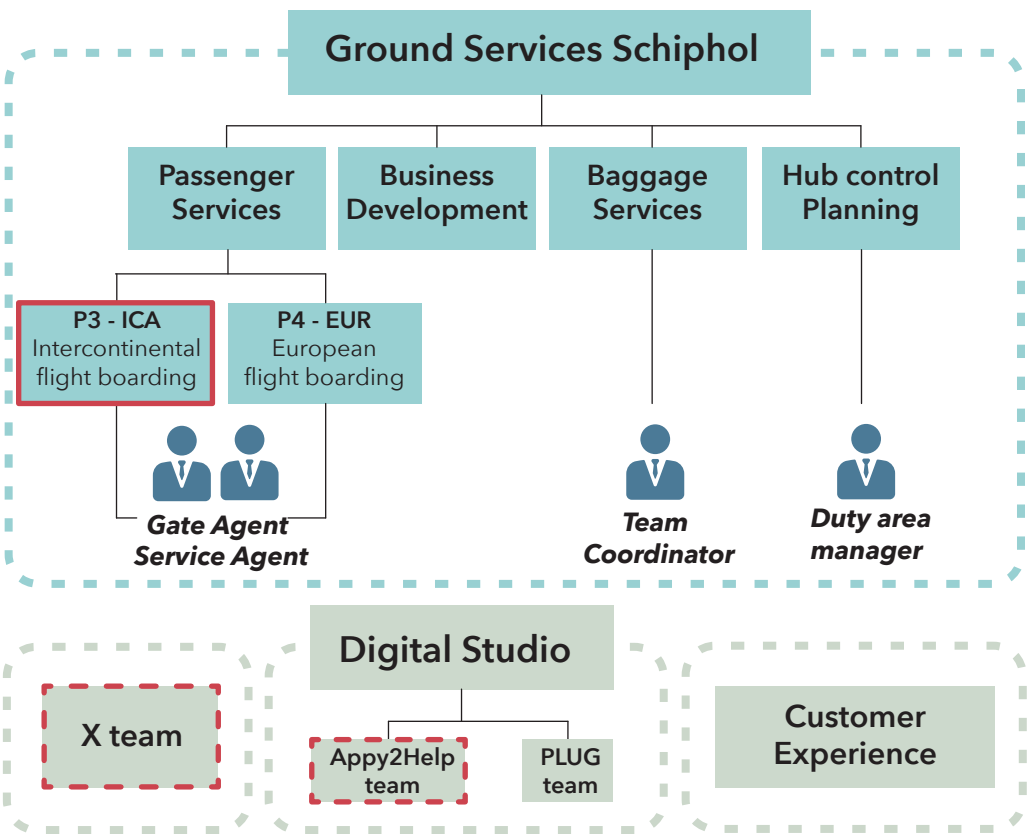


Figure 1.2 Scope of the project

CHAPTER 2.
Understand the context

This chapter will give an introduction of what happened, who is invloved and what matters in the current boarding process.
Literature review, observation and expert interview were conduct to get a holistic understanding of the boarding process.
After all the research, a list of problems perceived by me were made in the conclusion part.

2.1 Methodology

To have a deep dive into what happened and what employees need to do in the current boarding process, a list of research questions are come up with:
* Who are involved in the boarding process?
* What are the regular operations of boarding?
* What are the irregular interruptions of boarding?
* Which digital tools are used during boarding?

There are several research methods used to understand the research questions above.

Documents review

There is a detailed manual for agents about the boarding process made by KLM. In the boarding manual, what action need to be taken at what time frame is defined clearly. It is an easy way to get an overview of agents' responsibilities and actions through reading the manual.

Observation

By staying with a gate agents for half a day, observation was conducted to understand in reality what actions does a gate agent take before and during boarding, as well as what interruptions she has encountered . 3 flights were observed: one to Moscow (European flight), one to Shanghai (International flight), and the other one to New York (USA flight).
Notes are taken about:
- at which time what actions are done
- when is the gate agent busy
- what tools are involved

Expert interview

Several expert interviews were conducted with a gate agent, a shift leader (the manager of agents), and the unit manager(manager of shift leaders), so as to understand the boarding process from different positions.
During the interview, the following questions were answered:
- What are the regular operations of boarding?
- What is the goal and concerns during boarding?
- What are the most common issues about boarding?
- What information and action are required for all kinds of irregular interruptions?

2.2 Essence of boarding

According to all the research methods:

the essence of boarding is to authorise the right access for all passengers and their hand baggages through the gate to an aircraft in a planned time slot.

The authorising process is currently operated by a group of agents at the gate: a gate agent, who has more expertise and is managing the whole process, and two or three service agents, who has less expertise and operating the identification of the majority of passengers. There are specific responsibilities and actions for each character (SA1, SA2, SA3), please find it in figure 2.1.

Identification is the core need of each boarding process, which means compare the personal information on a boarding pass with the personal information in the booking system. Currently the personal information is mainly the name of a passenger. If there is a match, the light of scanning machine will turn green, the state of that passenger in the booking system will changed into boarded, and the passenger has the access to walk on a flight.

Gate agent

"Manager of every flight departure"

Make sure the boarding process is on track, which means authorising right access to passengers to the aircraft

Main Task:

- conduct regular operations on time
- deal with all kinds of irregular interruptions
- solve issues for passengers
- monitor the whole process

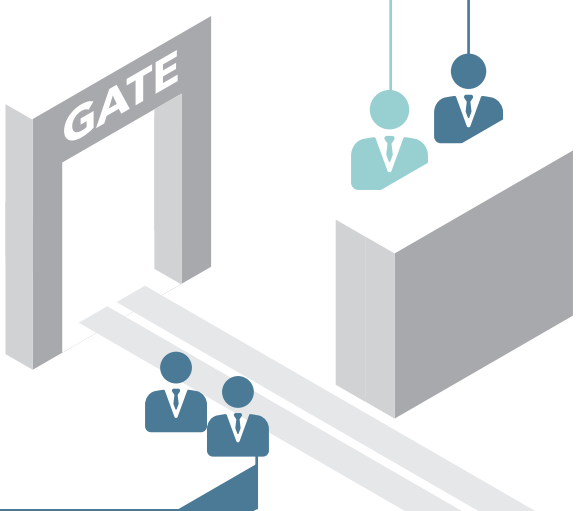
Service agent 1

"Right hand of Gate Agent"

Personal assistant sitting next to the gate agent, help gate agent prepare for boarding and solve problems for passengers.

Main Task:

- prepare the lanes and gate
- solve issues for passengers
- anwser questions from passengers



Special passengers

"All kinds of Special needs"

Besides the common needs of every passenger, there are many minority groups may have special need. Including priority passengers, PRMs, UMs, ITBLs, Infants, NOC, NOC TNB, Standby pax, No show passengers and etc. Please find the detailed analysis in Figure 2.7 on page 17

Needs:

- priority boarding
- special help
- solve issues before boarding

Service agent 2&3

"Boarding pass scanning"

Stand at the boarding pass scanner, scan boarding pass for most pax.[1]

Main Task:

- scan boarding pass
- send pax cannot board to the desk

General passengers

"Basic need for every passenger"

Usually the majority of passengers on a flight. They are economy class, have no issues during boarding.

Needs:

- be notified to board
- the passport and boarding pass checked
- questions answered
- settle down in the aircraft

Team Coordinators (TC) are working on the platform and responsible for baggage loading and offloading. Every flight has one team coordinator. They are also involved in the decision making of offloading No Show passengers.

Duty Area Managers (DAM) are working in Hub Control Center. Every duty area manager is monitoring multiple flights at the same time. They have an overview of real-time status of each department for each flight. As part of the operation triangle, they are also involved in the decision making process to offload.

Operational Triangle means the collaboration among GA, TC and DAM. They need to inform each other special situations and make a decision to offload the missing passengers before departure.

Pursers and cabin crew go into the aircraft first and prepare the inflight service later. There are concerning about passenger inflight experience instead of on time performance.

[1] The amount and responsibility of SA are based on ICA flight, there might be difference for European flight.
[2] For special destination such as China, there are extra agents checking passports.

Figure 2.1 Boarding at the gate

2.3 Complexity of boarding

But in reality boarding does not go smoothly every time as planned in the manual. Because besides the core action (identification) and the majority of passengers, there are several irregular special passengers and disturbances which need extra attention and action from the gate agents. In 2.3.2, each kind of irregular interruptions will be described in detail.

2.3.1 Regular passengers and operations

If everything goes smoothly, every passenger arrives on time, does not need special attention and have no problem for identification. The gate agents need to:
1. prepare the infrastructure (to make sure the path to aircraft is smooth)
2. announce the passenger to board (first priority passengers then economy)
3. close the gate after everyone is boarded
4. report to important colleagues (TC and DAM) that boarding is finished by phone.

There are three different time schedules applied for European flights(EUR), intercontinental flights(ICA), and USA flights. The gate agent need to keep the different schedule in mind, and announce the passenger at different time.
And the service agents stand besides the scanning machine and help passengers to scan the boarding pass. They are the ones who operate the actual identification for each passenger. So operating the regular passengers identification does not need any expertise and any special attention.

2.3.2 Irregular disturbances

Several irregular interruptions might happen during boarding, which need gate agents' attention and expertise to deal with.

A. ITBL passengers
B. Standby passengers
C. Pre-boarders
D. NOC passengers
E. Missing passengers
F. Disruptive passengers
G. Hand baggage check-in

information

action

solution meets the need

solution does not meet the need or not efficient

A. ITBL passengers

An ITBL (ineligible to board list) passenger can not be identified successfully unless his or her issue is solved beforehand.
There are many reasons that a regular passenger become an ITBL passengers. Most common reasons are: need to validate travel documents before identification, seat has changed, randomly selected to do a security check (only for USA flights).
For the ITBL passengers, the gate agents' wish is **to solve issues for most of them before boarding starts**, otherwise it will cause much workload during boarding and the smooth passenger flow is also influenced.

NEEDS	CURRENT SOLUSIONS	DESIRED SOLUSIONS
know the list of names and their reasons beforehand	in Appy2Help	
notify them they need to solve a issue and why	in Appy2Help GA can send a SMS to notify all ITBL passengers to come to the gate no earlier than 70 minutes before departure, but no reason is provided in the notification	- Notify the ITBL passengers earlier - Notify the ITBL passengers with specific reasons - Notify the ITBL passengers by more methods besides SMS

B. Standby passengers

Standby passengers come from an overbooked flight, and it is unsure who of them can be on board until they arrive and gate, sometimes even until the last minute before gate closed. Gate agents need to decide who in the list of standby passengers will be accepted on that flight, if there are vacancies.
There are two types of standby passengers:
- Commercial standby passengers. They are passengers booked an overbooked flight. So they know already that probably they cannot make this flight beforehand. They are admitted that if they cannot make this flight, KLM will help them to rebook a new flight.
- IPB passengers. They are employees of KLM. They also know that it is uncertain if they can make that flight. They always have a lower priority than the commercial ones.

The goal for standby passengers for gate agents is **to accept them according to their priority and also how many people they travel with.** There are usually two time frame to accept standby passengers for a gate agent: 1) when check-in is closed, there might be some vacancies due to passengers who did not check in. 2) when the gate is going to close, some passengers will not show up so there might be some vacancies to accept standby passengers.

information

action

solution meets the need

solution does not meet the need or not efficient

NEEDS	CURRENT SOLUSIONS	DESIRED SOLUSIONS
know the list of names, know their priority and how many people they travel with beforehand.	in Appy2Help	- check the list of passengers with priority and also how many people they are travelling with.
accept passengers to board	ALTEA will automatically accept standby passengers by their priority. The gate agents need to check and change the result because the system does not consider people travelling together.	

C. Pre-boarders

Pre-boarders are a combination of several kinds of special passengers who need to board earlier before the regular boarding starts, including:
- PRM, who has reduces mobility and moves slower, so they need to board beforehand. They often come with the help of a third company, Axxicom.
- UM, stands for unaccompanied minor, are children travel alone. They need special attention so also need board early. AFS are the employees in charge of escorting them to go to the gate.
- DEPU/DEPA, stands for deportee unaccompanied/accompanies. They need special attention and board early. KMAR, the border police, is in charge of these passengers.
- People travelling with infants. Also due to moving slow, they need to be boarded before the regular boarding.

The goal of pre-boarders for gate agents is **to board all of them before regular boarding**. They have no issue with identification, so they are very similar to the regular passengers.
But when they are not arrived at the gate on time, the gate agents need to pay some special attention to check where are they, because it might lead to a delay.

NEEDS	CURRENT SOLUSIONS	DESIRED SOLUSIONS
know the amount and list of names of different kinds of preboarders beforehand	in Appy2Help	- have the shortcut to call the related stakeholder if they are not there
check if they have arrived the gate on time	Compare the amount in Appy2Help and show up at the gate	
announce them to pre-board	generate announcement in AGC	
for preboarders do not show up on time, ask stakeholders	for preboarders not show up on time, search the stakeholders' number (for PRM, call Axxicom; for DEPA/DEPU, call KMAR; for UM, call AFS.)	

information

action

solution meets the need

solution does not meet the need or not efficient

D. NOC passengers

NOC passengers are the transfer passengers who cannot make the flight, due to delay of the last flight. Some NOC passengers are quite sure that there is no chance to catch the flight, because there is a big delay. But some are very uncertain whether they can hurry up and catch the next flight.
Currently the ticket office, another department from KLM, is in charge of rebook for NOC passengers.
But as a gate agent it is still necessary to check the transfer passenger list beforehand. Besides the common goal **to accept as much as transfer passengers on the flight**, there are different goals of different NOC passengers for gate agents:
- for NOC passengers that cannot make the flight for sure, make sure they are offloaded
- for NOC passengers that maybe can make the flight, ask the ticket office not to rebook for them immediately, but wait until the last minutes
- for NOC passengers that maybe can make the flight, keep continuous contact with DAM while boarding, to check if they can wait longer (overlapped with E. missing passengers)
- for passengers who can make the flight but the baggage cannot, which also called NOC TNB passengers, notify them as soon as possible

NEEDS	CURRENT SOLUSIONS	DESIRED SOLUSIONS
check the list of transfer passengers, their name, their flight's arrival time and arrival gate, their baggage status, are they rebooked or not.	in Firda	
check the real-time information and status multiple times.	Manually check Firda multiple times to get updated.	- have the real-time information automatically updated
call the ticket office to ask them wait more time for some flights	search the number of ticket office and make the call	- have the shortcut to call ticket office
offload rebooked NOC passengers	in ALTEA	
notify rebooked NOC passengers they are rebooked	No solution	- have an access to notify NOC passengers they are rebooked
notify NOC TNB passengers their baggage status	No solution	- have an access to notify NOC TNB their baggage status

information

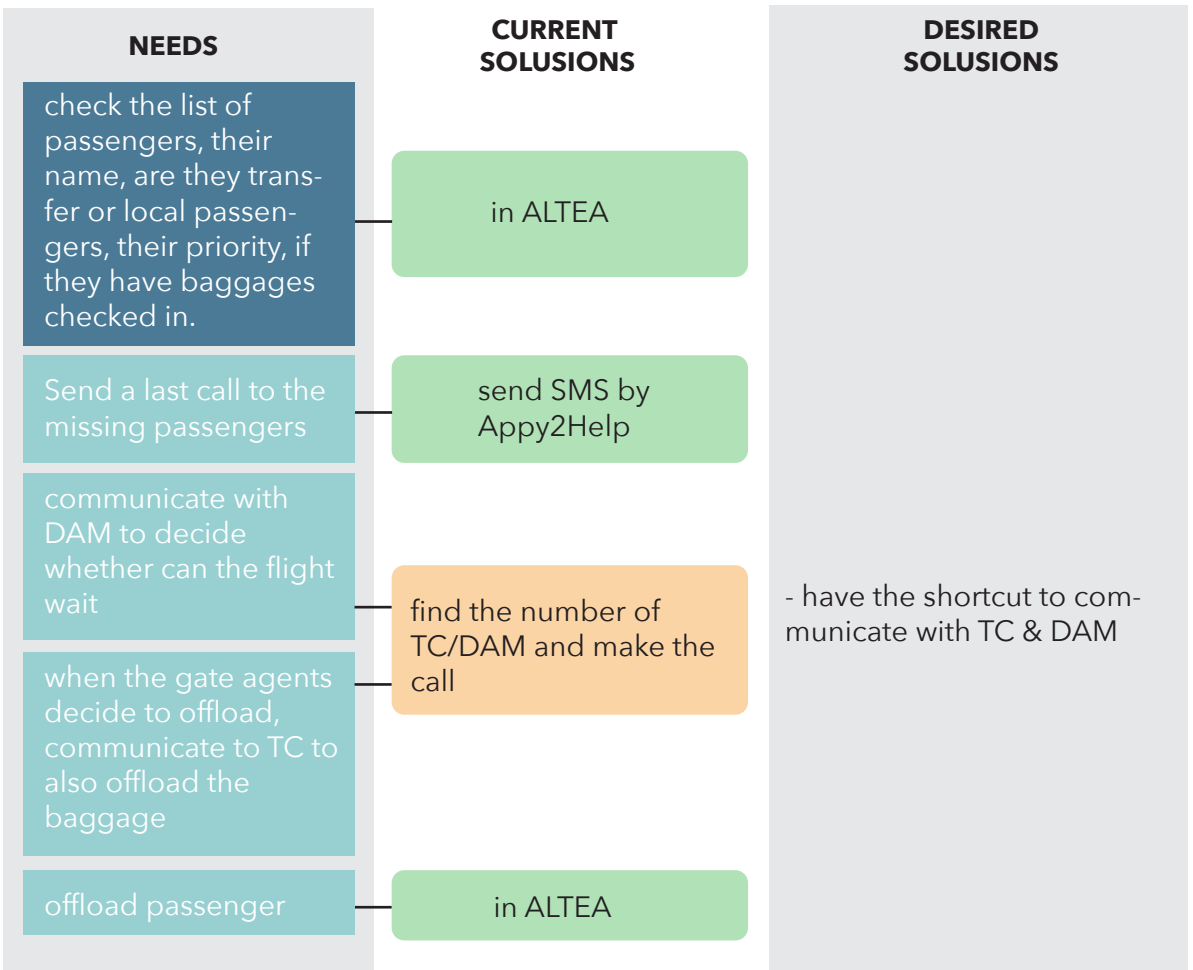
action

solution meets the need

solution does not meet the need or not efficient

E. Missing passengers

Missing passengers are the passengers who did not show up at the gate until 15 minutes before departure.
The goal of managing missing passengers is **to make a good decision whether to wait for them and how long to wait**. TC and DAM are also involved in the decision making process.



F. Disruptive passengers

Disruptive passengers are passengers who is drunk or aggressive at the gate. Compared to other irregular interruption, this situation does not happen a lot. But it is unpredicted and each time when it happens, it will cause a lot trouble for gate agents.
The goal of managing disruptive passengers is to **make them under control and decide whether to accept them on the flight together with purser.**

information

action

solution meets the need

solution does not meet the need or not efficient

NEEDS	CURRENT SOLUSIONS	DESIRED SOLUSIONS
make sure whether the disruptive passenger is on the passenger list of that flight	try to communicate with passenger	- have the shortcut to call shift leader and purser
ask for help from shiftleader if the situation is severe	find the number of shift leader and make the call	
ask purser to go to the gate to decide whether to accept the passenger	find the number of purser and make the call	
offload the passenger if needed	in ALTEA	

G. Hand baggage check-in

Some flights have a small capacity of hand baggages. If there are more hand baggages at the gate than the capacity, the gate agent need to **recruit volunteer passengers to check in their hand baggage at the gate.**

NEEDS	CURRENT SOLUSIONS	DESIRED SOLUSIONS
know beforehand whether it is a flight with baggage issue	in Appy2Help	- have the access to notify passengers earlier
notify the passengers about the issue beforehand	Notify at the gate	
print the bag tag and check in the baggage	in ALTEA	- have a shortcut to contact TC
contact porter to take the checked baggages to the platform	For flight always has a baggage issue, there is usually a porter at the gate	
contact TC to collect the baggages	Find the number of TC and make the call	

2.3.3 Overview of gate agents' workflow

For gate agents, what they need to do is usually handling and managing several different disruptions at the same time. Figure 2.2 shows the timeline of the regular operation and irregular actions for a gate agent.

The workflow of a gate agent can also be summarised by attention levels. Figure 2.3 shows three circles of boarding. The inner one is about regular operations. The middle one shows different disruptions that predictable and need some special attention. The outer one indicates irregular interruptions need a lot attention from passengers.

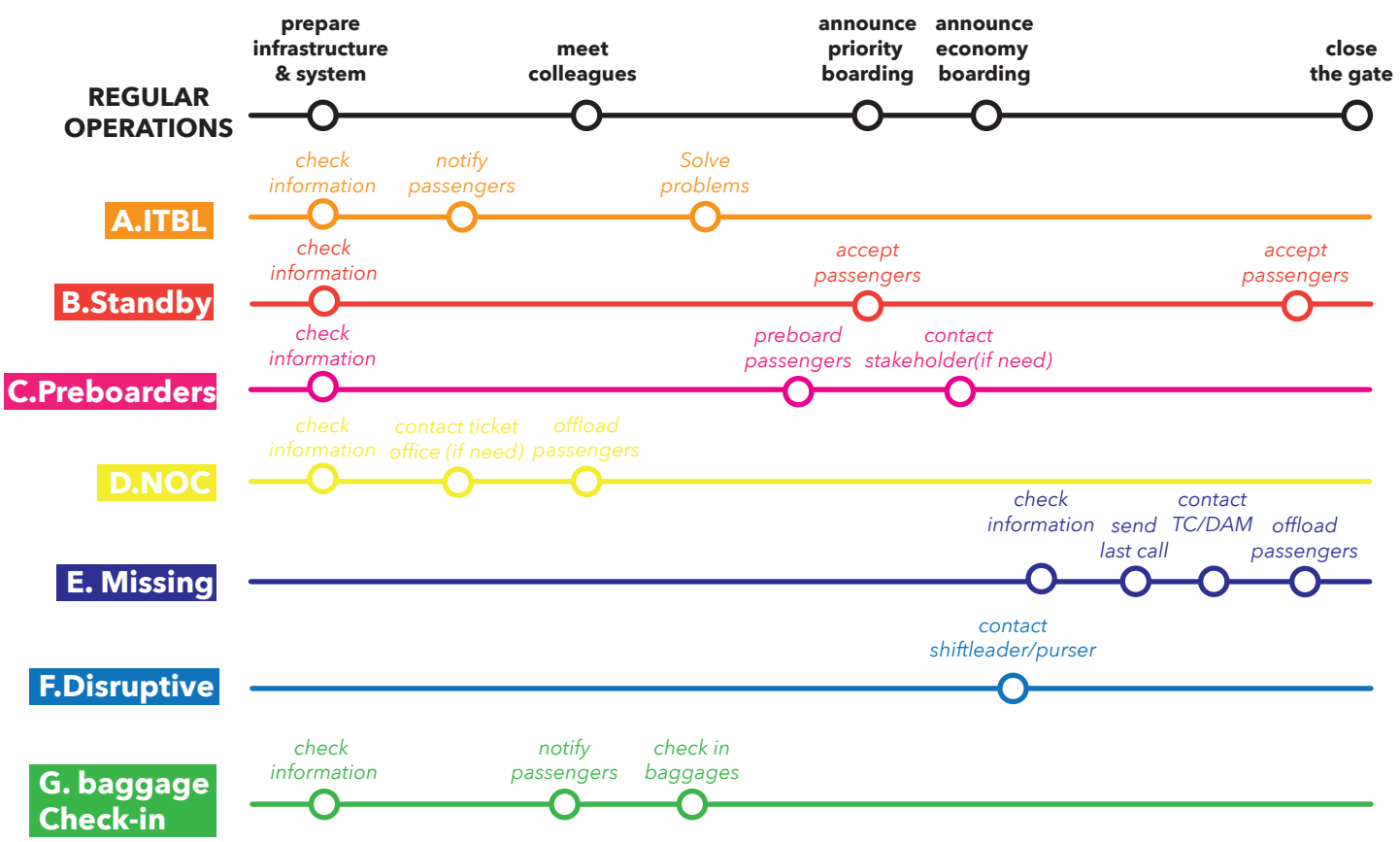


Figure 2.2 timeline

BOARDING PROCESS

Same topic

Relative topics

A.ITBL

B.Standby

C.Preboarders

D.NOC

E. Missing

F.Disruptive

G. baggage Check-in

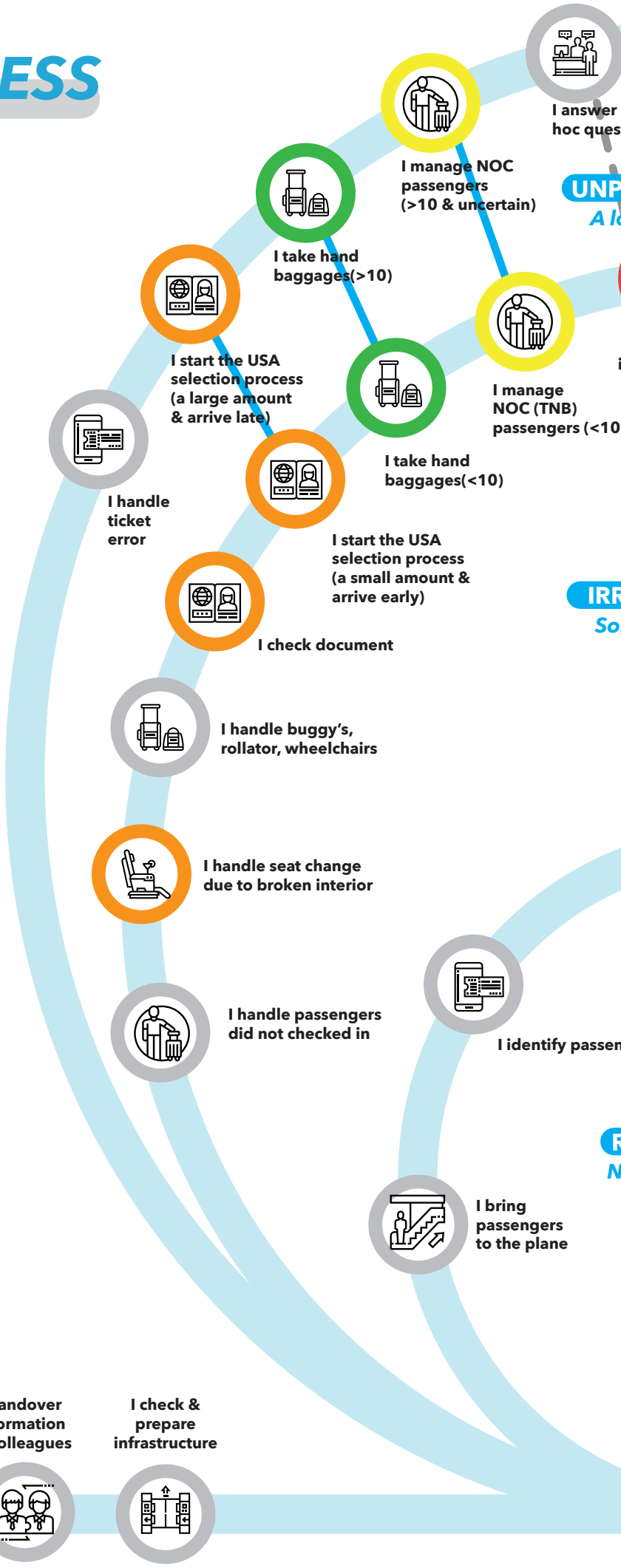


Figure 2.3 ECO SYSTEM

BEFORE BOARDING

I sign up at the gate

I collaborate in a team

I boot all the systems

I handover information to colleagues

I check & prepare infrastructure

er ad
uestions

I have a medical incident

I manage missing pax

I answer questions about different rules from other airlines (transfer)

I handle disruptive passengers

NPREDICTED DISTURBANCES
A lot of special attention needed

I handle iPB passengers

I handle overbooked commercial passengers

I handle infants

I handle business downgrade

10)

I handle Ulti & VIP passengers

I handle unexpected PRMs

I handle DEPU/DEPA passengers

RREGULAR DISTURBANCES
Some special attention needed

I handle PRM passengers

I handle UM passengers

I handle ITBL passengers

I inform colleagues start/end boarding

sengers

I activate the system to accept boarding

I check for special passengers

REGULAR OPERATIONS
No special attention needed

I inform passsengers to board

AFTER BOARDING

I report to collegues

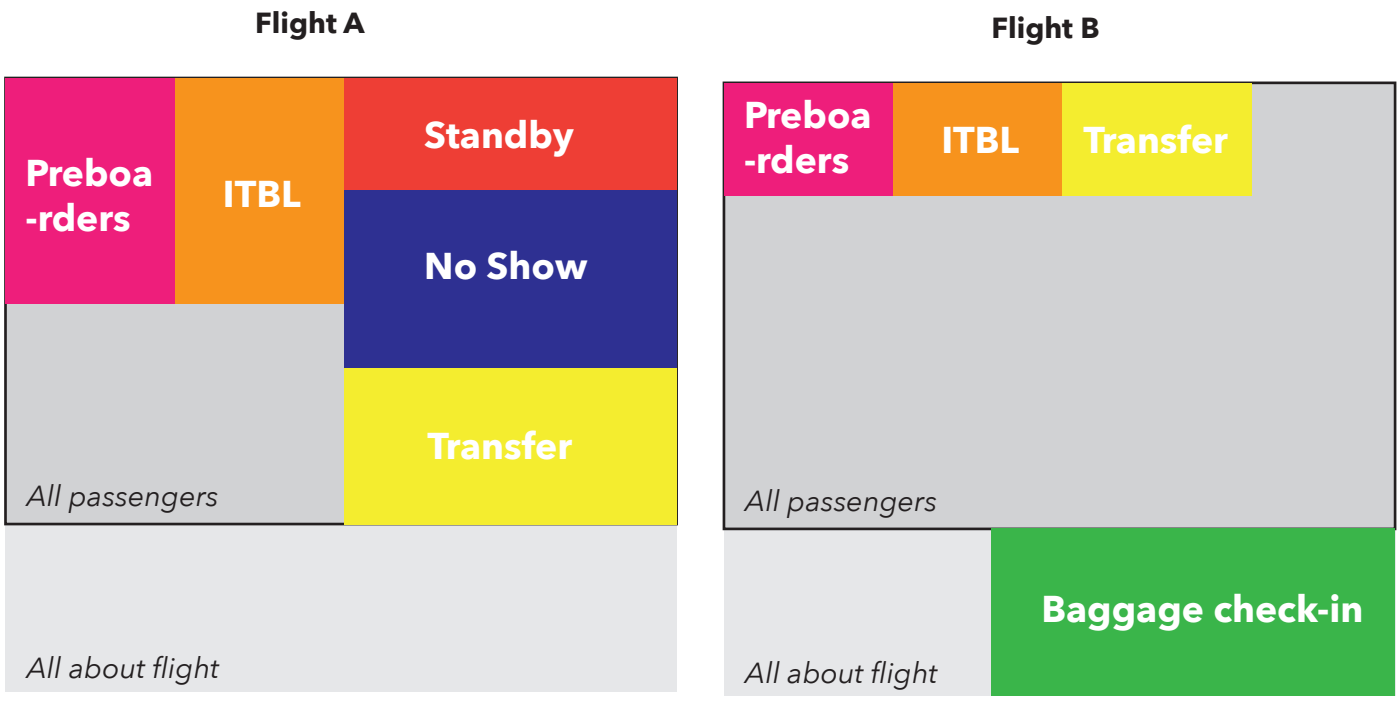
I close the gate

I write a report for important details

I close the systems

2.3.4 Diverse workload

Every flight is unique. Some go smoothly and there is no big interruptions to pay attention. But some can be very stressful and encounter many interruptions. So the workload of every flight could be very diverse.
How much the workload is and what kind of interruption happens is highly related to the destination. So gate agents can get mentally prepared with their sufficient experience before they go to the gate.



2.4 Digital tools during boarding

Multiple digital tools are used during boarding process by different stakeholders. As for gate agent, it is common that several tools and screens are used at the same time. Different agents have different preferred tools. Here is an overview of boarding related tools.
Figure 2.4 shows the work space of a gate agent.
Figure 2.5 illustrates the main tools and platform of a gate agent.

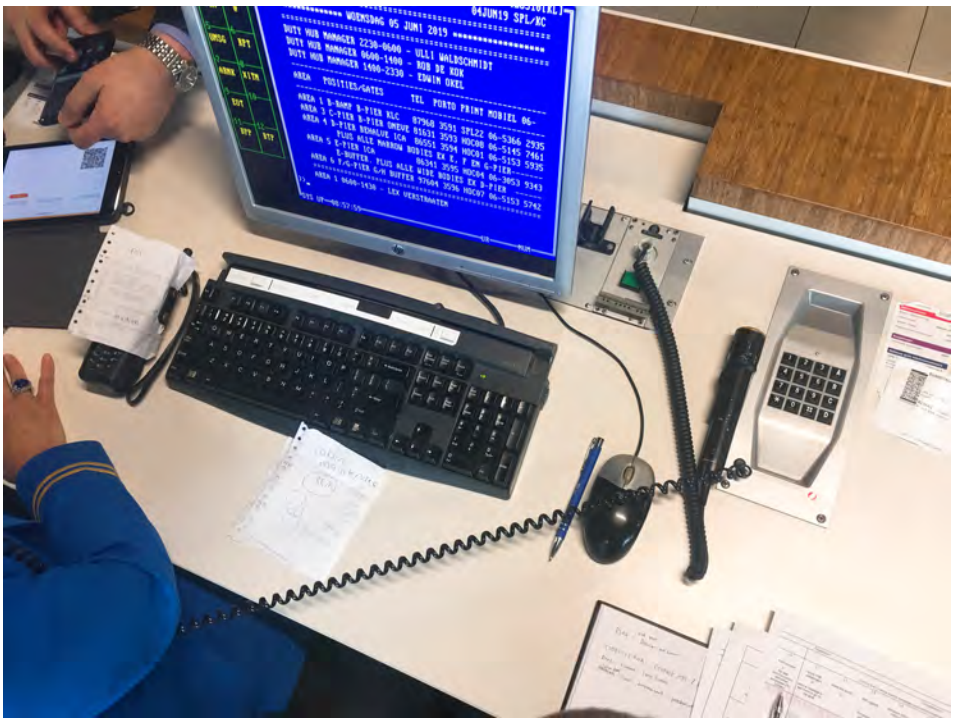


Figure 2.4 GA work space

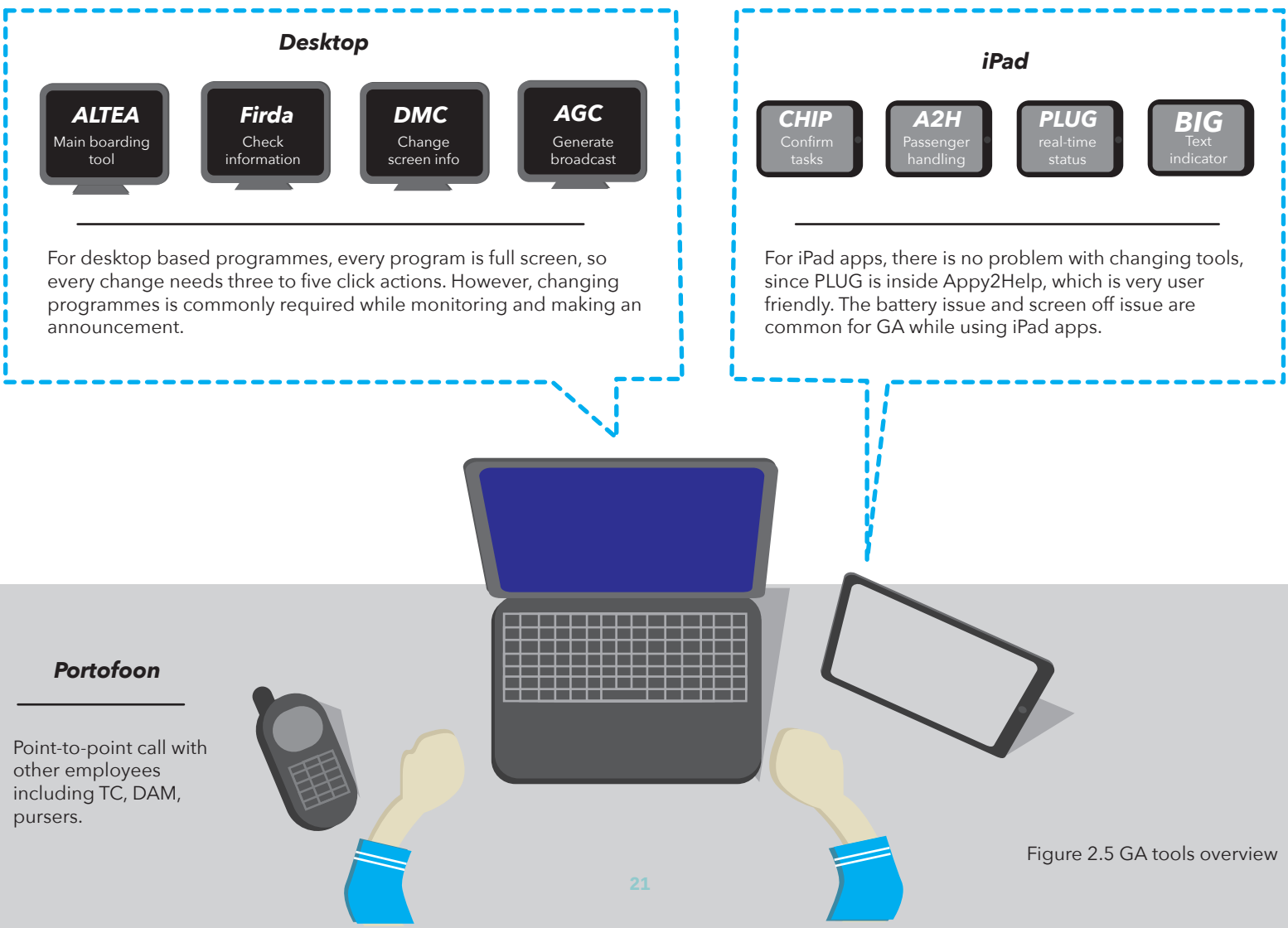


Figure 2.5 GA tools overview

ALTEA

Main tool and main screen for current boarding



ALTEA is the main tool and main screen used for boarding process currently. It is a program with many applications, among which flight application and boarding application are the most commonly used.
Flight application provides an overview of the flight, including booking information, aircraft information and so on.
Boarding application can start and end boarding, as well as confirm a passenger "boarded".

++ Most information and most actions in one program
++ Data shared with other airlines and update fast
- - Interface not friendly
- - Sometimes too many clicks to a function

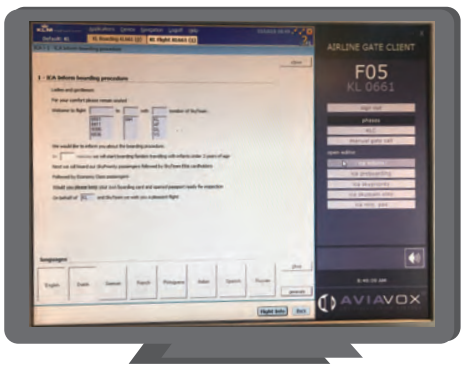
Firda

Support screen for real-time info and internal communication



Firda is the second screen providing information of boarding. Gate agents use it to
- check and print all the contacting numbers of stakeholders,
- check real-time KCC list before boarding
- read information from DAM
- make reports about the flight

++ KCC list most accurate, update quickly
++ Detailed data shared with other stakeholders
- - Interface not friendly (Linux)
- - Passive information providing



Airline Gate Client

Generating announcements

AGC is a desktop program generating broadcasts and making announcements for passengers. Different languages and contents can be customised to make the announcement, such as "start priority boarding" and "boarding will start in 20 minutes". Besides AGC, GA can also make announcement by the microphone on the desk.

++ interface friendly and simple (several buttons)
- - manually change every time
- - change program need several clicks



DMC

Changing status on screens

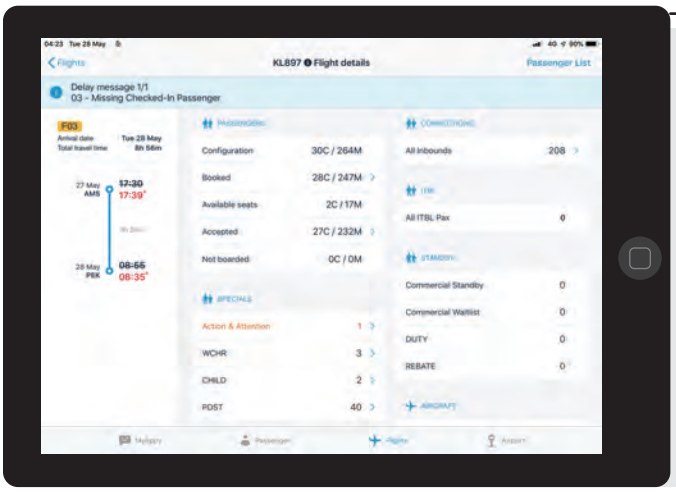
DMC is a desktop program controlling the information on every screen (lane screens and gate screen). By changing the gate status and lane information (priority or economy), passengers are guided to board.

++ interface friendly and simple (several buttons)

- - manually change every time
- - change program need several clicks

Appy2Help

iPad App for passenger handling at the gate



Appy2Help is a iPad-based application used by ground staffs, in order to enhance customer intimacy while independent of infrastructure.
As for boarding process, Appy2Help is currently used as a second screen next to ALTEA so as to improve the on time performance of boarding.
Appy2Help provides the same function of flight status as in ALTEA. Additionally, providing a overview of special passengers, selling upgrade, notifying ITBL passengers and sending last calls are functions ALTEA cannot achieve.

++ Overview of special passengers
++ Send SMS to ITBL and no show pax
++ User friendly interface

- - Slow interaction sometimes
- - Battery goes down quickly
- - Passive information providing

PLUG

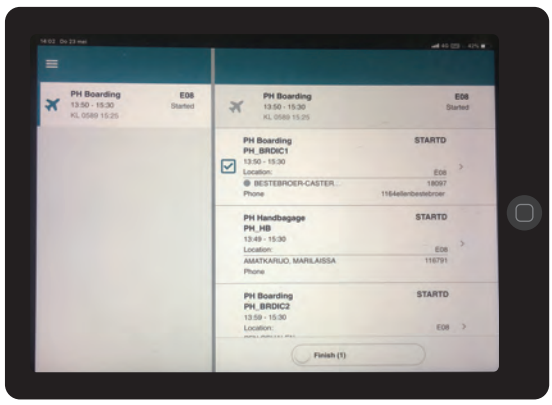
Transparent real-time information sharing platform in A2H



PLUG is an application inside Appy2Help, indication a real-time status of different departments for each flight, such as how many passengers boarded and how many baggages loaded. It also provided real-time prediction of time when boarding finished, according to the current boarding speed. It makes gate agent feel more in control.
Plug is also used by TC, Purser and Cockpit.

++ Real-time status update
++ Clear overview of different process
++ Simple prediction of finished time
++ Proactive information (color bar at the top)

- - Slow interaction sometimes
- - Battery goes down quickly
- - Could be more possibilities and more accurate prediction





CHIP

Check tasks and confirm tasks

CHIP is an App for both GA and SA to check and confirm tasks. They can also see status of other team members.

++ clear information of others' status
- - only shows name of other member

Big

Text indicator for late priority pax

Big is a text indicator for priority passengers showing up late, guiding them to board at the desk.

- - need to type and choose color manually

2.4.2 Tools analysis

The two main problems of all the tools are ***passive and inefficient***.

The tools are ***passive***, because they currently only work as a provider of information and actions. All the analysis about flight, such as which issues for this flight should pay more attention, are done by GA in their head. When GA start a flight, they go through several programs to gather detailed information of every special group (see 2.3.2). Then they analyze the flight in brain and decide to take what action.

Besides *not helping analyze*, the tools *do not provide a time reminder*. Since the boarding process is a task strongly related to time. There is strict time schedule about when to do what. But currently GA need to always keep an eye on time and do the right thing at the right moment.

The tools are also ***inefficient*** for the following reasons.

- There are *too many programs* being used in the boarding process. GA need to go through several programs to gather info and tack actions. When it's time to start boarding, three programs should be used as the same time.
- The *information hierarchy is too deep* in current tools, especially Firda and ALTEA. Usually it takes five clicks to go to the information page or take an action, which caused a lot of inefficiency.
- The *real-time information needs to be checked multiple times*. Currently only info in PLUG can be updated automatically. All the other real-time info, such as the transfer passenger list, need GA to check by themselves.

2.5 Conclusion

Complexity of boarding

The boarding process has a simple essence literally but is quite complex in real world.

The essence of boarding is to authorize the right access for all passengers and their hand baggage through the gate to an aircraft in a planned time slot.

The regular operations for the majority of passengers are simple and stays same for different flights. What make the boarding process complex are:

1. Every flight is unique. How much the workload is and what kind of interruption happens could be varied from flight to flight. And it is highly dependent on its destination. ***Every flight could have different types of issues*** which need GA's attention.
2. It is a task within a planned time slot. ***At different time the issues could be different.*** Before boarding the major issue need attention is find the pre-boarder, while when time to close the gate, deciding whether to accept missing passengers need all the attention.

Problems List

During the research, many problems about boarding were figured out. To make it clearer, they were divided into three topics: about tools, about the whole process and about organization in KLM.

About the whole process

Unstandardized is the general problem for the whole process. There is neither overview of the process, nor clear task division for the team in any tools. Every gate agent does their job in their own way. They are very experienced, so they know when to do what, which also means the boarding process is totally dependent on their expertise and experiences.

- *Lack of process overview*
- *Lack of clear task division in the group*
- *Brief of flight does not provide useful data for database because different GA write different things in brief.*

About the tools

Passiveness and inefficiency are the problems of the tools.

The tools are ***passive***, because they are working only as a provider of information and actions. They do not help agents analyzing anything. There is also no time reminder.

- *Lack of time reminder*

- *Need to analyze all the info in brain and keep in mind*

The tools are ***inefficient***, because GA need to go through several tools to gather info. And the information hierarchy is quite deep, so GA need around five clicks to check info or take actions. Moreover, the real-time information is not updated automatically, so GA need to check multiple times.

- *Need to check several tools to gather info*
- *Need to check real-time info multiple times*
- *Need to check info by several clicks and typing (deep information hierarchy)*
- *Need to change tools to take actions*
- *Need to open three programs to start boarding*

About the organization in KLM

Problems about the organization are out of the scope of boarding, but they do have a large impact on boarding.

Currently the two problems below are both solved by GA's expertise and experience.

1. Training: There are many new SAs with quick training in the past years. So, the SA are not well prepared to handle flight. They have no idea what to do.
    - *Double work when there is a SA with less experience*

2. Planning: The planning department is using an unsmart system to plan "task" (flight) for GA and SA. All the international flights have the same time to prepare and same numbers of staffs, and so does all the European flights. But actually, flight to different destinations could have a very different workload.
    - *Diverse workload for different destinations.* For example, for a flight to Dehli, gate agents might encounter hundreds of questions from passengers, while for a flight to Japan they only received ten questions.

CHAPTER 3.
User Research

This chapter will introduce all the research conducted with users, including passengers, agents and managers.
Starting from research goal and research questions, a combination of quantatitive and qualitative research methods were used to gain fruitful insights from the three stakeholders. After analyzing the results, a problem list as well as a Vision in Product figure was made to concluding all the research phase.

3.1 Methodology

3.1.1 Research goal

There are mainly three goals for user research:
1. Understand how the main stakeholders think of current boarding process and tools
2. Explore what is the desire for different stakeholders about future boarding
3. Have a holistic understanding of the emotions of stakeholders, current interaction characters and desired interaction characters.

3.1.2 Research methods

To achieve the research goals, both quantitative and qualitative research methods are used. The main stakeholders are divided into three group:
1. *for agents*, an online questionnaire, five interviews and a group session are conducted, in order to have a comprehensive understanding from their perspective.
2. *for business concerns*, three interviews were conducted with three managers to gather insights about business needs.
3. *for passengers*, ten small interviews at the gate and four long interviews with friends are conducted.

For agents

1/ Online questionnaire

An online questionnaire was conducted to have a general impression of how agents think of current boarding. Both gate agents and service agents are invited to fill in the questionnaire. It contains three parts: how do agents think of current boarding process; how do agents think of digital tools; demographic information. The questionnaire has received 57 responses, in which 43 are from gate agents and the other 14 are from service agents.

2/ Interviews with gate agents

Interviews with gate agents were designed to make a journey map for current boarding process. The gate agents were asked to rate their emotion level at different time frame during boarding. Moreover, they are asked about the worst experience in the last month, in order to understand their perceived problems during boarding.

3/ Group session with three gate agents

The aim of group session is to explore the desired future from gate agents' perspective. The session started with discussing the worst experience with each other, which could sensitize the participants. Afterwards, they were asked to use post-it's to brainstorm their desired future boarding. And then they shared their desires and make them into clusters.

For managers, three interviews were conducted with two Unit Managers (in charge of European flight and intercontinental flight) and the manager of passenger services. The following questions are asked for each interview:
- how do you think of current boarding process?
- what do you think are the main issues for current boarding?
- what is your personal vision for future boarding?

For passengers

1/ short interviews at the gate

The short interviews at the gate were conducted to gather how do passengers from different ages think of current boarding. They are asked with the following questions
- Are you a local or transfer passengers?
- Did you have problem finding the gate?
- How do you feel currently? (while waiting in line)
- Did you ever have bad experience related to boarding?

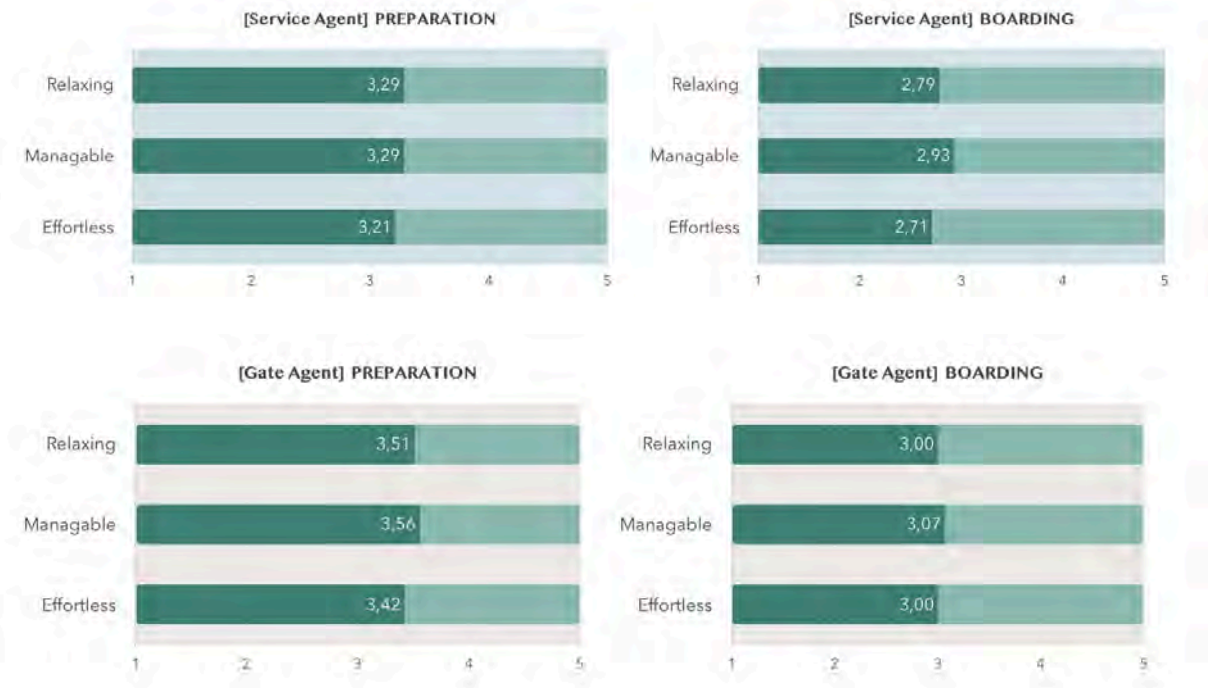
2/ long interviews

The interviewees are recruited among friends, asking them to recall a recent flight. The age of interviewees ranges from 22 to 31, which might cause a limitation for insights. The interviewees were asked to fill in a journey map at the airport, talk about previous issues related to boarding, and also map out the desired future boarding.

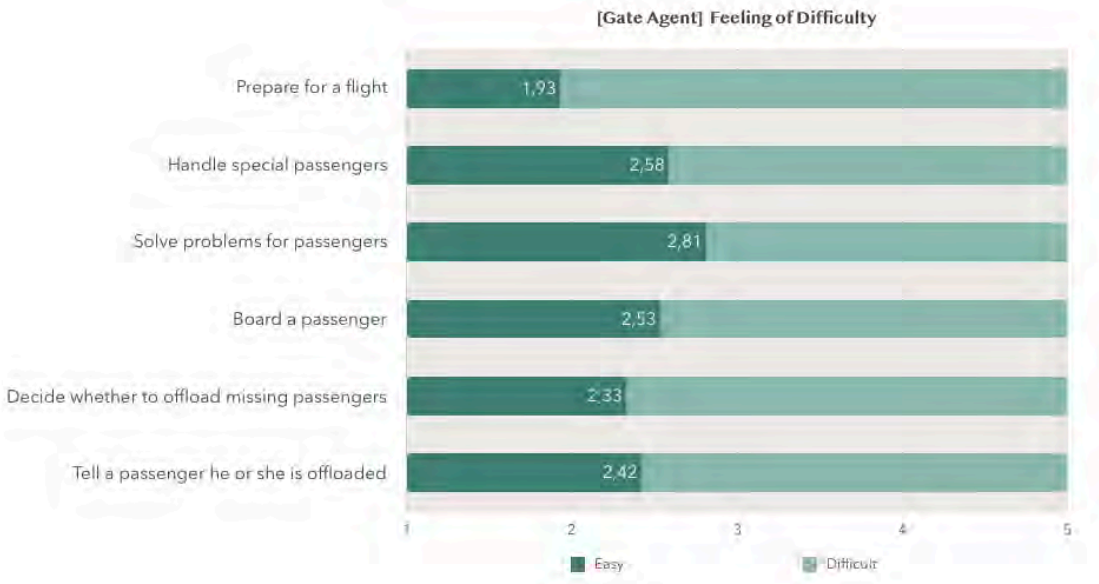
3.2 Results

3.2.1 Understanding the agents

Survey results



The figure above shows how gate agents and service agent feel about preparation and boarding in general. Although gate agents take more responsibility, they feel more relaxed and effortless than service agents, which is based on their fruitful experience. And boarding is less relaxed than preparation for everyone.



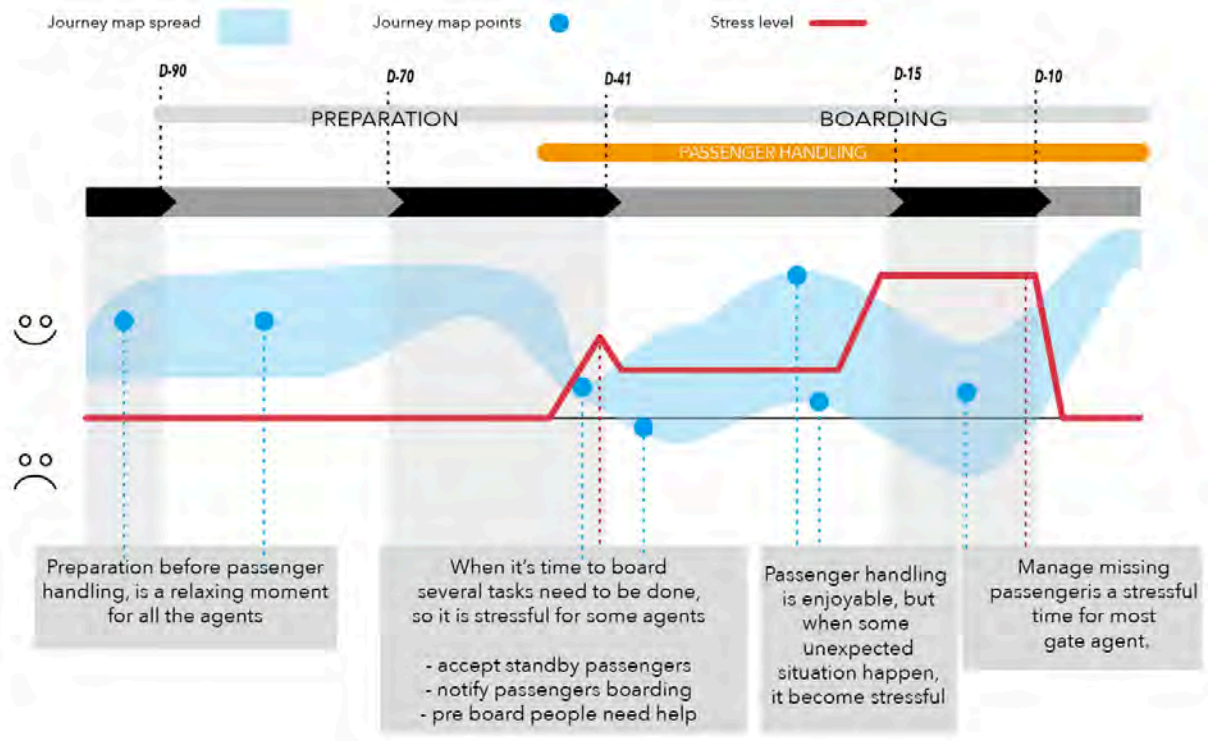
The figure above shows how gate agents rate the difficulty level of some tasks. Solving problems for passenger is the most difficult task, followed by handle special passengers and board a passenger.

1. Basically, all agents think preparation is more relaxed, manageable and effortless than boarding.
2. Service agents are more stressful than Gate agents.
3. Top 3 reasons why gate agents like their work are: every flight is different, helping passengers, contacting colleagues.
4. Top 3 things gate agents dislike about their work are: SA don't know what to do, some flights really stressful, taking hand luggage.

Interview results

A. Journey map

To understand the experience of current boarding, a journey map as well as the stress level is mapped according to the interviews (see figure below).



Here are the key findings from the interviews:

1. It is hard to answer an average emotion or stress level, because it varied from different flights. Some could be very positive while some could be very negative.
2. Another factor that highly influence the stress level of a gate agent is how much experience the service agents have. When there is a service agent with little experience in the team, the gate agent needs to deal with double workload.
3. The work become stressful when the gate agents start to solve problems for passengers. Unpredictability is the main reason of stress.

4. Managing missing passenger is rated by everyone as the most stressful period, because the time is quite limited, and the gate agent need to make a quick but good decision.
5. The experience could be quite different for handling passengers. The bad experiences are all related to situations when they have to tell the passengers bad news (rebooked, offloaded).

B. Current interaction

Passive

The gate agents feel passive in general ***when talking about their interaction to passengers.*** Although they take the initiative to announce passengers to board, there are several kinds of situations they would really like to be proactive to notify the passengers, including:
- notify ITBL passengers earlier
- notify ITBL passengers with specific reasons
- notify rebooked NOC passengers
- notify NOC TNB passengers their baggage status
- notify passengers of a flight with baggage issue they need to check in hand baggage at the gate.

Uncertain

For the interaction with service agents, the gate agents feel uncertain in general. Usually they have no clue how experience the service agents are until they start to work. An experienced service agent can help gate agent a lot.

Unsupportive

The gate agents ***feel unsupportive by the tools, when something unexpected happened***, such as an aggressive passenger, or to decide whether to offload missing passengers.

Group session results

According to group session with gate agents, they would like to have the following improvements for future boarding:
- Better teamwork: The service agents have better training.
- Efficient communication: There is a more efficient way to contact the TC &DAM
- Balanced workload: There are more agents for a stressful flight
- Connectedness: There is a community to share and discuss with other agents.
- Supported decision: When make decisions for missing passengers, the computer can provide support.
- The system works faster and there are less errors.

3.2.2 Understand the business

Three interviews with managers to get input from a business perspective.

For the *current boarding process*, all the managers are *not satisfied* due to the following reasons:
- The agents are more focused on the eligibility of passengers to board, instead of the passenger experience.
- The cost of staffs is expensive.
- The staffs are working mainly behind the desk and computer screen, instead of among passengers.
- For premium passengers, there should be different levels of priority. But currently they are provided with same services.
- The current system is too old which causes extra workload.

For the *personal vision of future boarding*, the managers have *almost achieved a consensus* with following aspects:
- The infrastructure is improved, and biometric boarding is largely applied.
- There is no need to have one gate agent for each flight, the work content and responsibilities of agents change a lot.
- The service agents can also work as gate agents.
- The identification of boarding will be done mainly by passengers' self-service. And the agents are offering help when there is a issue.
- The workload has been simplified by a new system.
- There will be almost no ITBL passengers, because the issues are solved beforehand, which is called" a clean gate".

3.2.3 Understand the passengers

According to the short interviews at the gate, the passengers ***feel in general relaxed and calm at the boarding phase***. Because it is the last step before entering an aircraft and making the flight. But all the interviews are conducted with passengers who arrive early at the gate, which cannot represent the variety of people. Besides the interviews with those calm passengers, I have also observed passengers arrived late at the gate. They look more stressful and in a hurry.

According to the long interviews, the experience of boarding varies from person to person. Some think it is the most relaxing phase, because they are almost on board. But some rate it as relatively negative because they are afraid that the scanning machine will turn red, due to previous experience.
While talking about issues related to board, here are the most frequently mentions problems from passengers' perspective:
1. ***Uncertain and stressful when something wrong happen***: It will be very stressful when the light of scanning machine turns red and the passenger need to go to the gate agent's desk to solve an issue. People with such experience will tend to feel uncertain about boarding.

2. ***The announcements are confused sometimes***. The passengers can hear announcements from several gates nearby, they always need to pay attention and check if it is their flight making annoucements.
3. When arrive at an unfamiliar airport and do not have much time, ***it is usually stressful to find the way to gate.***

3.3 Analysis

This section will have a look through the whole research phase (including chapter 2 and 3), and analyze the problems and needs for different stakeholders, future vision of different stakeholders and finalize the list of problems.

3.3.1 Problems of different stakeholders

Perceive problems by Agents

According to the survey and interviews, a list of problems that gate agents perceived was collected. Before looking into details of the list, there are some interesting conclusions while comparing this list to the list in chapter 2.5.

- Agents are quite used to the tools, so they did not perceive the inefficiency and passiveness of tools. On the other hand, I think the problems about tools are quite significant.
- Most of perceived problems are about passenger handling. There is a common need from agents for different special passengers, which is to notify passengers earlier and more proactive. For example, currently agents can only notify ITBL passengers 70 minutes before boarding, but they would like to start handling those passengers earlier so that they will not be behind schedule. These problems are essentially about process and procedure, instead of tools. There is not much design space for those issues, except creating a button to notify passengers in an earlier phase.
- The problems due to organization turn out to be important and severe problems for gate agents. Besides organizational solutions, there could be some way that digital tool can help.
- Another category of perceived problems is unpredictability. Among all the unpredictable issues, managing missing passengers is a common and severe problem for most agents. Because offloading a passenger when he or she has a checked in baggage, it often takes some time. During that the passenger maybe suddenly show up. So whether to wait for several more minutes is always hard to decide. Especially when a missing passenger is a premium passenger or a passenger with wheelchair, the decision is even harder.

Let's look into details of the problems perceived by agents:

About organization:

1. Training: There are many new SAs with quick training in the past years. So the SA are not well prepared to handle flight. They have no idea what to do.
    - *Double work when there is a SA with less experience*
2. Planning: The planning department is using an unsmart system to plan "task"(flight) for GA and SA. All the international flights have the same time to prepare and same numbers of staffs, and so does all the European flights. But actually flight to different destinations could have a very different workload.
    - *Diversed workload for different destinations (for example, a flight to Russia often encounter unexpected PRM, which need special attention and extra workload.)*
3. Overlap of work with another department: For transfer passengers, especially NOC, it is the ticket office department take the responsibility to rebook for NOC passengers. Sometimes the ticket office has already rebooked for some uncertain flights, but the transfer passengers finally arrive at the gate on time. Then GA need to tell them that they cannot board because they are rebooked. GA feel passive and sorry for those passengers, so some GA would call the ticket office in advance and ask them to rebook passengers from a certain flight later. Because once the rebooking is finished, it is hard to board a passenger to the original flight.
    - *some NOC arrived but already rebooked and cannot on board*

About process and procedure

The problems about process and procedure are related to notifying special passengers. And the common need is to have access to notify them earlier.

- *Feel passive for late notify passengers when: need volunteers to check in hand baggage at the gate*
- *Feel passive for ITBL passengers, wish to notify earlier, and with reason*

About Unpredictability

The problems about unpredictability are quite severe and important for agents. They are also tasks that need most senior expertise from GA.

- *Uncertain to decide whether to offload missing passengers*
- *Feel unsupportive when encounter an aggressive passenger*

About the tools

Only one problem was perceived about the tool, which is quite specific. Currently the system accepts standby passengers automatically, but there are always mistake. Because the system chooses standby passenger only according to premium level. In reality, it is also important whether passengers travel alone or with companion. Passenger would not like to board alone if he or she has companions. So, gate agents need double check for the choice system made.

- *Often need double check for accepting standby passengers*

Chapter 3.3.3 will combine the list above (problems agents perceived) with the list of problems I perceived, which is in chapter 2.5 conclusion, and make a thorough summary of the problems.

Business

There are three needs from business perspective.

1. *Reduce the costs of staffs.*
2. *Better time performance*
3. *Better service for premium passengers*

Passengers

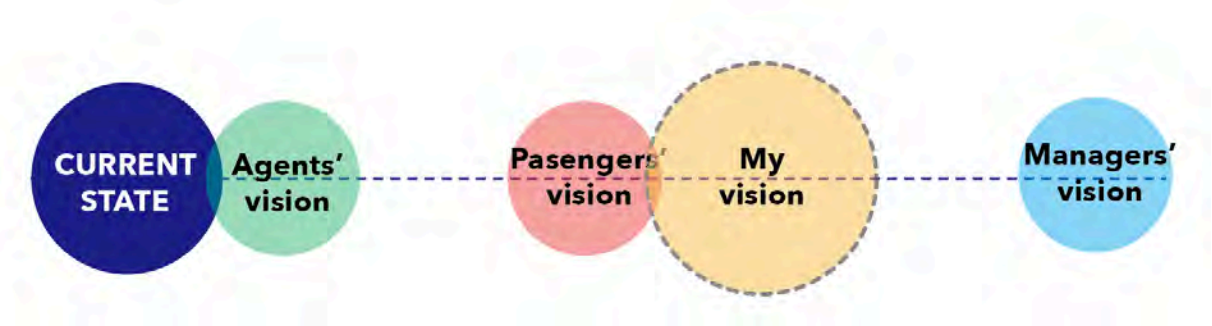
There are three problems commonly mentioned in the research by passengers:

1. *Unsure whether can board smoothly – worried about special case*
2. *Always need to check time*
3. *Sometimes hard and stressful to find way to gate.*

The first one is more urgent and significant, because when there is something wrong happen while boarding, the whole experience would ruin. Meanwhile, the first problem could be solved at the same time when solving problems from agents.

3.3.2 Visions of different stakeholders

It is very interesting to compare the future visions come up by different stakeholders. (see figure below)



The vision of agents is quite near the current state. It is more like a list of suggestions to improve the current state, instead of thinking a new way to work in the future. They are used to the current working content and are satisfied with it in general. Their needs are very specific, including better SA training, faster system and better way to contact colleagues.

The vision of managers is quite far from now. They are looking into a big picture and in a long term. They built the vision based on the planning of a new terminal in Schiphol, and the widely application of self-service boarding. So the working contents of agents and even the organization has changed a lot in that vision.

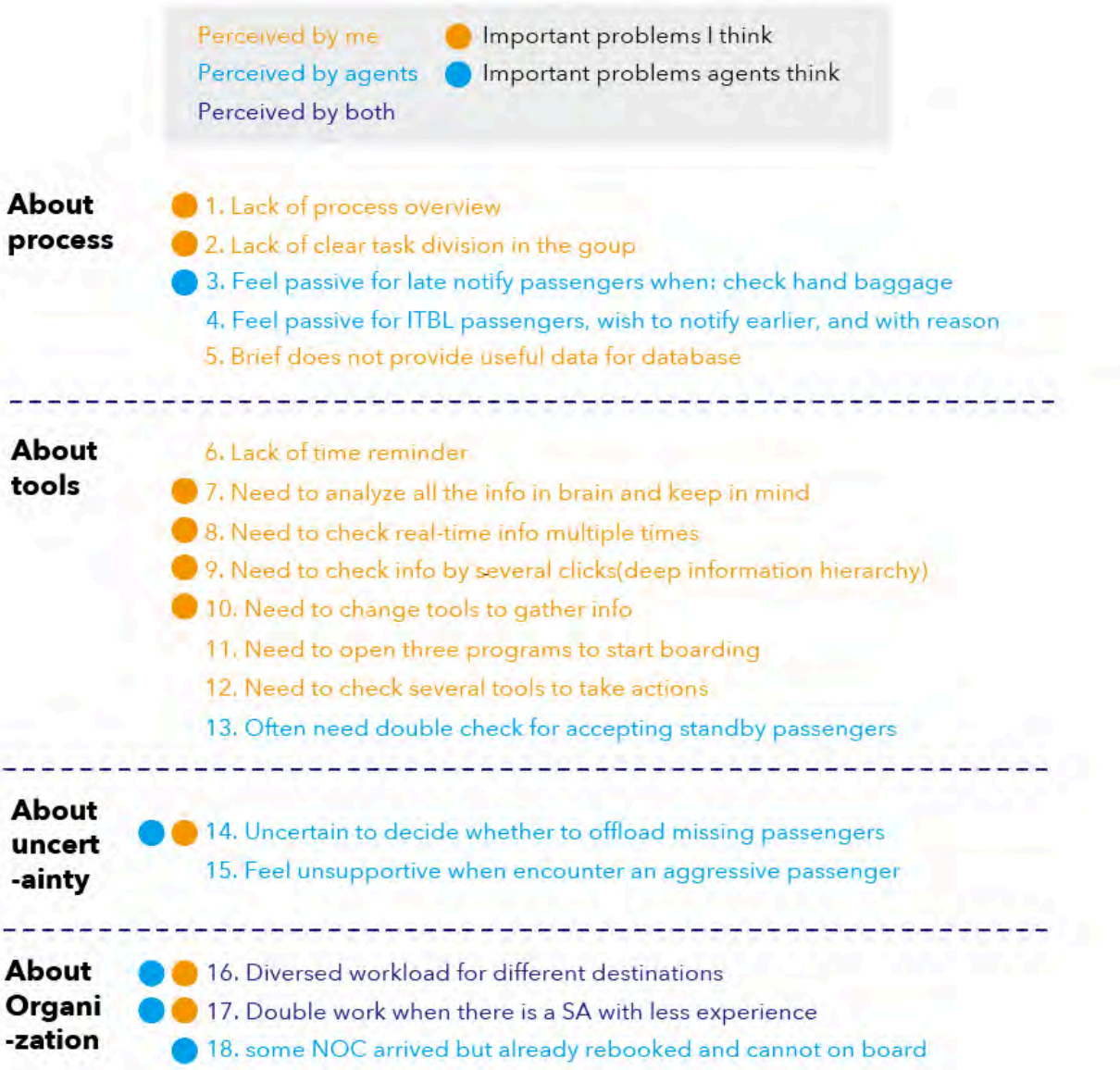
The vision of passengers is in the middle of the other two visions. The passengers built the vision with a different view. While agents and managers draw more attention on efficiency and fluent passenger flow, the passengers are looking forward to personalized service in the future, including time reminder, way finding, activity recommendation.

I need to build a personal vision in the later phase of the project. After learning from the three visions, I would build my vision between agents' and managers', and a bit further than the passengers'. I will consider the technology part from the managers' but do not take it as a prerequisite. I will try to achieve the needs of agents, but also think in a long term.

3.3.3 Problems cluster

List of problems

According to all the research, a list of problems could be clustered as the final version.



In the later design phase, there will be more focus on the problems agents or me mark as important, especially for problem 14, 16 and 17.

Clusters of problems

As summarized in chapter 2.5, the list could be shortened by keywords:

A. *Unstandardized process (1,2,5)*
B. *Passive/late passenger notifying (3,4,18)*
C. *Passive tools (6,7)*
D. *Inefficient tools (8,9,10,11,12,13)*
E. *Uncertain passenger handling (14,15)*

F. Uncertain planning (16,17)

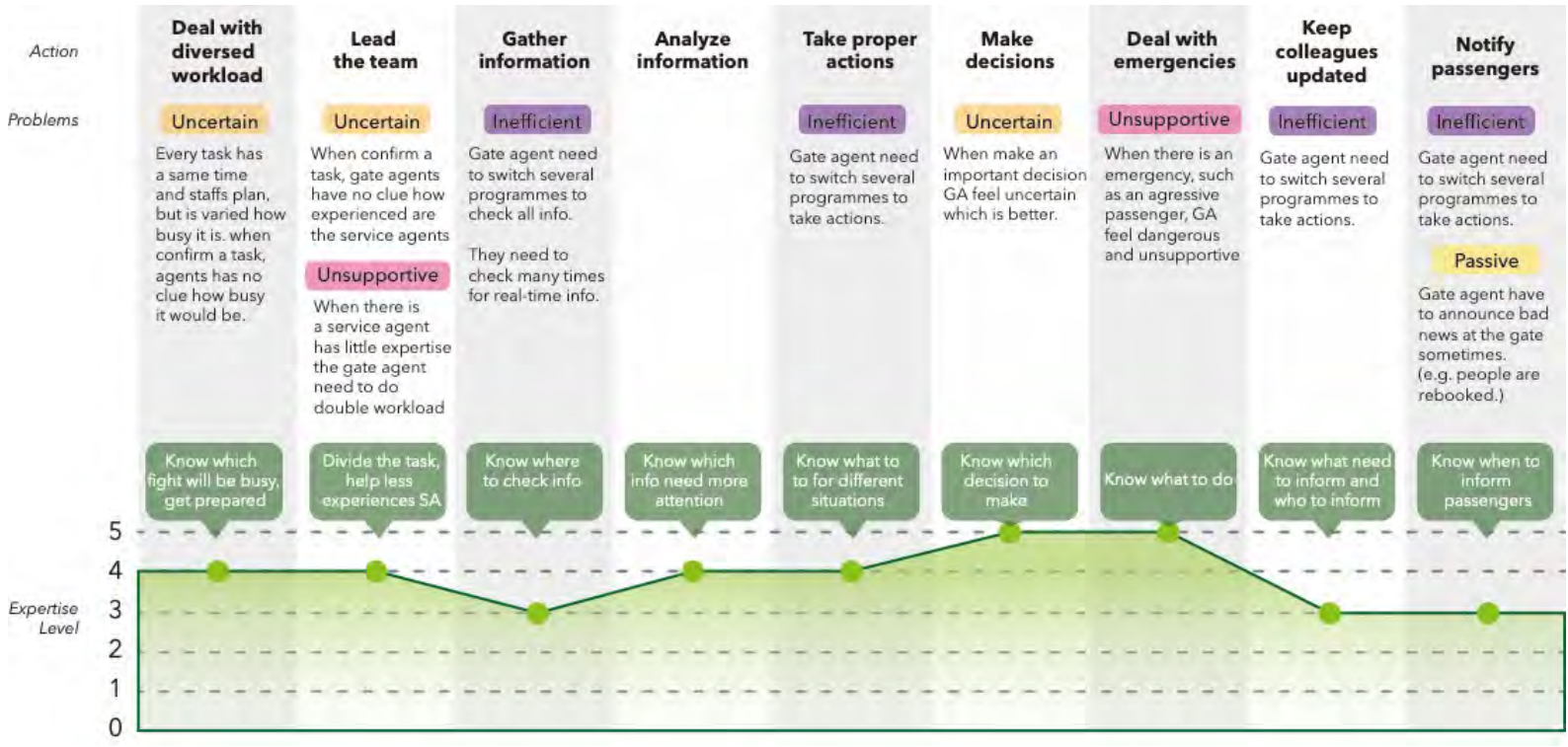
And the ideation would focus on *A. Unstandardized process, C. Passive tools, D. Inefficient tools, F. Uncertain planning,* because there is a bigger design space.

Main problem redefinition

The list could be shortened again to one sentence: the main problem lies on that ***the whole process of every flight is highly dependent on gate agents' expertise. But their expertise, on the other hand, is not utilized by the company Meanwhile, the current digital tools are unstandardized, inefficient and passive.***

The sentence above can summarize all of the problems in the list, because the current solution of almost all problems is "senior expertise of GA".

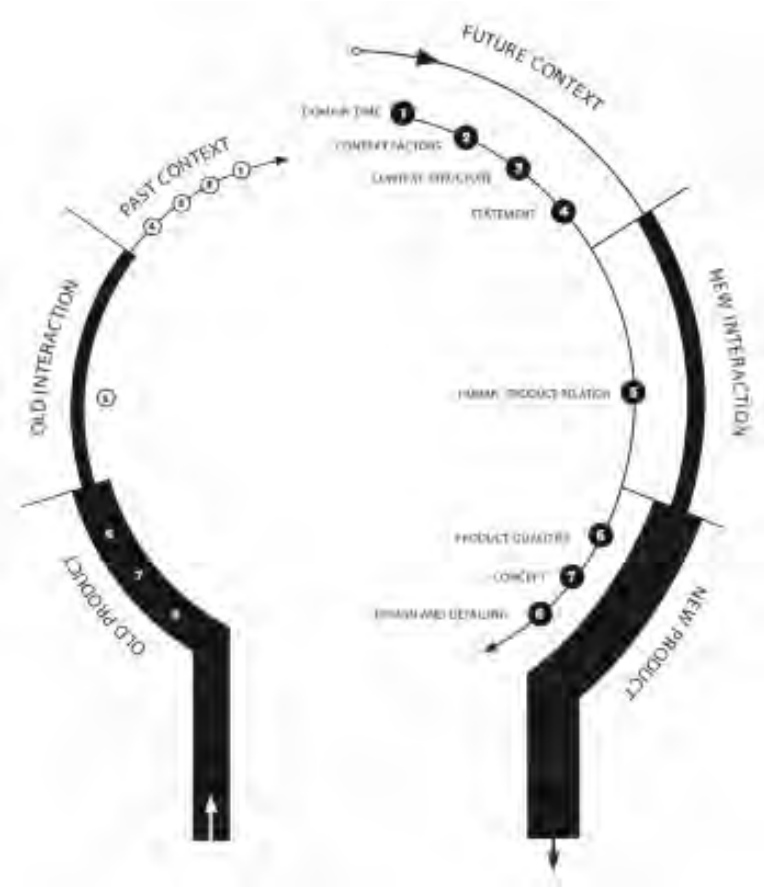
To have a detailed view about it, please see figure below:



3.4 Conclusion

The model of Vision in Product is used to make a summary for all the research.

PAST CONTEXT:
- User: Gate agents are very experienced, and there are more and more SAs with little experience at the gate.
*- Process: **Unstandardized**, lack of overview*
- Organization: unsmart planning, diverse workload



OLD INTERACTION:
*- **Unsupportive**: by the tools, while facing unexpected situation*
*- **Uncertain**: about how the groupwork goes, about some hard decisions*
*- **Passive**: to passengers, when need to notify them some special case*

OLD PRODUCT:
*- **Passive**: absent from info analysis, and lack of time reminder*
*- **Inefficient**: many tools, deep information hierarchy, real-time info cannot refresh automatically*
- Outdated interface and system
- Hard to understand at first sight

FUTURE CONTEXT
- Domain Time: Boarding, in 5 years
- Context factors:
    - Users: Standardized groupwork, not much dependent on GA's expertise
    - Process: Standardized tasks for every flight (the regular operation)
    - Organization: smart planning and balanced workload

NEW INTERACTION:
- Supportive: by the tools, while facing unexpected situation
- In control: in general, about how the groupwork goes
- Proactive: to passengers, when need to notify them some special case

NEW PRODUCT:
- Proactive: time reminder, help to analyze info and support decision making
- Efficient: flat information hierarchy, all info in one interface
- User-friendly interface
- easy to understand and self-explainable

CHAPTER 4.
Future Vision

This chapter will introduce the boarding vision in five years as well as a roadmap to arrive there with three horizons.
To design the vision and roadmap, a research about external and internal trends was conducted, as well as a cocreation session with four students. Based on the session results, a three-step roadmap was designed to achieve the 5-year-vision of future boarding.

4.1 Trends analysis

4.1.1 External Trends

Since this is a project designing for future, it is significant to conduct a research about trends in the coming years. Trends in relevant areas were collected, including trends in aviation industry, technology trends, customer trends as well as UX design trends. Here are the highlights of trends.

Growing PAX market in aviation industry

The travel market is growing after years of decline (Rabo, 2017). According to Statista, between 2017 and 2036, the number of airline passengers is expected to grow at a Compound annual growth rate (CAGR) of 4.7%. That means with the same infrastructure and volume as the current airport, more passengers are expected to be handled, so the passenger flow is expected to be quicker and more seamless.

Technology applied in aviation industry

SITA Air Transport IT Trends Insights (2017) has predicted that 80% of airports will invest in Internet of Things initiatives by 2020, and 29% of airports plan to implement secure single-token passenger identity management schemes by 2020. Besides Internet of Things and single-token identity management, other technologies, such as Augmented Reality, Blockchain partner will find their place in aviation industry in the near future.

Big data is widely applied in decision making in real world

With the development of deep learning and machine learning, more and more companies in various industries are capable of exploiting big data, in order to support business decision making. And reinforcement learning (RL), a form of neutral network that learns from its environment with the help of observations, actions and rewards, has not be widely used in real world yet due to many obstacles. But it will become one of the most significant trends in 2019.

Personalization in customer

It has been several years that personalization is playing a significant role in customers trends. In the coming year it is still a growing expectation for customer, to receive personalized service and product.

Device agnostic in UX design

Device-agnostic design is focused on creating a user journey that allows users to pass through different touch points—be it a desktop, mobile phone, smart speaker, or wearable—and have a smooth user experience through each one. It will become more popular to design the consistent user experience across platforms.

4.1.2 Internal Trends

Besides external trends in relevant industries and topics, it is also very important to research the internal strategy and trends. It can help to choose a feasible design direction. All the insights are from talking with experts, as introduced in chapter 2.1 methodology.

Biometric application in boarding

KLM is now working on a project in collaboration with Schiphol airport and the government, aiming to create a seamless flow for passengers in the airport in ten years. Biometrics is the main technology involved in this project. In the desired future, all the touchpoints including check-in, baggage drop-off, passport check and boarding would be done by biometrics.

Flight prediction based on big data

The department Operational Decision Support (ODS) is working on several projects to help make better predictions for flights. Based on the large database from KLM with all the customer information and flight information, more accurate predictions could be made for each flight, aiming at generating higher revenue and providing better service for passengers.

A2H as the main and independent tool for boarding

The Appy2Help team is now working on implementing features related to boarding in Appy2Help. According to the company's digital strategy, Appy2Help is desired to use independently from ALTEA in the boarding process in the near future. The concern behind the strategy is to encourage agents help passengers in a more flexible and closer way, instead of always sitting behind the desktop.

4.2 Co-creation session

To generate ideas as much as possible for future boarding, a co-creation session was conducted with four students. Two of them are design students and the other two are studying computer science, because it is a project related to emerging technology and students from CS could provide another view of technology application.

The session had two parts: brainstorming and horizon mapping. In the first hour, all the trends (see chapter 4.1) , the list of problems (see chapter 3.4) and the needs of different stakeholder were introduced. And the participants were asked to come up with all kinds of solutions for the problems and needs, inspired by the coming trends. Figure 4.1 shows the results of the brainstorming process.

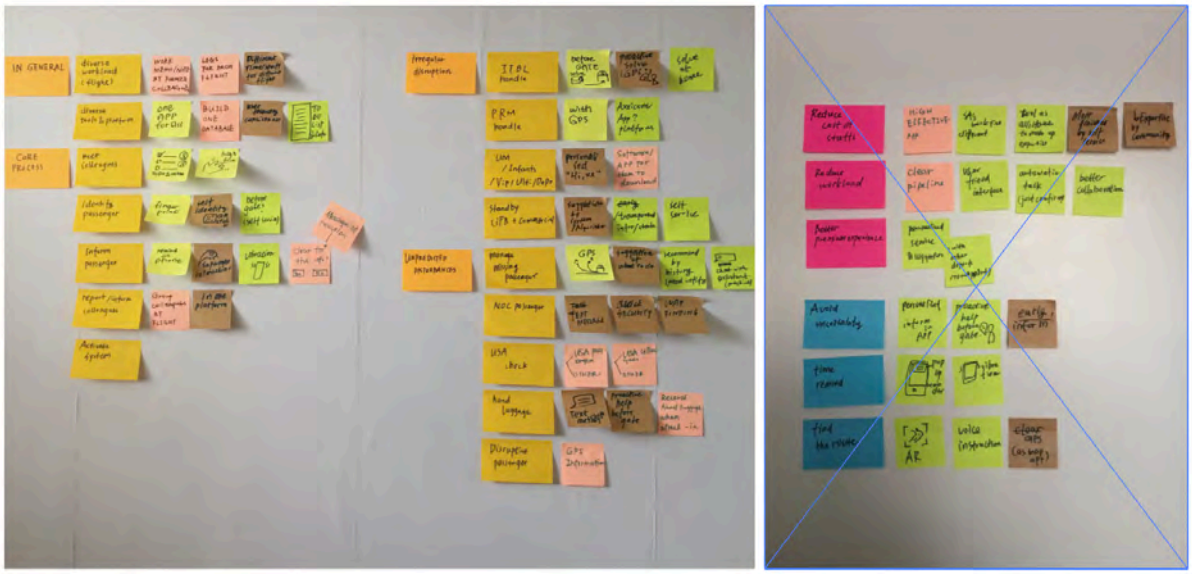
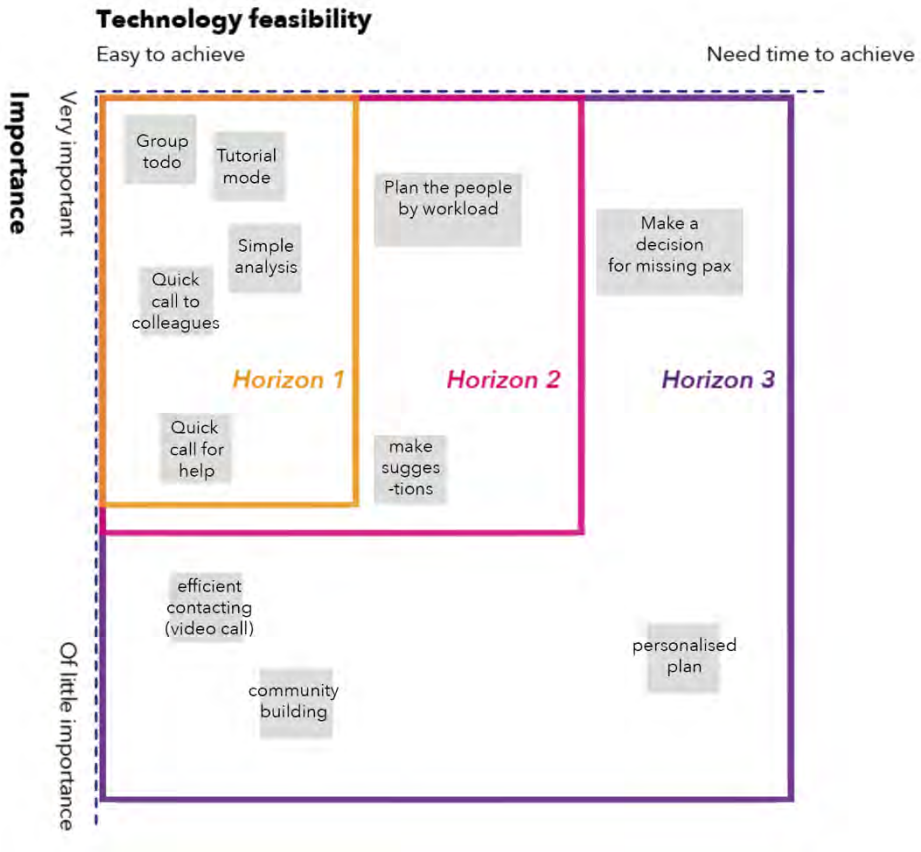


Figure 4.1 Cocreation

After a break, the second part of the session began. The participants were asked to cluster all the ideas in a coordinate system, with the horizontal axis for technology feasibility and the vertical for importance. For the technology feasibility evaluation, if an idea could be applied immediately, it should be pasted on the left side; if an idea cannot be applied immediately due to insufficient data or immature technology, it should be pasted on the right side. For the importance evaluation, if an idea could solve more than one problem or need, or it will make a big difference, it should be pasted on the bottom; and if an idea just solves a small problem, it should be pasted on the top. (see Figure 4.2)



After the cluster of ideas, three horizons were concluded with detailed functions. The first horizon consists of ideas that could be achieved immediately and also of the most significance. The second consists of ideas that can be achieved after some data input but not very far from now. And the third horizon consists of ideas far from reality, some are dependent on the data collection from the first two horizons and some are waiting for technology application in real world.

4.3 Vision and 3 Horizons

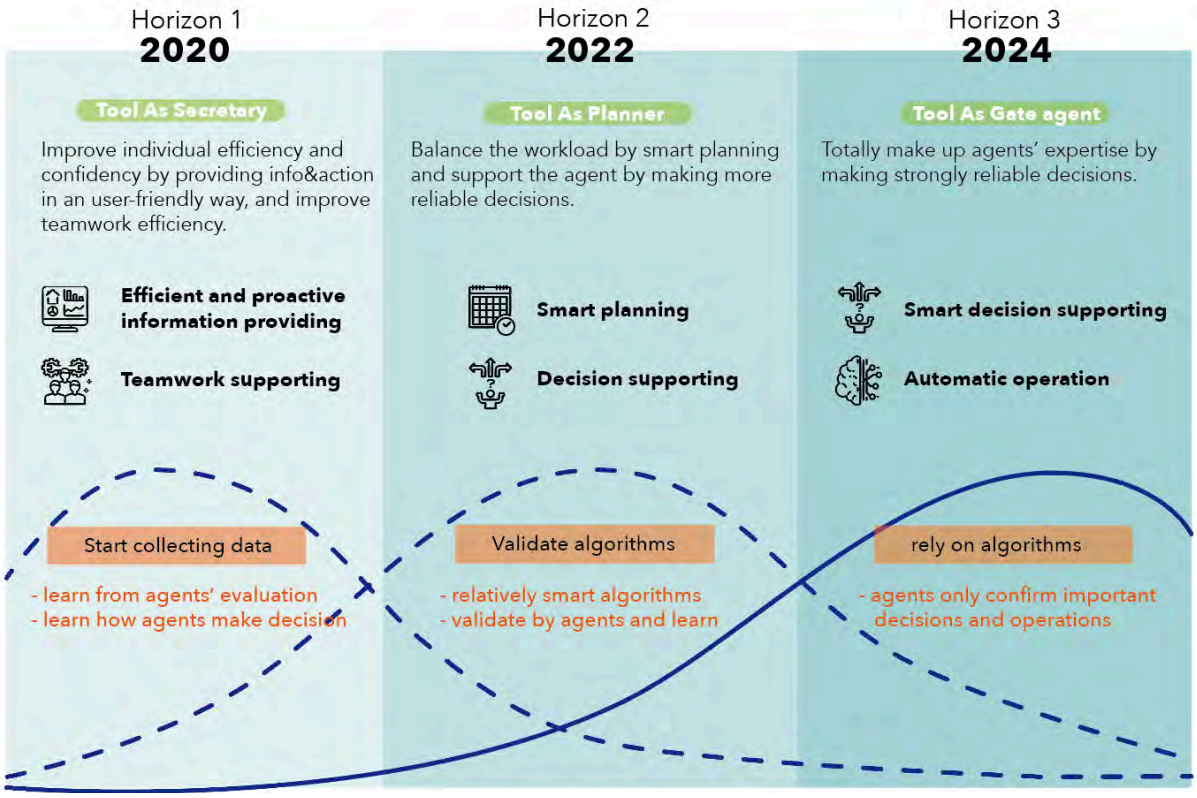
4.3.1 The future vision

According to the former research, the main problem lies on that ***the whole process is highly dependent on gate agents' expertise, while not utilize their expertise. Meanwhile, the current digital tools are unstandardized, inefficient and passive.***

So the vision of future boarding in five years is: ***The digital tool will take most of responsibilities and tasks that currently gate agent does. They can make up the agents' expertise so that service agents can also work as gate agent, and agents can pay more attention on passenger services.***

The vision is designed to solve the problems and meet the needs from different stakeholders, and have a focus on the main problem solving.

To achieve the vision step by step, a roadmap with three horizons based on timeline will be introduced.



4.3.2 The first horizon: Tool as secretary

The first horizon has two major purposes: to improve individual and teamwork efficiency for each flight, and to collect sufficient data for the later horizons.

Problems and solutions

The most urgent and important problems are solved in this phase, such as the unstandardized process, the inefficient tools and the unstandardized groupwork. And the solution is generally focused on user experience and interface design. By providing the information in an user-friendly and hierarchic way, the process could be largely standardized and the efficiency would be improved a lot.

It should be noticed that this phase focus more on agents' problems and needs, because these are the most significant and root needs. While solving some problems for agents, some problems from passengers could also be solved.

Here is a detailed list of the problems and their solutions in the first horizon.

PROBLEMS (GATE AGENTS)	CATEGORY	SOLUTION
1. Lack of process overview	Process and procedure - unstandardized	A standard to-do list with timeline
2. Lack of clear task division in the goup	Process and procedure - unstandardized	A standard to-do list with timeline shared with every group member
3. Diversed workload for different destinations	Organization – unsmart planning system	(could not totally solved) Provide former agents' evaluation when give the "task"(a flight handling)
4. Double work when there is a SA with less experience	Organization – many new SAs with quick training	Provide tutorial mode for less experienced SA (the state could be seen by GA)
5. Lack of time reminder	Digital tools - passive	Automatic time reminder
6. Need to analyze all the info in brain and keep in mind	Digital tools - passive	Color coding the information to help GA distribute attention
7. Need to check several tools to gather info	Digital tools - inefficient	All necessary info in the same interface
8. Need to check real-time info multiple times	Digital tools - inefficient	Automatic refresh for real-time info
9. Need to check info by several clicks and typing (deep information hierarchy)	Digital tools - inefficient	All necessary info in the same interface (flat information hierarchy)
10. Need to change tools to take actionsff6**5**	Digital tools - inefficient	Provide shortcuts of frequent action buttons
11. Need to open three programs to start boarding	Digital tools - inefficient	Provide shortcut to open them at one button
12. Brief does not provide useful data for database	Process and procedure	A new way to brief a flight: with labels and ratings
13. Feel passive for late notify passengers when: check hand baggage	Process and procedure	Allow early message informing

14. Feel passive for ITBL passengers, wish to notify earlier, and with reason	Process and procedure	Allow early informing and with reason
15. Often need double check for accepting standby passengers	Digital tools - inefficient	Change the way to rank the standby passengers (also consider their companion)
16. Uncertain to decide whether to offload missing passengers	Expertise needed – ability to adapt to unexpected situation	Provide the baggage container information with the missing passenger list, so TC can offload the baggage quicker
17. Feel unsupportive when encounter an aggressive passenger	Expertise needed – ability to adapt to unexpected case	A quick help button to call security
18. some NOC arrived but already rebooked and cannot on board	Organization – different departs	a button to "CALL ticket office" for uncertain NOC
NEEDS (BUSINESS)	**CATEGORY**	**SOLUTION**
Reduce cost of agents	Business	
Better time performance	Business	
Better service for premium passengers	Business	
PROBLEMS (PASSENGERS)	**CATEGORY**	**SOLUTION**
Unsure whether can board		Receive the notification early for special cases (see problems 13,14)
Always check time		
Hard to find way to gate		

All the solutions could be clustered as main functions as follows:

1. ***Teamwork supporting – solving the unstandardized process***

A to-do list with timeline for every agent per flight could help everyone in the team knows what need to do. And because it is shared in the team, so it is clear which task is done and which need to do. It could also help new SAs to adapt to the work.

2. ***Provide all needed info in one interface – solving the inefficiency of tools***

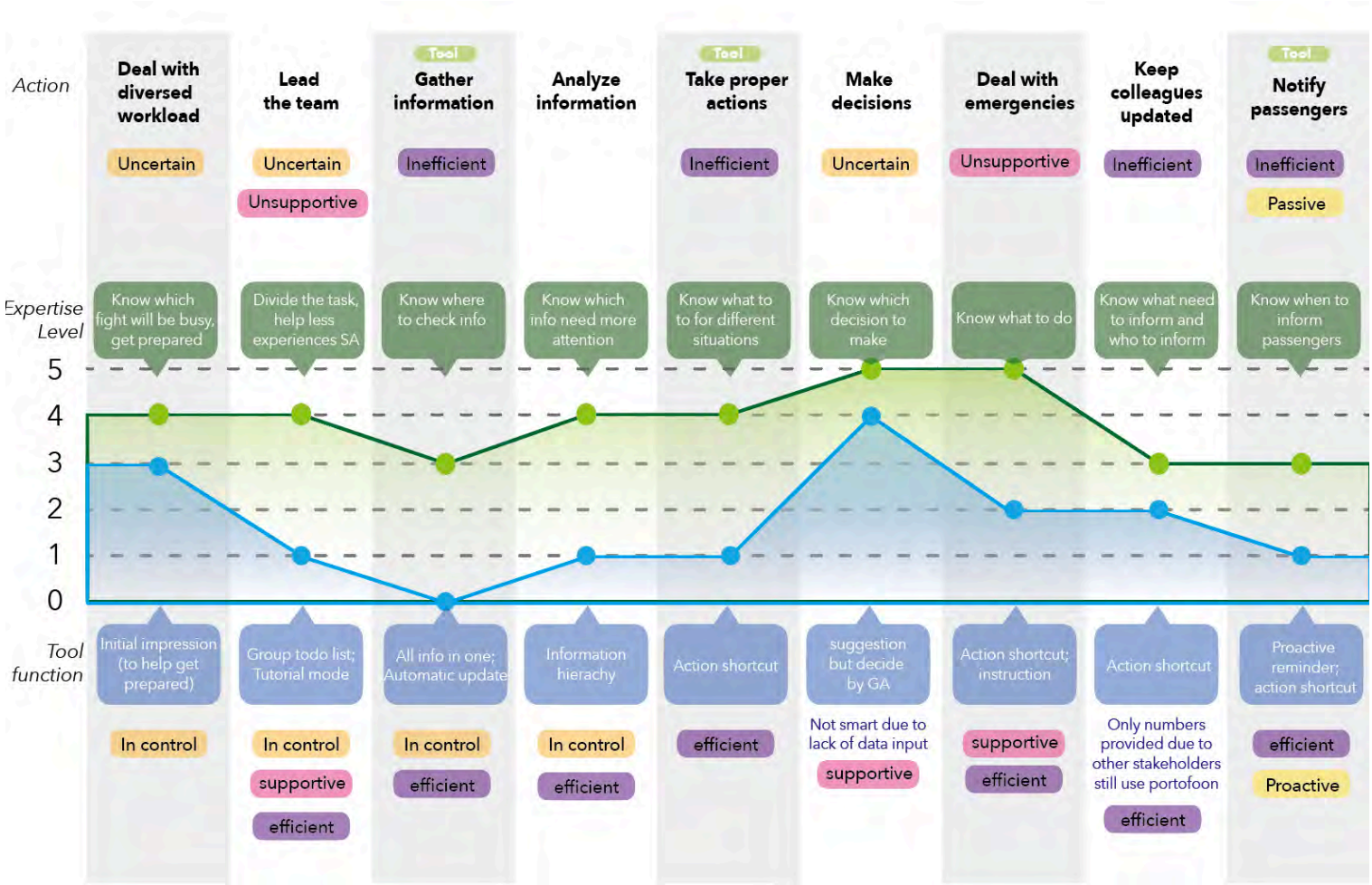
Currently all the information is stored in different programs and devices, and the information hierarchy is deep, which means it usually need several clicks to check an information. So, make them in one interface and change it into flat information hierarchy will enhance agents' efficiency.

3. ***Proactively info providing - solving the passiveness and inefficiency of tools***

By automatically refresh real-time info, pop-up time reminder and color coding the special groups, the tool will support the agents by helping them analyze the flight and distribute attention.

How it solves the main problem

As the following figure, the expertise level needed is largely reduced by the main functions and a new interface.



4.3.3 The second horizon: Tool as planner

The first horizon leaves an unsolved important problem, which is diversed workload for different destination. It is due to the planning system is not smart, so every flight has the same timeslot. That is because there is not much data or information to evaluate different workload for different flights.

So a main function from first horizon, brief a flight with label and comments, could help the company to collect many useful information for every flight: how busy is it? What kinds of issues are common? Which flight need more people or time? After the data collected in first horizon, there would be a list of flights with a difficulty score. This list will help the planning system to work smarter. So difficult flight could have an extra staff or more time, while easy ones could have less staffs.

Problems and solutions

Most problems from gate agents have been solved in the first horizon. Some are partly solved due to the data is not enough. In this horizon, there are better solutions for them.

Besides, business needs start to be fulfilled and passengers problems start to be solved.

Problems (Gate agents)	Category	Solution
1. Lack of process overview	Process and procedure - unstandardized	*Solved in Horizon 1*
2. Lack of clear task division in the goup	Process and procedure - unstandardized	*Solved in Horizon 1*
3. Diversed workload for different destinations	Organization – unsmart planning system	Smart planning
4. Double work when there is a SA with less experience	Organization – many new SAs with quick training	*Solved in Horizon 1*
5. Lack of time reminder	Digital tools - passive	*Solved in Horizon 1*
6. Need to analyze all the info in brain and keep in mind	Digital tools - passive	*Solved in Horizon 1*
7. Need to check several tools to gather info	Digital tools - inefficient	*Solved in Horizon 1*
8. Need to check real-time info multiple times	Digital tools - inefficient	*Solved in Horizon 1*
9. Need to check info by several clicks and typing (deep information hierarchy)	Digital tools - inefficient	*Solved in Horizon 1*
10. Need to change tools to take actions	Digital tools - inefficient	*Solved in Horizon 1*
11. Need to open three programs to start boarding	Digital tools - inefficient	*Solved in Horizon 1*
12. Brief does not provide useful data for database	Process and procedure	*Solved in Horizon 1*
13. Feel passive for late notify passengers when: check hand baggage	Process and procedure	*Solved in Horizon 1*
14. Feel passive for ITBL passengers, wish to notify earlier, and with reason	Process and procedure	*Solved in Horizon 1*
15. Often need double check for accepting standby passengers	Digital tools - inefficient	*Solved in Horizon 1*
16. Uncertain to decide whether to offload missing passengers	Expertise needed – ability to adapt to unexpected situation	Smart suggestion
17. Feel unsupportive when encounter an aggressive passenger	Expertise needed – ability to adapt to unexpected case	*Solved in Horizon 1*

18. some NOC arrived but already rebooked and cannot on board	Organization – different departs	*Solved in Horizon 1*
NEEDS (BUSINESS)	**CATEGORY**	**SOLUTION**
Reduce cost of agents	Business	By smart planning
Better time performance	Business	By smart planning
Better service for premium passengers	Business	Personalized service
PROBLEMS (PASSENGERS)	**CATEGORY**	**SOLUTION**
Unsure whether can board		*Solved in Horizon 1*
Always check time		Personalized time reminder
Hard to find way to gate		Personalized way finding

All the solutions could be clustered as main functions as follows:

1. ***Smart planning***

The first horizon leaves an unsolved important problem, which is diversed workload for different destination. It is due to the planning system is not smart, so every flight has the same timeslot. That is because there is not much data or information to evaluate different workload for different flights.
So a main function from first horizon, brief a flight with label and comments, could help the company to collect many useful information for every flight: how busy is it? What kinds of issues are common? Which flight need more people or time? After the data collected in first horizon, there would be a list of flights with a difficulty score. This list will help the planning system to work smarter. So difficult flight could have an extra staff or more time, while easy ones could have less staffs.

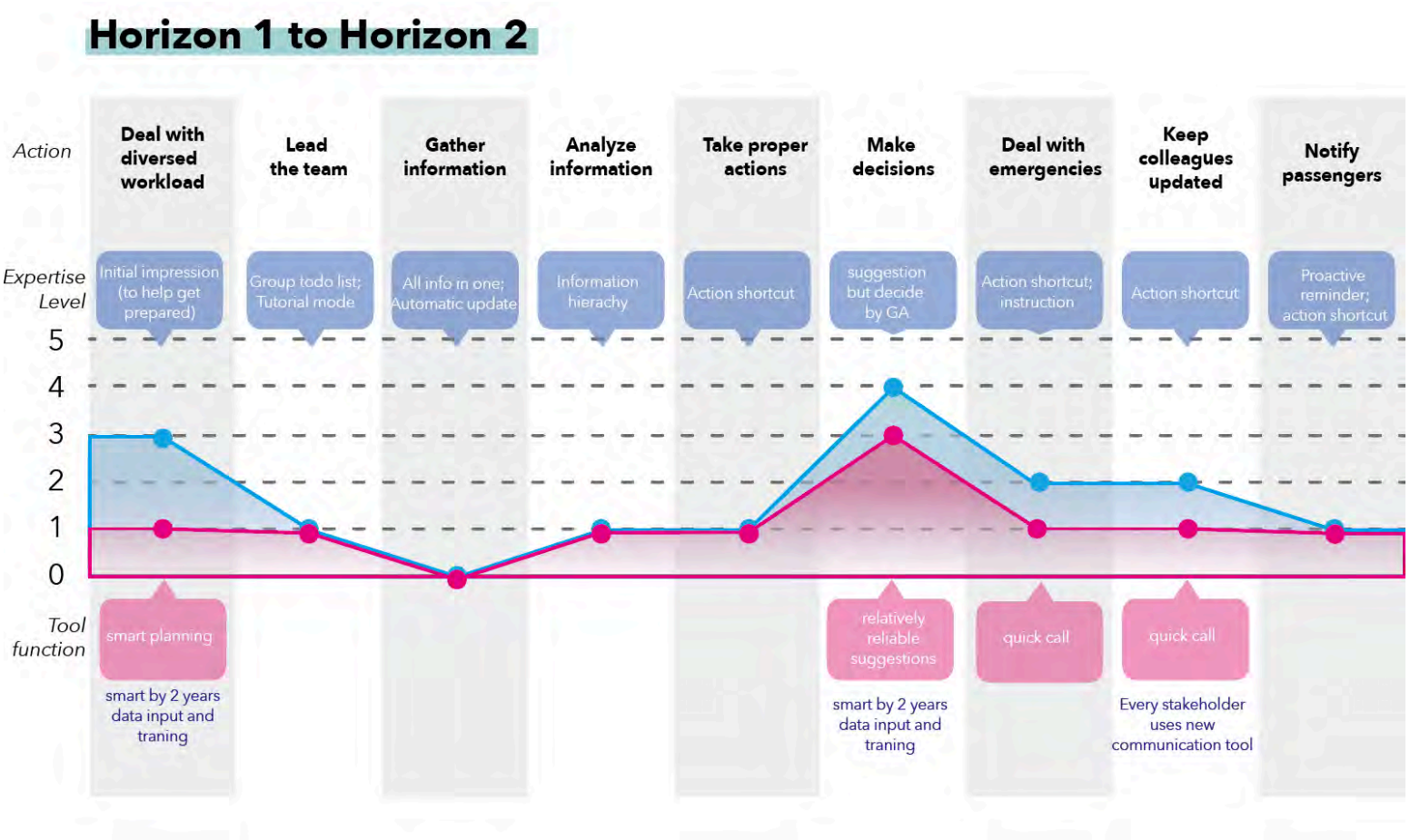
2. ***Smart suggestion***

According to the user research with gate agents, deciding whether to offload missing passenger is the most difficult and uncertain part for gate agents. And it is also the most difficult part to achieve the vision, to let tools replace the gate agents' work. Only with lots of training data and a strong and reliable algorithm could the decision work for real world, because it is a complex situation with many factors, the weather, the number of missing passengers, etc.
In horizon 2, with the data collected in the first horizon, the algorithm is started to be built and trained. So it would provide suggestion for whether to offload missing passengers. But it is still determined by gate agents. This function is aiming at providing access to learn from gate agents, after observing the GA's choice, it can better stimulate a reliable choice in the third horizon.

3. ***Personalized passenger service***

Passengers will receive a personalized service, including way-finding and time reminder. For premium passengers, suggestions of activities will be made according to their preferences.

How it solves the main problem



4.3.4 The third horizon: Tool as Gate Agent

In this horizon, the vision is almost achieved. The purpose of this phase aligns with the final vision, which is to make up the expertise so service agents could also work as gate agents. And They can make more time and attention for passenger service.

Problems and solutions

For gate agents the only unsolved problem is still "uncertain to decide whether offload missing passenger". In this phase by millions of billions of data input, the algorithm could be reliable enough to make a good decision.
For business needs, it would achieve more in this phase.

PROBLEMS (GATE AGENTS)	CATEGORY	SOLUTION
1. Lack of process overview	Process and procedure - unstandardized	*Solved in Horizon 1*
2. Lack of clear task division in the group	Process and procedure - unstandardized	*Solved in Horizon 1*

3. Diversed workload for different destinations	Organization – unsmart planning system	*Solved in Horizon 2*
4. Double work when there is a SA with less experience	Organization – many new SAs with quick training	*Solved in Horizon 1*
5. Lack of time reminder	Digital tools - passive	*Solved in Horizon 1*
6. Need to analyze all the info in brain and keep in mind	Digital tools - passive	*Solved in Horizon 1*
7. Need to check several tools to gather info	Digital tools - inefficient	*Solved in Horizon 1*
8. Need to check real-time info multiple times	Digital tools - inefficient	*Solved in Horizon 1*
9. Need to check info by several clicks and typing (deep information hierarchy)	Digital tools - inefficient	*Solved in Horizon 1*
10. Need to change tools to take actions	Digital tools - inefficient	*Solved in Horizon 1* Automatic operation
11. Need to open three programs to start boarding	Digital tools - inefficient	*Solved in Horizon 1* Automatic operation
12. Brief does not provide useful data for database	Process and procedure	*Solved in Horizon 1*
13. Feel passive for late notify passengers when: check hand baggage	Process and procedure	*Solved in Horizon 1*
14. Feel passive for ITBL passengers, wish to notify earlier, and with reason	Process and procedure	*Solved in Horizon 1*
15. Often need double check for accepting standby passengers	Digital tools - inefficient	*Solved in Horizon 1*
16. Uncertain to decide whether to offload missing passengers	Expertise needed – ability to adapt to unexpected situation	Reliable suggestion
17. Feel unsupportive when encounter an aggressive passenger	Expertise needed – ability to adapt to unexpected case	*Solved in Horizon 1*
18. some NOC arrived but already rebooked and cannot on board	Organization – different departs	*Solved in Horizon 1*
NEEDS (BUSINESS)	**CATEGORY**	**SOLUTION**
Reduce cost of agents	Business	SA can work as GA
Better time performance	Business	Reliable decision making
Better service for premium passengers	Business	Staffs make more time for passenger services
PROBLEMS (PASSENGERS)	**CATEGORY**	**SOLUTION**
Unsure whether can board		*Solved in Horizon 1*
Always check time		*Solved in Horizon 2*
Hard to find way to gate		*Solved in Horizon 2*

All the solutions could be clustered as main functions as follows:

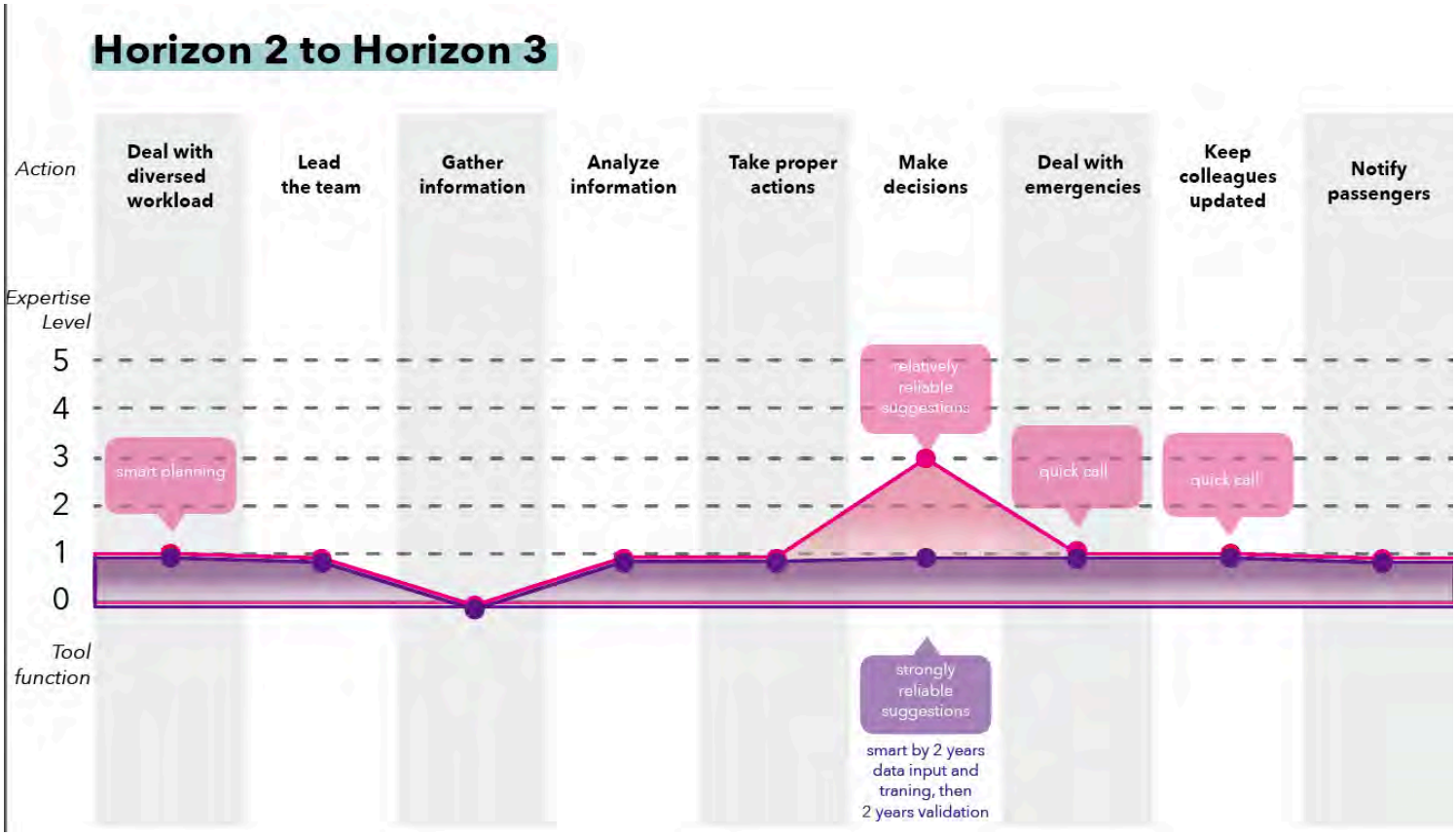
1. ***Reliable decision making***

According to all the data collection and algorithms training in the past four years(Horizon 1&2), the algorithm could be smart enough to make the right decision and totally replace gate agents. From the former research , decide to offload missing passenger is admitted by agents and managers as the most difficult task, which requires the highest expertise level. So it is the last step for the tools to take over.

2. ***Automatic Operation***

For easy operations, such as inform passengers to board, it could be automatically done in this phase. So agents have more attention for passenger services.

How it solves the main problem



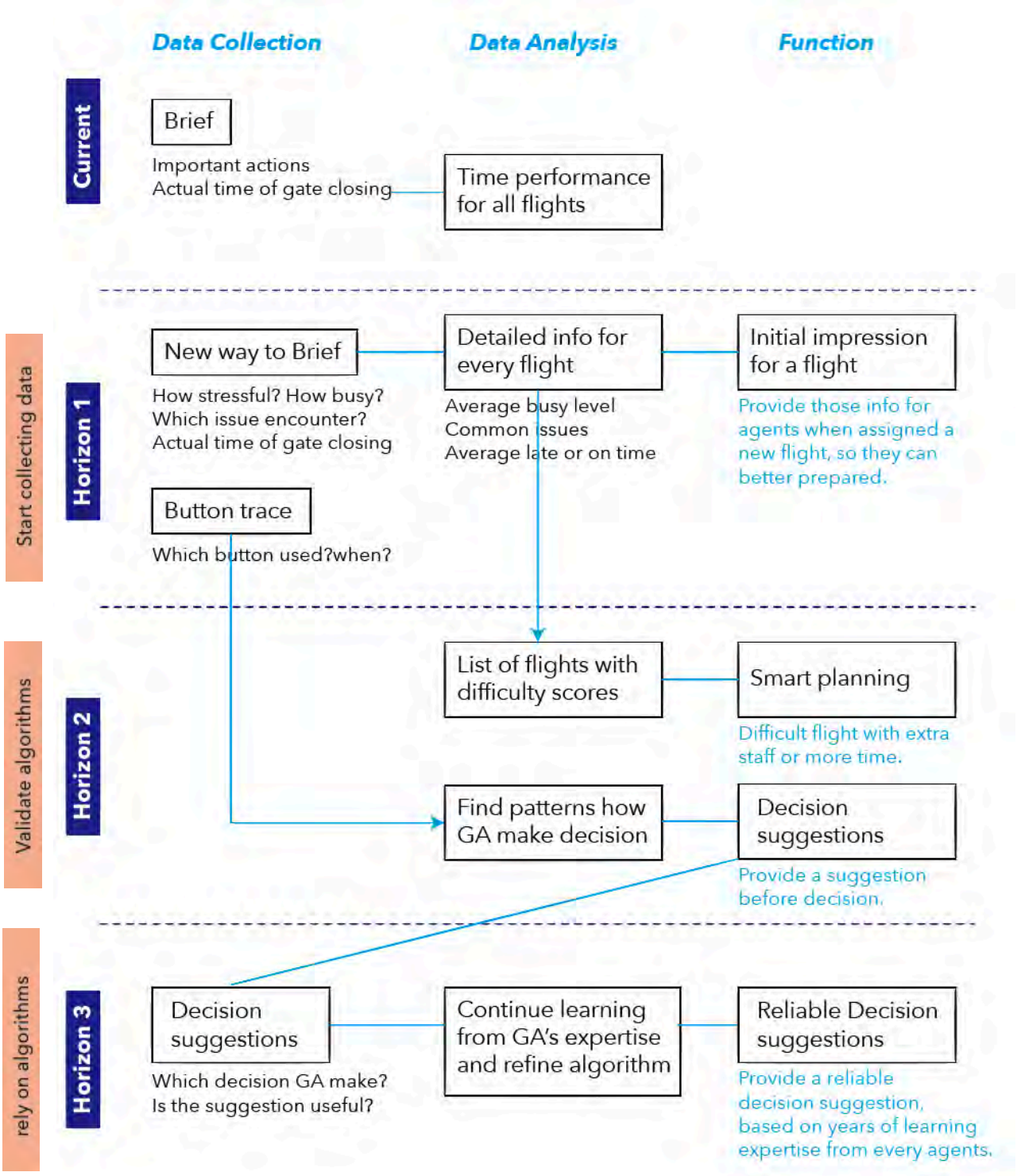
After three horizons, the expertise level needed for the whole boarding process would be reduced to 0-1, which means, a SA with even less experience and handle the whole process. So the vision could be achieved.

4.4 Technology

Since technology plays a significant role in this roadmap, it is important to validate its technical feasibility with an expert. Therefore, a data flow is made to explain from the current state to the ideal final vision, what kind of data and by what means

is collected. And would it be feasible to achieve the functions above in second and third horizons.

4.4.1 Data flow



4.4.2 Expert Validation

With the data flow above, an interview with an data scientist working in KLM was conducted. The interview was designed to validate a list of questions about the technical feasibility:

1. It Button trace feasible to learn from GA about how to make decisions?
2. Is it possible to make smart planning in horizon 2?
3. Is it possible to make reliable decision suggestions in horizon 2?
4. It is possible to finally reach the vision from technology side?

And here are the results from the interview:

1. In general it is an innovative roadmap. It is brand new. I see a lot of potential in it. From technology part, it is mostly feasible.
2. Button trace could provide sufficient data to learn how GA make decisions.
3. But only based on the button trace it is hard to build an algorithm to suggest a decision. What you need in the design is actually Reinforcement Learning, which is learn from past and become smarter and smarter by itself. It is very strong, but not yet widely applied in real world. But since your design is in five years, so I think it would be quite feasible to achieve.
4. Another obstacle I see is, to have a reliable algorithm, you need tens of thousands of data to train the algorithm. I'm not sure if the data could be enough in four years.
5. The smart planning would definitely be achieved based on your data collection and analysis in first horizon. The list of flights with a difficult score will make it easy for data scientist.

In conclusion. It is a potential roadmap, and mostly feasible. Two obstacles before the final vision are: Reinforcement Learning should be applied in the company, and tens of thousands of data should be collected.

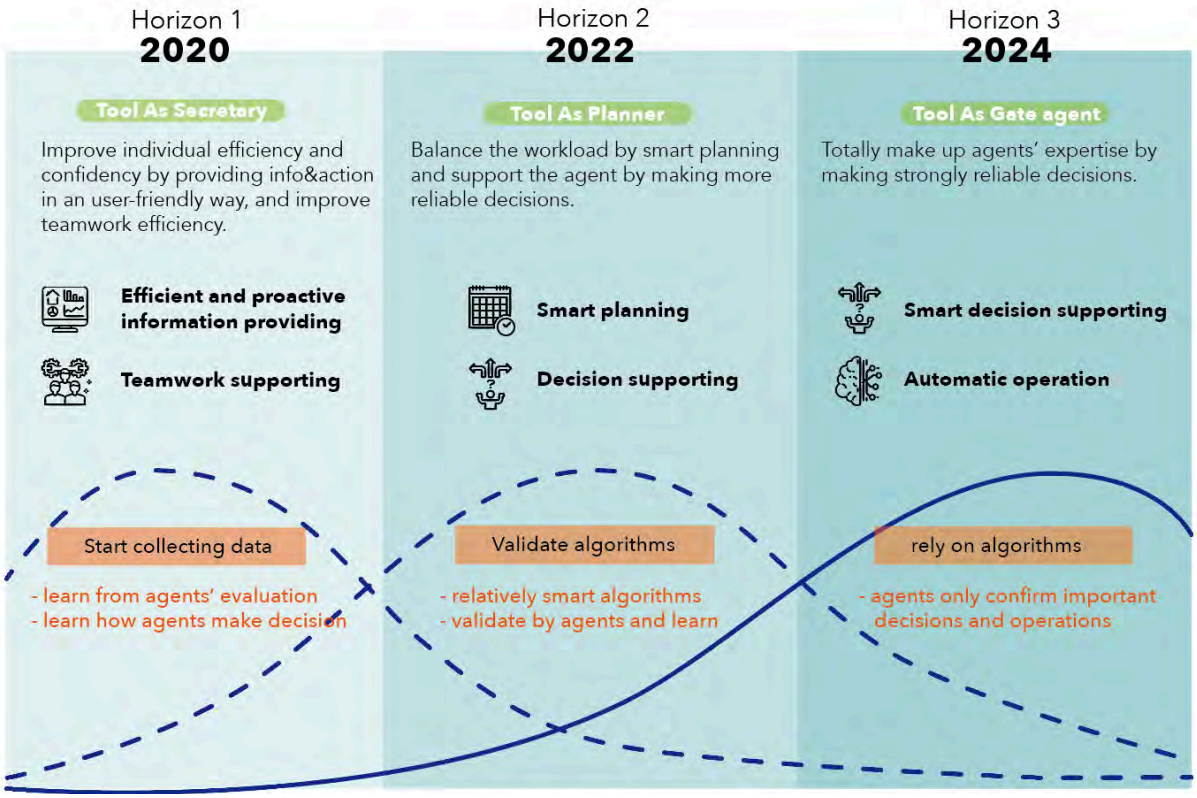
4.5 Conclusions

This chapter goes from research to design. With all the input from the research phase, including trends analysis, problems and needs, visions from different group, a cocreation session was conducted. Based on the results, a vision and three horizons were come up with. The later horizons are built on technology and data collection. Therefore, an interview with data scientist was conducted to validate the feasibility.

The future vision is ***the digital tool will take most of responsibilities and tasks that currently gate agent does. They can make up the agents' expertise so that***

service agents can also work as gate agent, and agents can pay more attention on passenger services.

And the three horizons are as follows:



In Horizon 1, solutions are focused on GA's problems. And by redesigning the UX and UI of digital tools, the efficiency could be enhanced. Besides, there are some suggested solutions about process and procedure.

In Horizon 2, Solutions are more made for business needs and passengers' problems. It is a more technical solution than UX design solution.

In Horizon 3, the solution is totally based on technology and smart algorithms. And it still have a focus on business needs.

After validation with data scientist about technology in this roadmap, it is proved to be innovative, potential and mostly feasible.

CHAPTER 5.
Design Brief

This chapter took a look into the first horizon and translated the ideas in horizon 1 into concrete design goal and specific design requirements.

5.1 Design goal

According to the conclusion of last chapter, the solutions in first horizon are focused on UX design for digital tools. And it should help gate agents on their work efficiency.

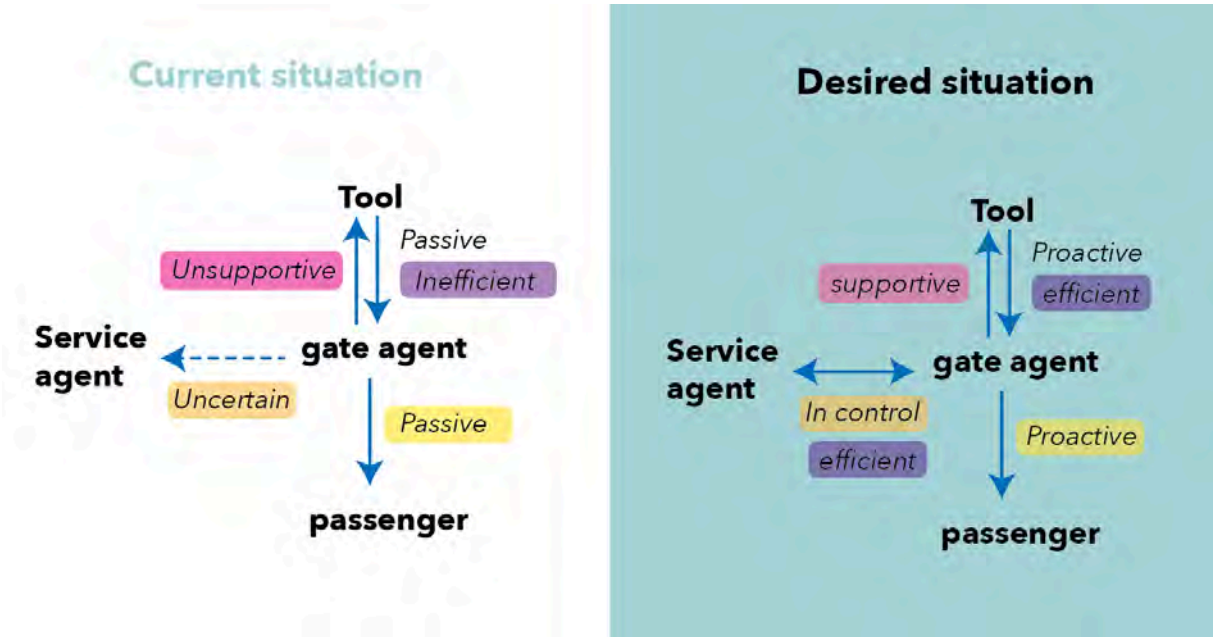
Moreover, since the company is going to build Appy2Help as the major tool during boarding, the designed interface should be compatible with the interface of Appy2Help. And the most common device agents use for A2H is iPad Mini. So, it should be designed in the size of iPad Mini, and also compatible with iPad normal.

The design goal for the first horizon is:

---

*To design interfaces and functions inside A2H application, that could improve the **efficiency** and confidence of **both individual and teamwork** for agents, especially **gate agents**.*

Besides the design goal, some interaction characters were defined based on the user research.



The desired interaction characters are:

In control (for the flight)

Supportive (by the tool)

Proactive (to the passengers)

5.2 Design criteria

To achieve the design goal and interaction vision, a list of requirements were made.

1. All infomation and action on one tool (inside A2H)
2. Consistent to currently used tools (Appy2help & Plug)
3. User-friendly interface
4. Proactive and transparent information providing
5. Help teamwork efficiency
6. Help efficiency and convenience of communication to colleagues
7. Support for emergency
8. Provide access to notify passengers proactively if needed
9. provide support for less experienced service agent.

CHAPTER 6.
Ideation and Iteration

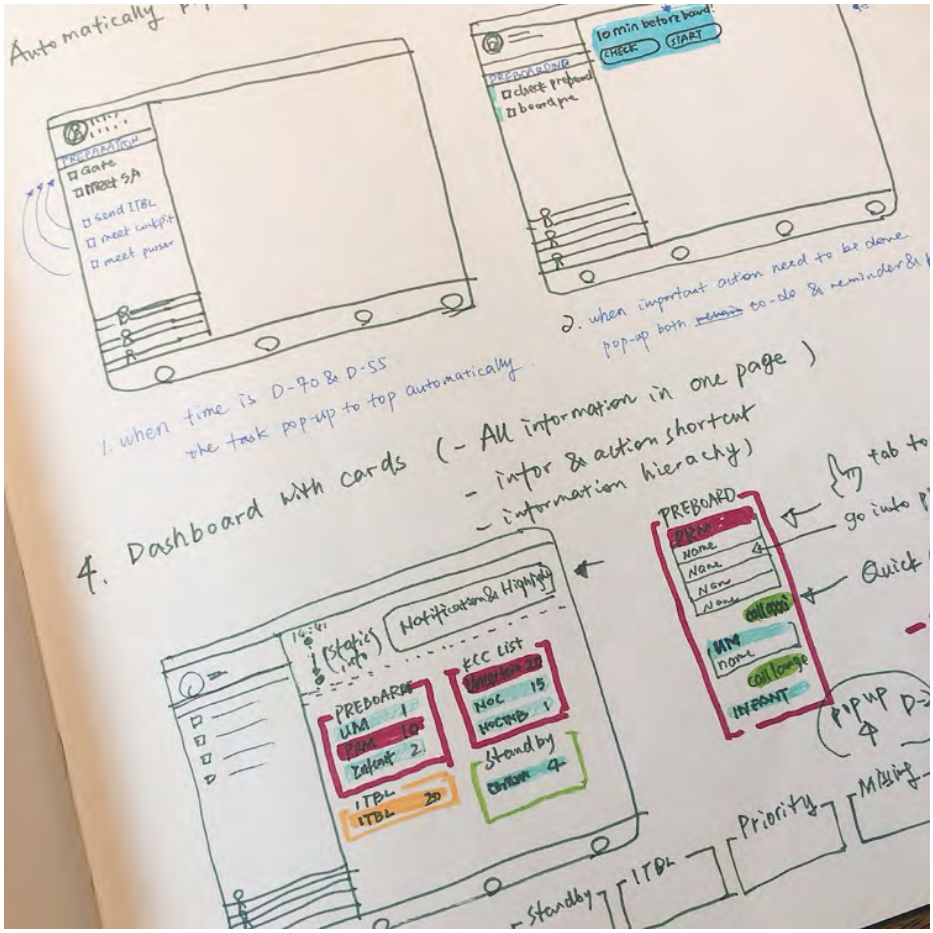
This chapter will introduce the design process, from the list of requirements, to sketches and low-fidelity prototype, to expert evaluation and the improvements.

6.1 Ideation

It is quite clear from the design brief that three main functions should be places in one interface: a shared todo list, all info needed with highlights, and shortcut button to call for help and contact colleagues.



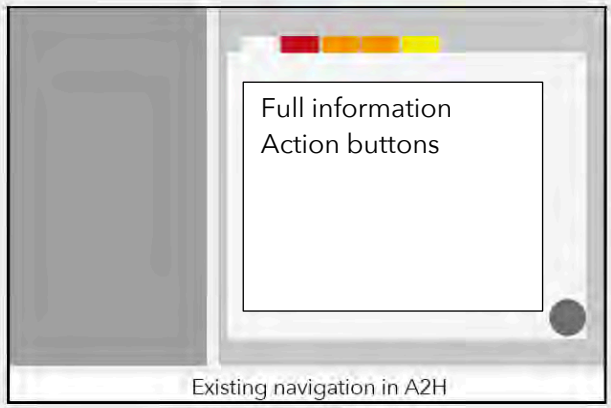
Based on the basic layout, sketched as made.



And for the right part of the screen, which shows all info needed, two concepts were designed as follows:



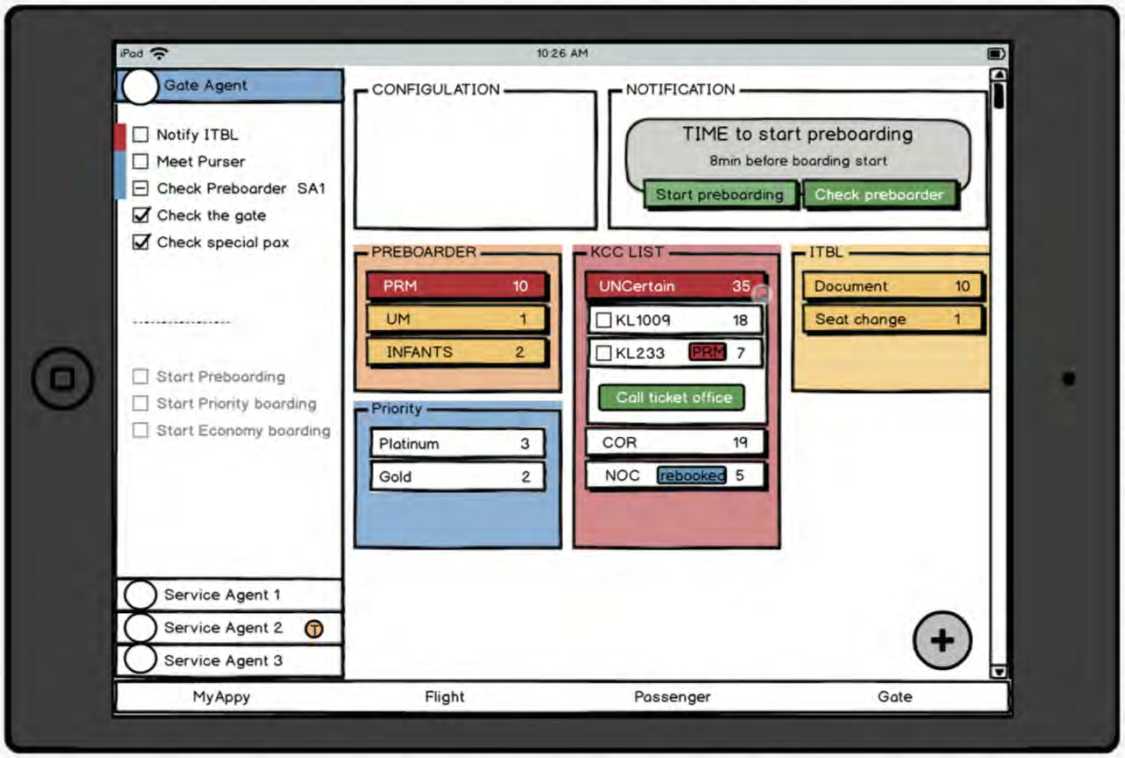
Concept 1 Cards
(Operational dashboard)



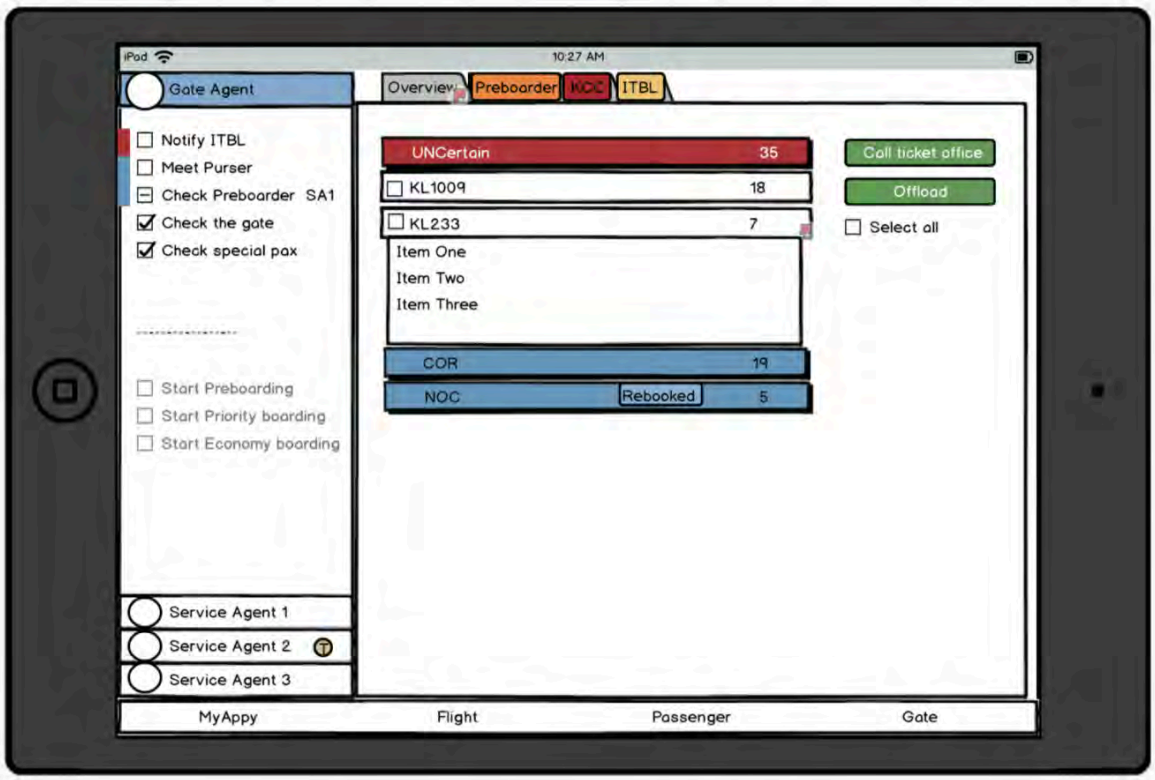
Concept 2 Tabs

Concept 1 and 2 shared the color- coding idea, to highlight which special groups need more attention. And they shared the float button.
Concept 1 use the layout of card, every group with some details was provided in one interface. Concept 2 use the tab view which could provide more specific information for each group.

To validate the two concepts and other functions, a low fidelity prototype was made as follows.



Concept A: Operational Dashboard



Concept B: Tab

6.2 Expert validation

6.2.1 Procedure

An expert validation was conducted to provide insights for later iteration. Two gate agents and one Shiftleader (the direct manager of gate agents) were invited to try the prototype separately. They were asked to first talk about how do they think about the interface, do they understand. Afterwards, every main function was introduced with this prototype, and they were asked to provide feedback about the functions.

There is a list of goals and hypothesizes to be validated in the three sessions:

1. It the interface self-explainable and understandable?
2. Which concept works better? The card or the tab?
3. For every main function, it is helpful to achieve the design goal?
4. For color coding: how many layers of attention should it be? Which color works better to draw attention? Which color works better for buttons and notifications? What do you feel about red, orange, blue, green?
5. For the action buttons, what is most frequently action for every special group?
6. In general, what do you think about this design?

Besides the questions above, the session with Shiftleader has another goal, which is to also validate the vision and roadmap.

6.2.2 Results

The results of the three evaluation sessions turned out to be quite positive. They thought it is very new but easy to understand. And many interesting and inspiring discussion about colors were made, which is beyond expectation.

Here are the detailed results for each hypothesizes in 6.1.1:

1. They understand the interface without any explanation, because they are very familiar to them. So three of them has figured out the to-do list and the info about special passengers at first glance. The float button with a plus is confusing.
2. They all agreed that concept 1, the operational dashboard wins. As a gate agent said, “I really like it because I can see both overview and details at one glance. It will help my work a lot.”
3. Seven main functions were introduced to them (please find detailed description in 6.3). And they agreed that with all these functions they would definitely have a more efficient work. Among the functions, the to-do list and

the operational dashboard are their favorite functions, for providing them an overview in one interface.

4. For color-coding, they agreed that two layers would be enough: orange for a lot of attention needed while yellow for normal attention needed. Red seems dangerous or wrong, which is too much for the colors. They think blue is a KLM color, a neutral color, and a color indicating everything on track. And Green means finished task and also fluent process.
5. For the action buttons, they provide explicit actions for every special group, which also validates that, although there are several special groups, but the actions towards every group is very limited, usually one or two.
6. In general, they think this design would be a great help for their work.

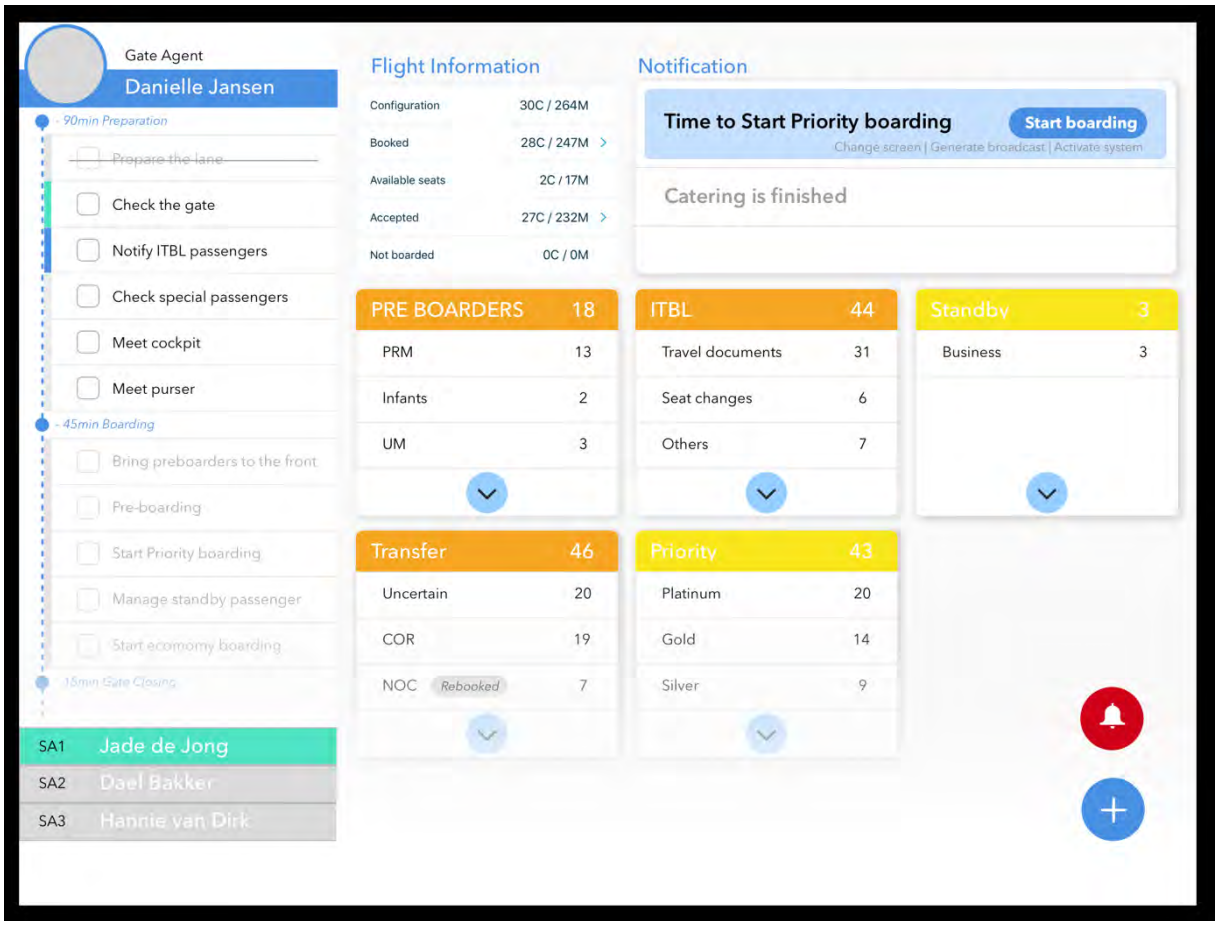
6.2.3 Improvements

Based on the results above, iterations were made to improve the product. And they are:

1. Choose concept 1 as the major interface.
2. Use orange and yellow to indicate the attention level and use green to indicate the group is all boarded. Use blue for buttons and notification, and also for static information about the flight. Use green when notification is checked, and a button is tapped. When something goes wrong or need super attention, such as forget to start boarding after 3 minutes, use red. (They are part of dynamic information.)
3. Separate the button on right bottom. Beforehand it is a button with three functions: contact colleagues, notify passengers, and find quick help when encounter an aggressive passenger. But now two buttons were designed, the emergency call is not frequently used, but once it is needed, it should be found at once.

6.3 Main functions

Seven main functions were designed. Some of them are overlapped, but they are compatible with each other. Every function is based on the main interface. Because that is the major idea of this design: to provide everything in one interface and design a flat information architecture.

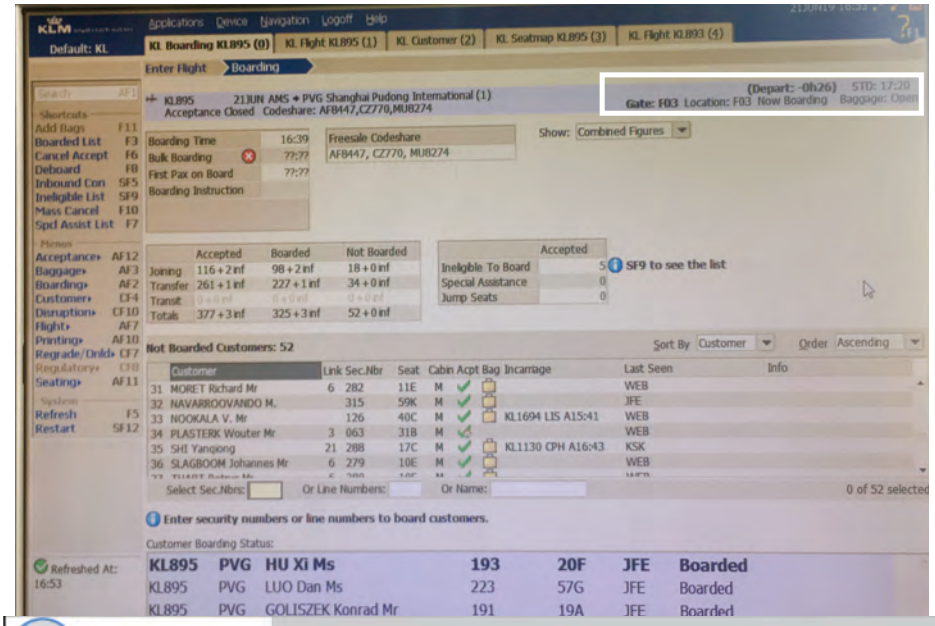


1.Group to-do list

Current tools (ALTEA)

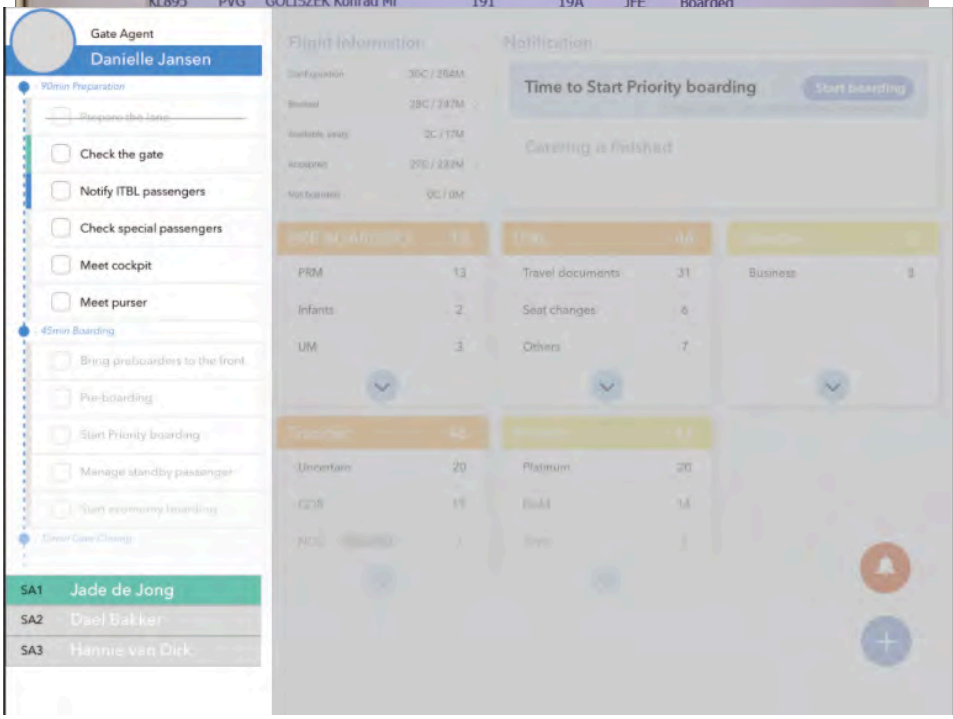
- no overview of process
- no timeline
- no place to see group Members' state

- only a countdown at the corner (see white square)



Design

- overview of process with timeline
- can see everyone in the group is doing what (Danielle is notifying iTBL and Jade is Checking the gate)
- GA can assign task for SA
- some tasks (in grey) cannot be done until it comes to some time
- tasks are automatically pop-up to the top when it is the time



Problems

This function is designed to solve ***the unstandardized process***, including

- Lack of overview
- Lack of clear task division in the group
- Double work when there is a SA with less experience
- Lack of time reminder

2. Operational Dashboard

Current tools

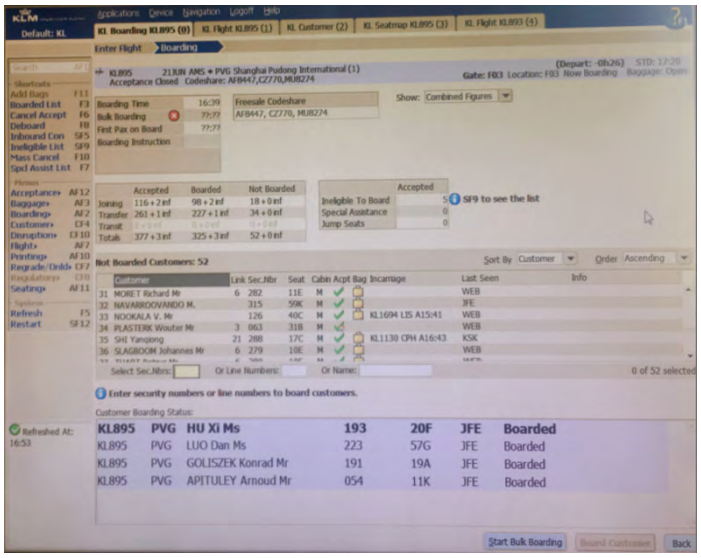
ALTEA

- the flight info
- Standby passenger list
- Missing passenger list
- Transfer passenger list

(but not accurate)

- No overview of the lists above
- Deep information hierarchy

(need several click to go for the information page)

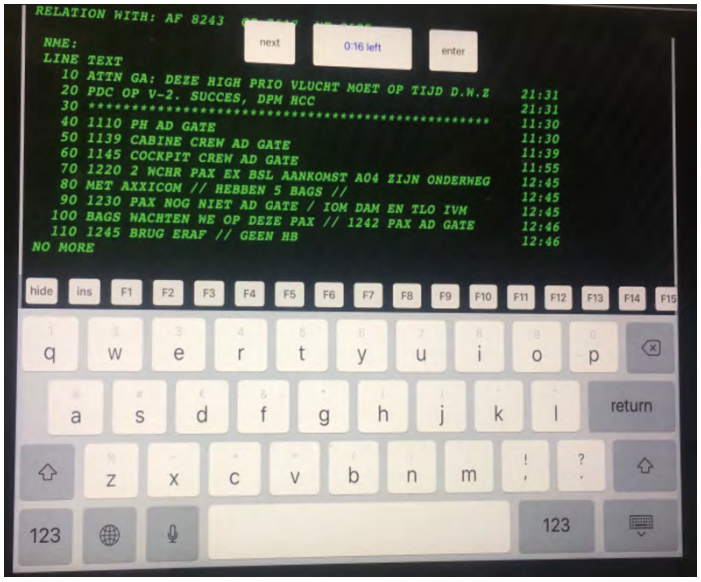


Firda

- Transfer passenger list

- No overview
- Deep information hierarchy

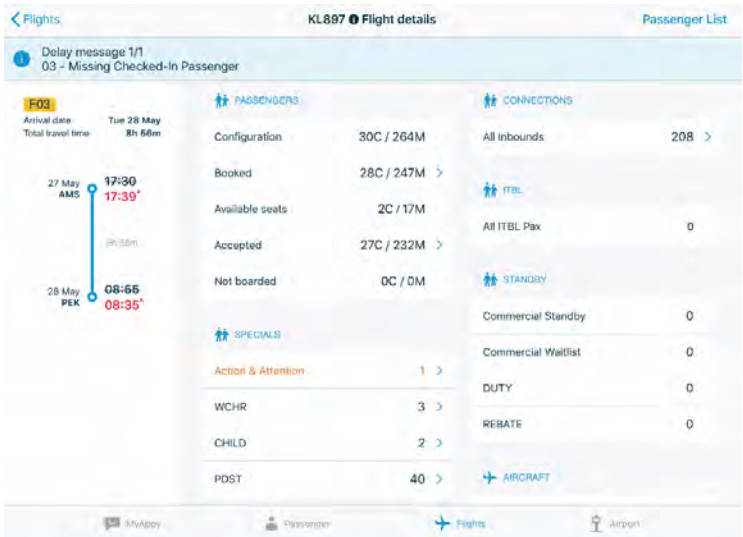
(need several click to go for the information page)



A2H

- Flight info
- Pre-boarder list
- ITBL list

- A nice overview
- Flat information hierarchy

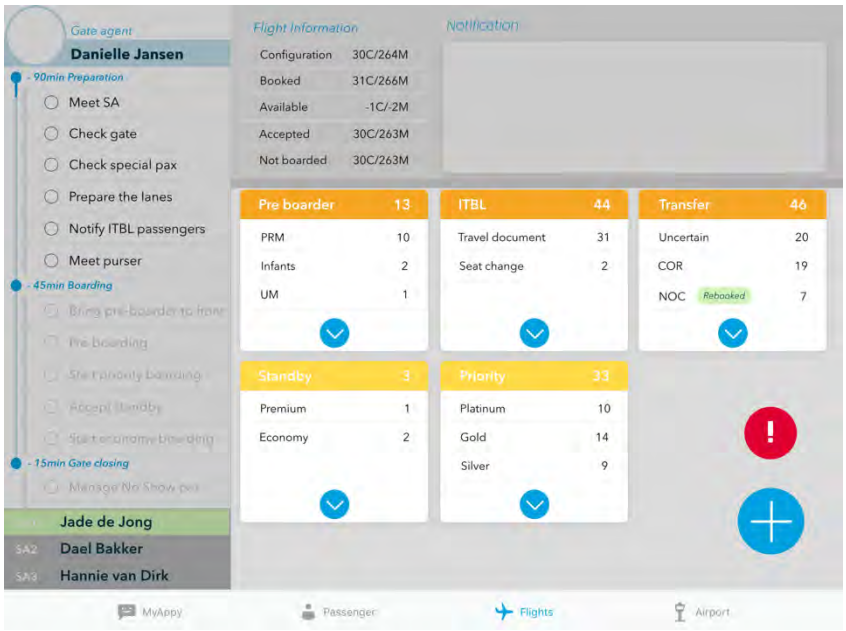


Design

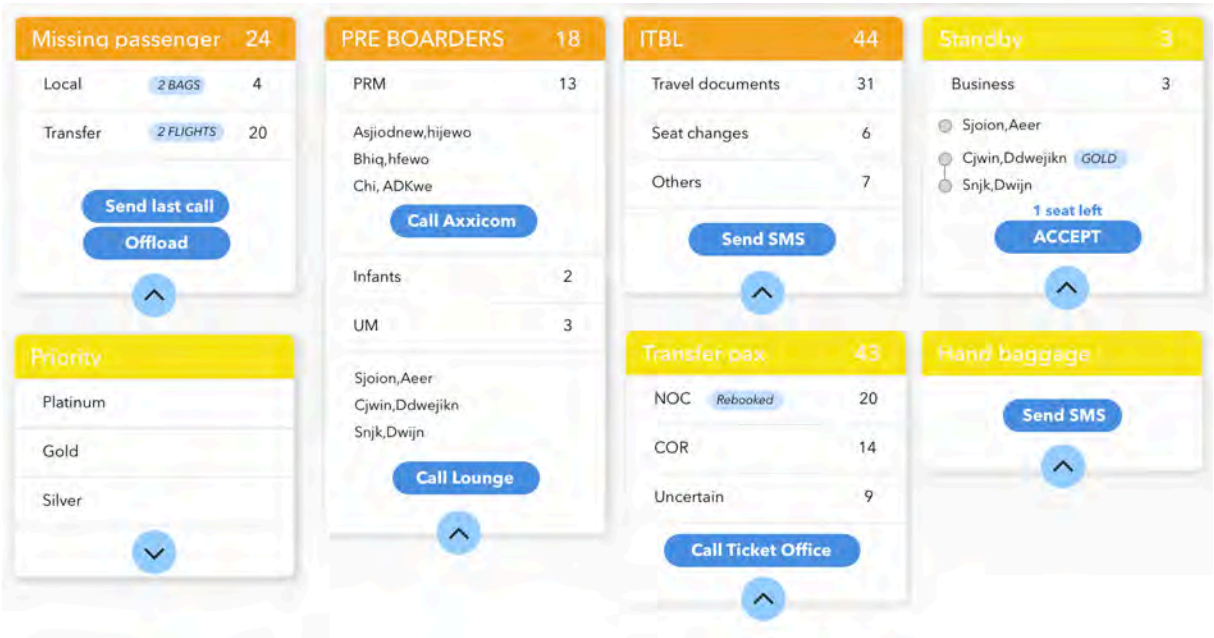
- Overview for every special group (from the three tools above)

- Colorcoding to highlight how much attention should gate agents pay for each group (based on how many people in there)

- Automatically refresh the real-time information, and change colors.



- Show some details in the overview, and when tapped the blue button, shows all the details and action button (see figure below).



- The information hierarchy is flat. So every action or information need less than three clicks.

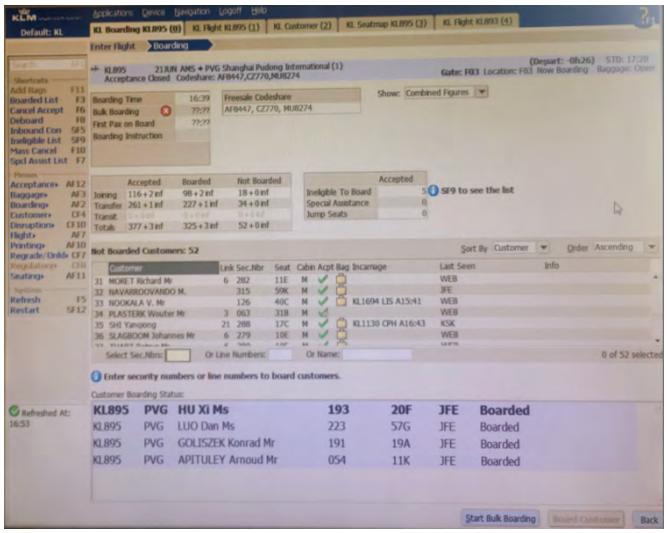
Problems

This function is designed to solve the ***inefficiency and passiveness*** of the tools:

- Need to analyze all the info in brain and keep in mind
- Need to check several tools to gather info
- Need to check real-time info multiple times

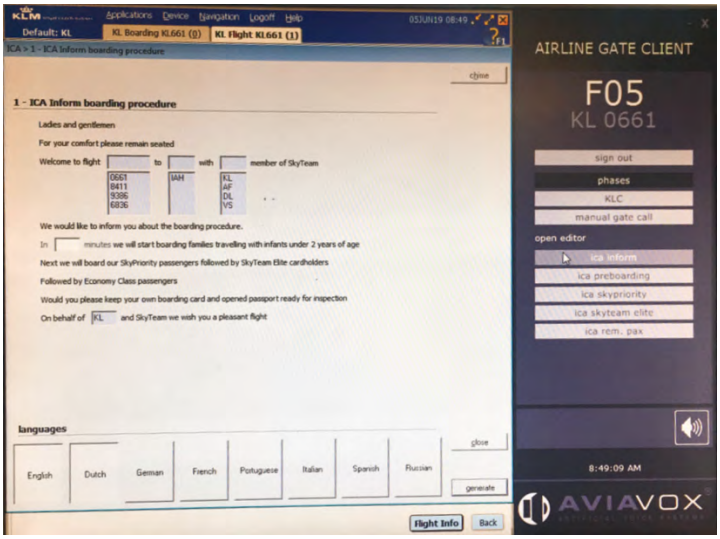
- Need to check info by several clicks and typing (deep information hierarchy)
- Need to change tools to take actions

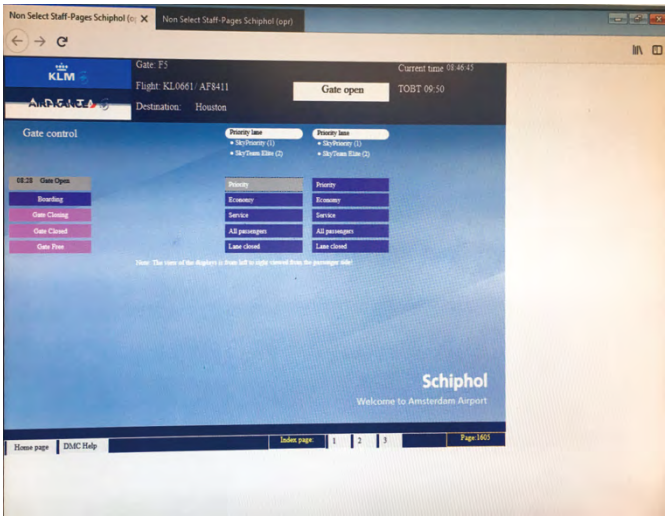
3.Start boarding with one button



Current tools

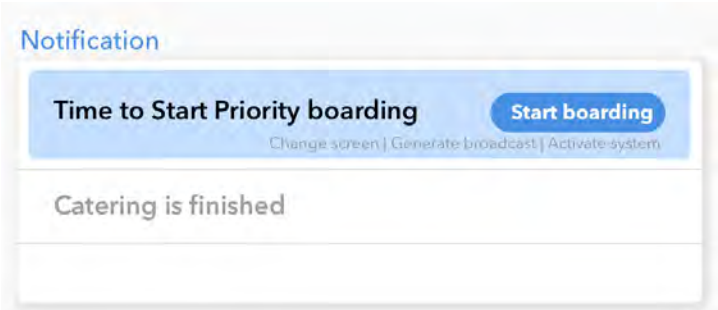
ALTEA (to activate the system)
DMC(change info on screen)
Airline gate client (to make broadcasts)





Design

Merge the functions in three applications above with one button



Problems

This function is designed to solve the ***inefficiency*** of the tools:

- Need to open three programs to start boarding

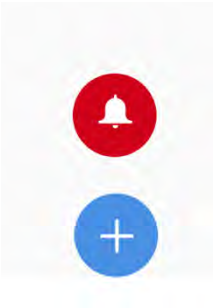
4.Quick help for emergency

Current

They have training about how to deal with an emergency, but there is no relevant contents in digital tools. Basically, it is dependent on GA's expertise to solve.

Design

A red float button on the right bottom is designed for quick help when emergency. When click the button, quick call can be made to Shiftleaders or medical help.



Problem

This function is designed to solve:

- Feel unsupportive when encounter an aggressive passenger

5.Quick communication

Current

Currently when GA want to contact a colleague, they need to check their numbers(printed) and make the call. When GA want to notify passengers, they need to use DMC and Airline Gate Clients to make broadcasts and change the screen.(see function 3)

Design

A blue float button on the right bottom is designed for quick communication. When click the button, three most frequently used actions are pop up: call TC, call DAM, notify passengers.



Problem

This function is designed to solve the ***inefficiency*** of tools:

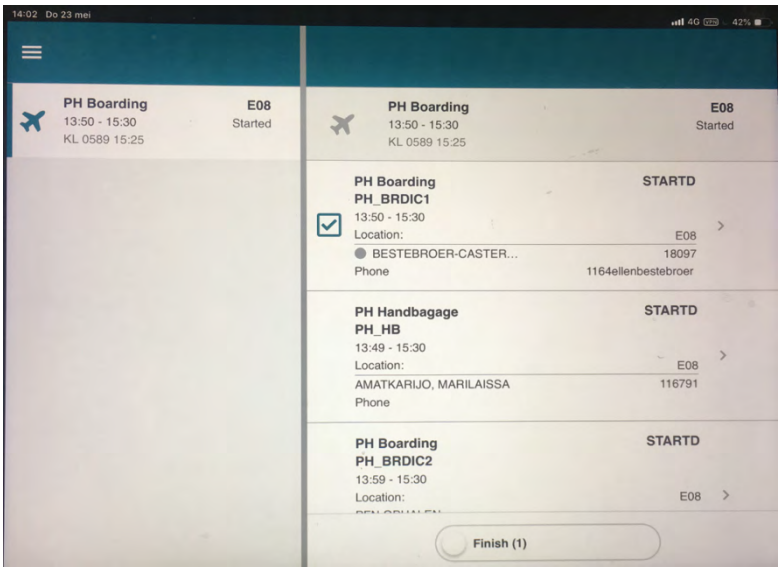
- Need open several programs to take actions

6.Initial Impression

Current

Currently when GA and SA received a "task" (new flight) in the CHIP Application, they can only see the gate number, flight number, destination and teammates' names.

There is no clue about the coming workload and how stressful would it be.

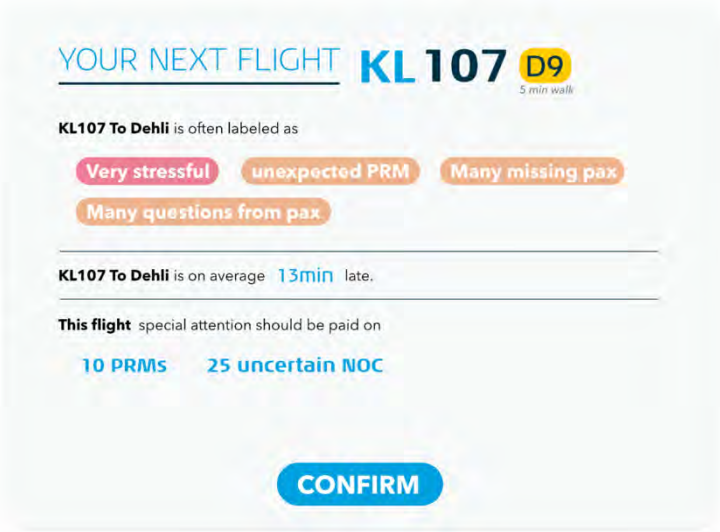


Design

Firstly, the task confirmation function is merged into A2H.

When receive a new task, besides the information of current system, there will be detailed information shows:

- Past time performance on average
- Past common issues
- Past workload (how stressful) on average
- Statistics for this flight



To achieve this function, the way of briefing a flight after gate closed should also be changed. Currently, GA brief in Firda system, writing things they think is important for this flight. And all the briefs cannot be exploited because they have different forms. In the new design, GA are asked to brief with labels, such as "very stressful", "unexpected PRM", so the labels could be counted and the most common labels of the same flight will be shown on the next GA's task confirmation page.

Problem

This function is designed to partly solve:

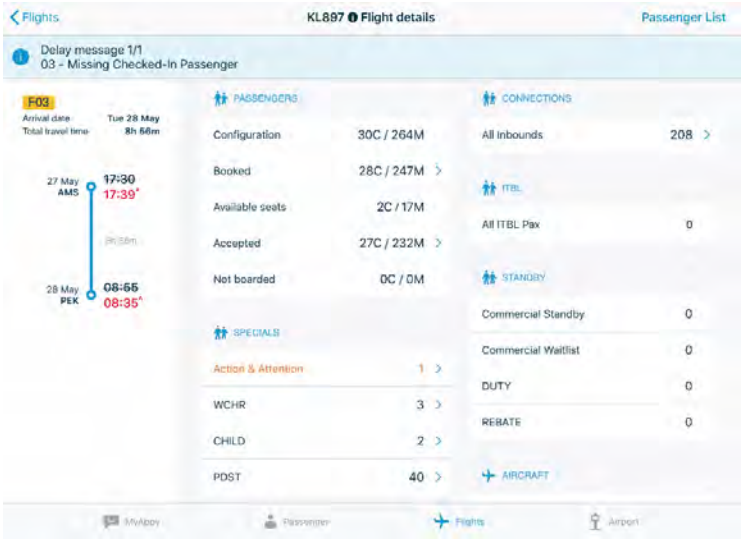
- Diversed workload for different destinations

7.Notifications and time reminder

Current

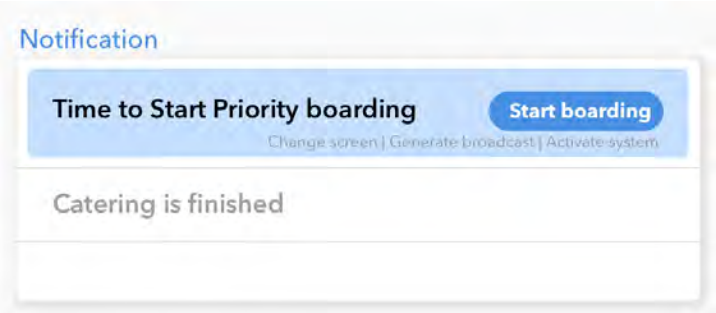
Currently important notifications are shown in A2H, and they are fixed on the top of A2H and is not able to interact with.

Currently there is no time reminder in any tools



Design

A notification card is designed on the right top of the screen. Important notifications as well as time reminders are shown.



There are three time-reminders:

- Time to start priority boarding
- Time to start economy boarding
- Time to manage missing passengers

The time-reminders and notifications are interactable, once a notification has be confirmed, it will turns grey. And once a time-reminder is finished, it will turns green.

Problem

This function is designed to solve the ***passiveness*** of tools:

- Lack of time reminder

6.4 Conclusion

Starting from the design brief in Chapter 5, ideation and iteration were made. It is quite clear from the design brief that to put all needed information in one interface and use a flat information hierarchy.
Two concepts were tested with experts (two gate agents and one shiftleader), and the concept with operational dashboard was chosen.
Seven main functions to meet the list of requirements were also validated by the experts, and the feedback is very positive.
Small improvements were made based on the experts' feedback.

CHAPTER 7.
User Test and Evaluation

This chapter will discuss the user evaluation, aiming to validate the design and also provide feedback for further improvement.

7.1 Procedure

Goal

The main goal of the final user test is to validate the usability as well as the experience of the new digital design concept with the agents, especially the gate agents. Moreover, this test is aiming at collecting feedback to improve the design. Several research questions were come up with to be validated during the user test:

1. Is the design goal achieved? (Does the design improve individual and teamwork efficiency?)
2. Are the interaction characters achieved? (Do agents feel more in control, supported and proactive with the new interface?)
3. Is the interface clear and easy to understand?
4. What are the strengths and weaknesses of this design?

Method

Five gate agents were recruited randomly for the final user test, and every test lasted for an hour. Figure 7.1 shows the demographic information of the participants.

Besides the tests with gate agents, two interviews were conducted with two service agents, as a supplement for the result from another side.



Figure7.1 Participants

According to former research, workload and stress level are very diverse for different flight, so a fake scenario was come up with to stimulate an example of "a worst scenario". In that scenario, gate agents need to handle a super chaotic and troublesome flight. Eleven tasks were defined for that scenario. Figure 7,2 shows the details of the scenario and task cards.



Figure7.2 Task cards

The user test with gate agents was conducted with four parts:

A. Old product rating, and task difficulty rating.

Before introducing the new interface, participants were asked to rate the user experience of the current digital tools in the questionnaire (see Appendix x). And then the scenario and task cards will be introduced to gate agents step by step. Agents are asked to rate the difficulty of each task with the current tools.

B. New tool exploration.

The new prototype was then introduced to the participants without exploration. They were asked to think aloud during their exploration, talking about what do they think about the interface and UI element, and if the prototype is easy to understand.

C. Task fulfillment with new interface

The same task cards and scenario as in step A will be given to agents. They are asked to fulfill every task following the sequence with the new prototype. When performing the tasks, participants are asked to think out loud.

D. Interview and questionnaire

After the tasks are finished, an interview will be conducted with following questions:

- What do you think about the design in general?
- What do you like about it and dislike about it?
- Is there anything confusing you or inspiring you?
- Is anything you want to improve for this design?

And the questionnaire has two parts, rating the interaction and evaluating the difficulty of each task. Among the interaction rating, “efficient” “supported” “in control” and “proactive” would be items to rate, and there will also be other words to make the test goal vague, so as to get more reliable results.

For the interviews with service agents, every function of the prototype was introduced. And then they were asked to talk about their opinion of the prototype, do they think it will help the efficient, and anything should be improved for service agents.

Set-up

The test was conducted in the Passenger Service office in Schiphol airport. Figure 7.3 shows the set-up of the test.

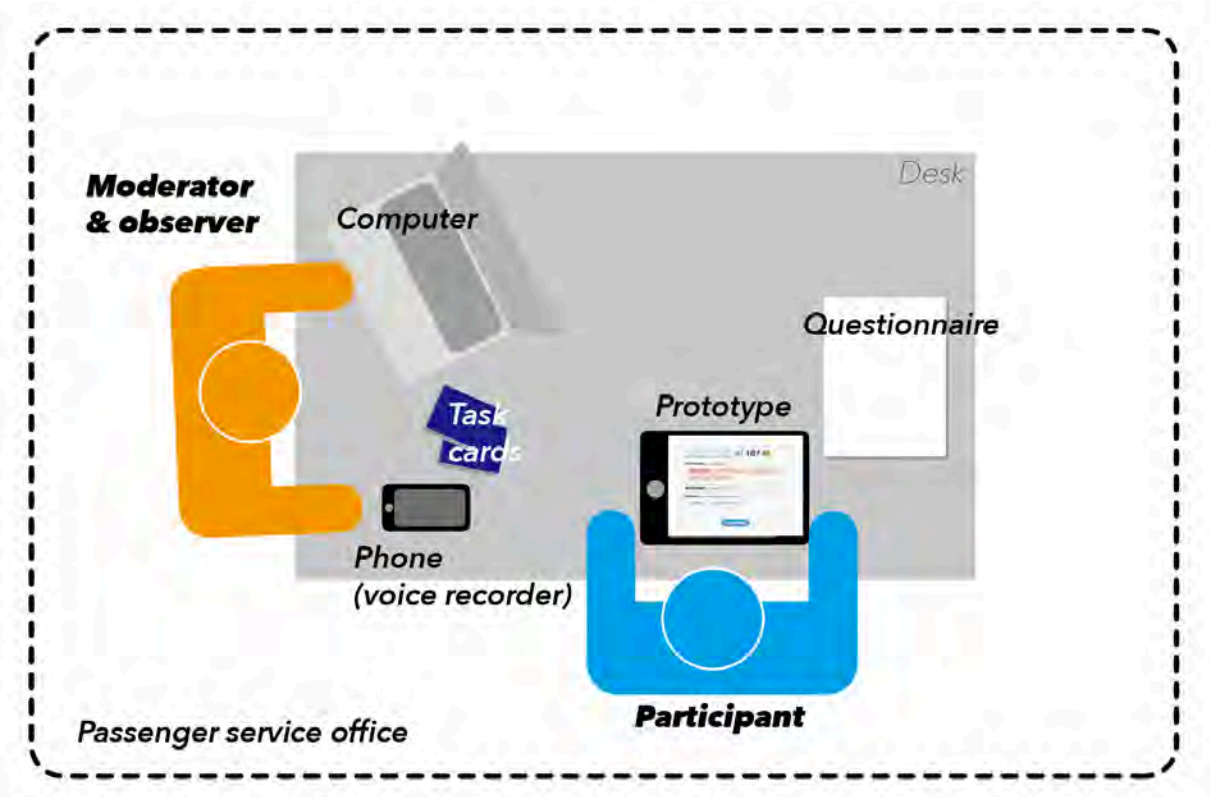


Figure7.3 Set up

I was the moderator and observer for the test. Besides asking the participants think out loud during the test, I was observing if every task is completed and is there anything confusing in the process.
Every interview session was voice recorded by my phone.

Data Analysis

To validate the research questions, data were collected by questionnaires and audio records. The questionnaire had two parts: the rate of user experience for old tools and new prototype, the rate of task difficulties with old tools and new prototype.
And data analysis was conducted as follows:

1. Design goal: according to the contrast of task difficulty rating, are they on average easier than the old tools? Also, according to the contrast of user

experience rating, do they feel more efficient using the new prototype? Last but not least, from the interview.

2. Interaction Characters: according to the interaction rating, are the desired character (in control, supported and proactive) rated higher than the old tools?
3. Interface user-friendly: according to my observation during their exploration of the prototype (step B). And also from the comparison of interaction rating, do they rate the prototype easy to understand?
4. Strengths and weaknesses of the prototype: according to the interviews.
5. Feedback to improve the prototype: according to the interviews.

7.2 Results

Design goal: is the efficiency improved?

According to the interviews, all the gate agents and service agents agreed that the efficiency would be improved a lot with the help of the new prototype.

"I can see everything going on at one glance: what should I do, who's doing what and how many passengers need attention. For sure it will make the work much more efficient." (Gate agent)

"This checklist will help me a lot to help the gate agent for the whole process." (Service agent)

The following functions were mentioned when they talk about the efficiency:

- The group checklist
- Gate agent could assign task with colors
- The automatic refreshing color-coding for each group
- The shortcut button for providing telephone number
- The time reminder for boarding on the notification bar

Figure 7.5 shows the contrast of task difficulty rating, with the current digital tools and the new prototype. There is an improvement with the use of new prototype, but it is not quite obvious. The reasons could lead to this result are discussed in 7.3 Discussion.

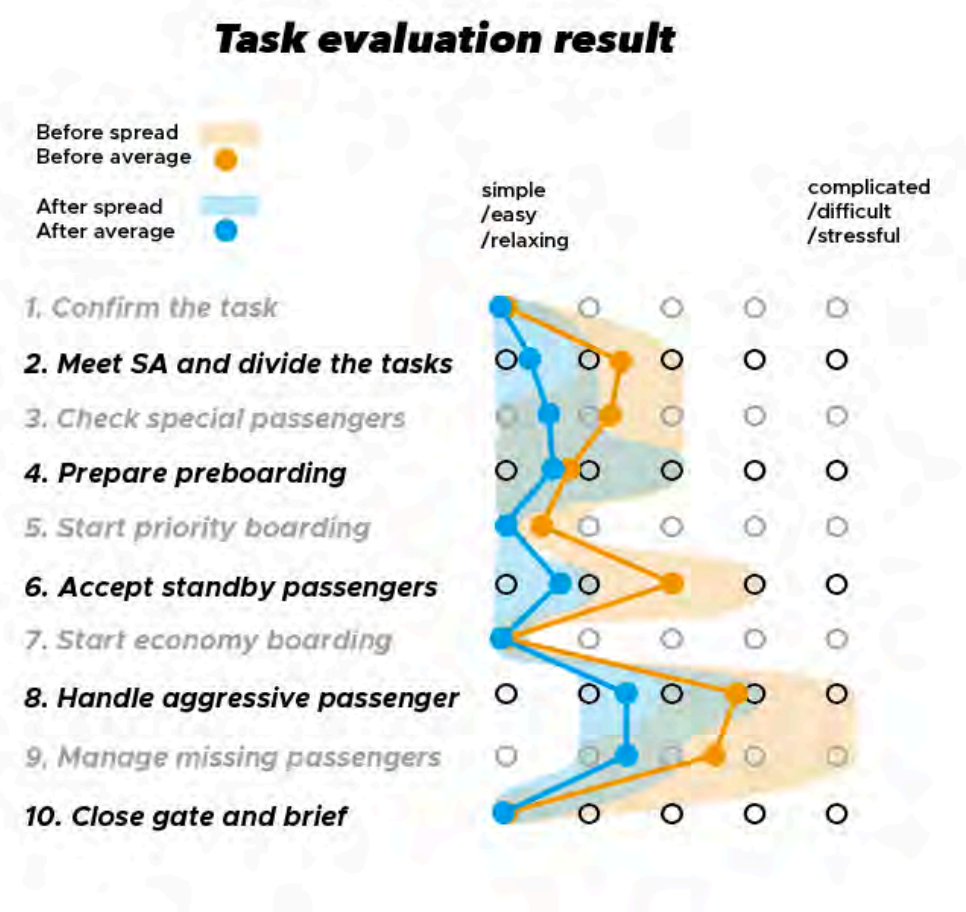


Figure7.5 Task difficulty evaluation

Figure 7.6 shows part of the contrast of interaction rating. It is very obvious that the agents think the new prototype is much more efficient according to the rating.

Desired interaction: more supportive, more proactive and more in control?

Figure 7.6 shows the overview of rating user experience of the new prototype. And figure 7.7 shows the comparison of the current tools and the new prototype.
Among all the characters, supportive, proactive and in control are most relevant to the desired interaction for this project.
From the figure, the three desired interaction characters were rated high scores: Supportive 4.6/5, proactive 4.4/5, in control 5/5.

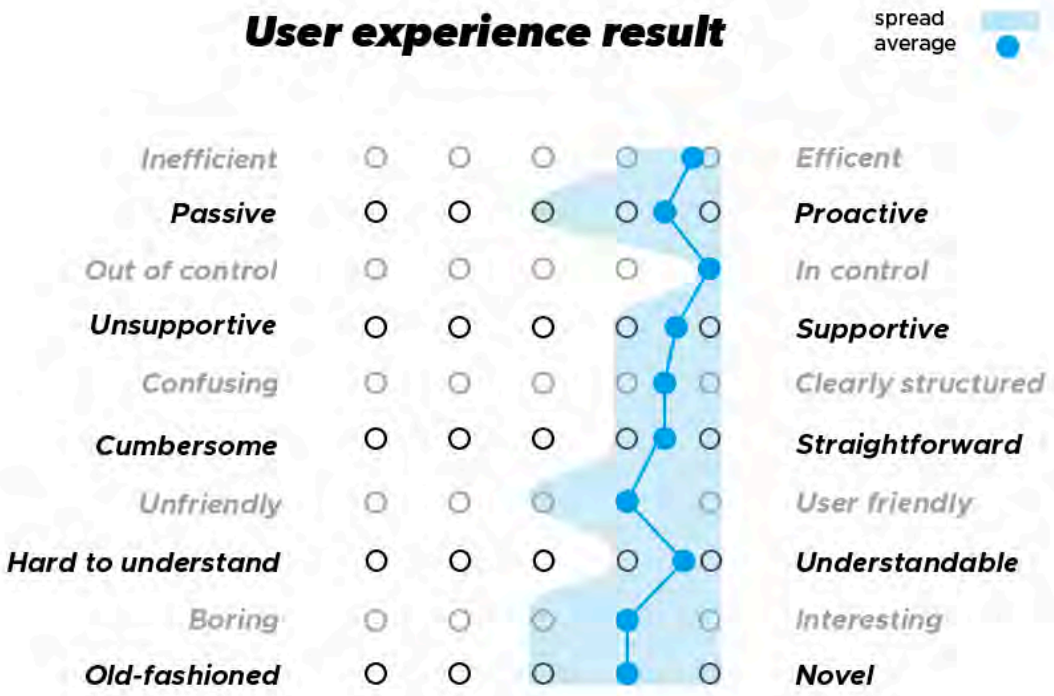


Figure7.6 User experience result

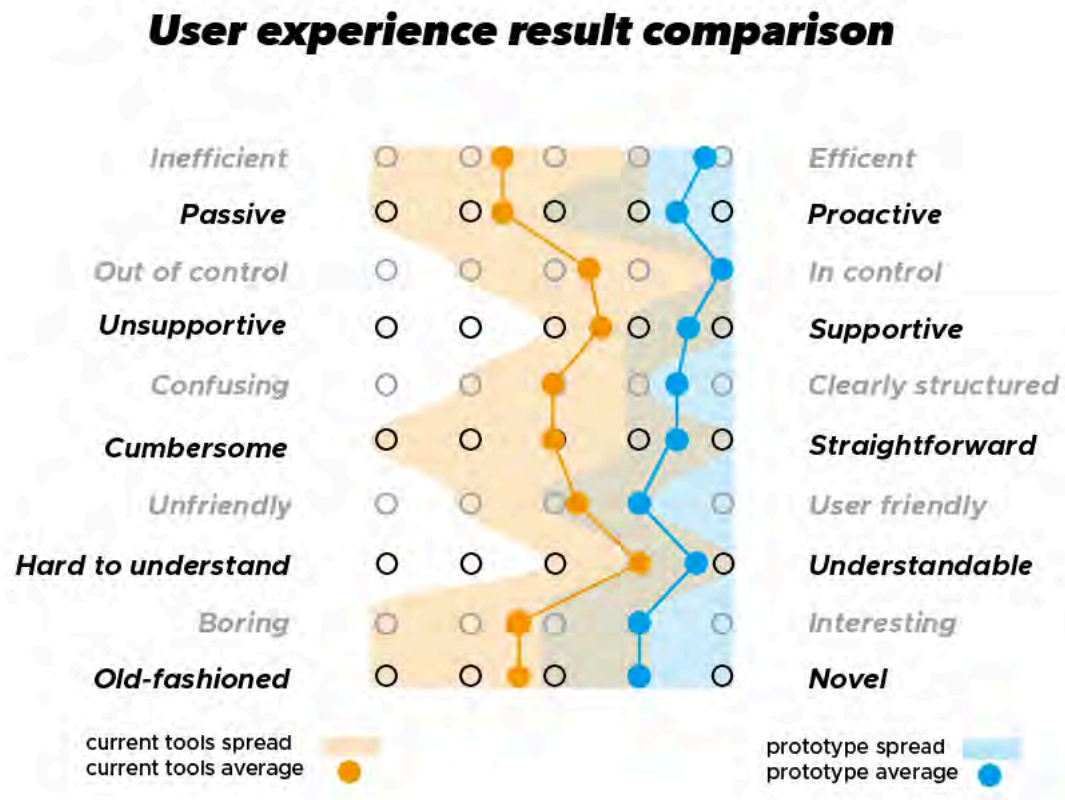


Figure7.7 User experience result comparison

And from the interviews, some quotes were selected to explain more about the interaction characters.

Supportive

"What I feel most supportive is the quick call button when a drunk passenger came to the gate." (Gate agent)

"The group checklist will support my work a lot." (Service agent)

Proactive

"The pop-up reminder for what to do next works very proactive." (Gate agent)

In control

"I really like the cards for all special passengers, you know you can see all the information just at one look. It will make you feel in control of everything." (Gate agent)

"You don't need to go through another program, make ten clicks and then solve a problem. You only need to unfold it and click the button, and all the other information are still there. That makes me never lost control." (Gate agent)

Interface and UI element clarity

From observation and also the interview, the interface and UI elements are generally easy to understand. All the agents figured out the confirm page, the group checklist, and the operational dashboard.

Some elements are kind of confusing at first glance, but after tabbing it became very clear. Those elements are: Quick help float button, quick contact float button.

Some functions are often not noticed during their own exploration: assigning a task for others, and the colors' meaning for the cards.

Three agents have mentioned that the design is easy to get used to, because the colors are consistent with tools that they are familiar with, such as PLUG and A2H.

According to the result of questionnaire (see figure 7.6), the "understandable" was rated as 4.6/5.

Some quotes related to the interface clarity are:

"When the last agent was testing your prototype, I saw the page at a distance, and I thought it is too crowded. But after playing with it myself, actually is it very clear. Which part means what function, they are all very obvious, and I don't feel lost the focus. It's a nice design." (Gate agent)

Strengths and weaknesses of the prototype

According to the interviews, a list of strengths (functions they like most) and weaknesses (functions they like least) was collected.

The strengths are:

- It provides a thorough overview of what to do and what need attention at that moment. Agents can know all the important information at one glance. (seven out of seven agents mentioned)

- The group checklist is a brand-new function which is not in any current tools, and it will help standardize the group work. (five of seven agents mentioned)
- The cards, their changing position and colors is a strong help to analyze the situation. (five of seven agents mentioned)
- The Interface is easy to learn and consistent with the current tools. (three out of seven agents mentioned)
- The shortcut button to provide telephone numbers is useful. Currently they need to prepare their own memo in their phone for useful numbers.

The weaknesses are:

- For the confirming page and briefing page, the current scale "very relaxing" to "very stressful" is too negative. One gate agent mentioned she didn't like to see a "very stressful" tag when receiving a new task, and she suggested to change it into "simple" and "complicated". Other two gate agents also talked about their negative perceiving of "stressful", they thought some people might not see it as stressful but challengeable, but they suggest to keep the "stressful" scale as it is. (three out of seven agents mentioned)
- There is a lack of service button for the majority passengers, such as selling an upgrade or change a seat. There actions are quite common but not in the prototype. (five out of seven agents mentioned)

Feedback to improve the prototype

- There should be some buttons to sell upgrade and change seats for majority passengers.
- The checklist should allow more flexibility. Currently only when ten minutes before boarding, the checklist of boarding part is interactive. But in reality it could happen earlier.
- The checklist could be merged with the current briefing: currently gate agents need to type the time they meet other colleagues, and with the new prototype it could be automatically recorded when the checklist is ticked.
- The service agents have slightly different attention for the special groups. For example, they usually don't need to pay attention to standby passengers. So the layout of the cards should be different for the service agents' screen.

7.3 Discussion

During the conducting and analysis of the test, several elements might have influenced the performance and the final results. They are discussed as follows:

Difficulty of rating current digital tools

When asked to rate the user experience of current digital tools, aiming for making a comparison with the new design, 4 of 5 agents said it is difficult to rate. Because the current tools are five programs, some on desktop and some on iPad. The user interface style differs from the very old DOC system (Firda) to the new designed interface (Appy2help). They found it hard to choose one score for all the tools, which might influence their rating for the current tools. If a second test would be conducted, I recommend rating the user experience of each current tool independently and then count the average score, which could be more accurate.

"Stressful", "Difficult" or "Complicated"

The rating of task difficulty (also said stress level in the questionnaire) also shown a less contrast than I expected. But according to the interview, all the agents gave quite positive feedback for the prototype. The mismatch of the questionnaire and interviews have mainly three reasons: the word used on the questionnaire ("Stressful" and "Difficult") , the participants experience and the test process(the latter two will be introduced in next sections).

Some agents, especially experienced agents, tends to avoid negative words when asked to evaluate their work performance. They are mostly unconscious of the avoiding. And the current question on the questionnaire (" Stressful" and "Difficult") are regarded as obvious negative. An agent said "*No I am not stressful, I am never stressful at work. It might be more work and more complicated in this scenario but is it not difficult and I am not stressful at all."* And another agent, while talking about the dislike part of the design, also mentioned*" I don't like the 'very stressful' tag on the confirm page, it is too negative. I don't want to see it when I got a task. Maybe it is for some agents but not for me."*

So the negative recognition of the word might influenced the rating of current task difficulty. If a second test would be conducted, I recommend to use a more neutral word to get real data, such as "complicated" or "more work".

Random participants recruitment

For the little contrast of task difficulty rating, another significant factor is the participants. I recruited them randomly, and in this case, they all have a more than 15 years working experience as gate agents. They are very in control of their work and also show a strong confidence for handling any sudden emergency. Therefore, they rate the current task difficulty as generally relaxing. So the improvement of the new prototype is not very obvious according to the rating. Moreover, three out of five gate agents introduced themselves as "a very calm person", to explain why they not rate stressful for current situation. One agent

said*," The stress level really depends on everyone's personality. I am a calm person so I would be no stressful at all, but I can imagine for some of my colleagues it would be super stressful."* So the experience level and personality would also influence the results.

Process sequence

Process sequence has also influenced the unobvious contrast of task difficulty rating. Since the rating of current digital tools is conducted before introducing the new prototype, some agents rated the difficulty with current tools very low (score 1 as very easy/relaxing). And after the new prototype was introduced to them, they were asked to rate for the same task again using the prototype. Some agents asked:" Can I rate the new one 0? Because it for sure make the work easier, but I have already rated the old one 1." But finally, they could only rate the new one with 1 because the scale was designed from 1 to 5.

7.4 Improvements

Here are the improvements I decided to make for the final design:

1. Allowing selling upgrade and seat changing.
2. Add "Change seat" button for standby passengers
3. Add the transfer information for Pre-boarders.

Other feedback that mentioned during the test will be collected and listed in 9.2 recommendation.

CHAPTER 8.
Final Design

This chapter will introduce the functions and interfaces of final design.

Confirm a Task
(before a flight)

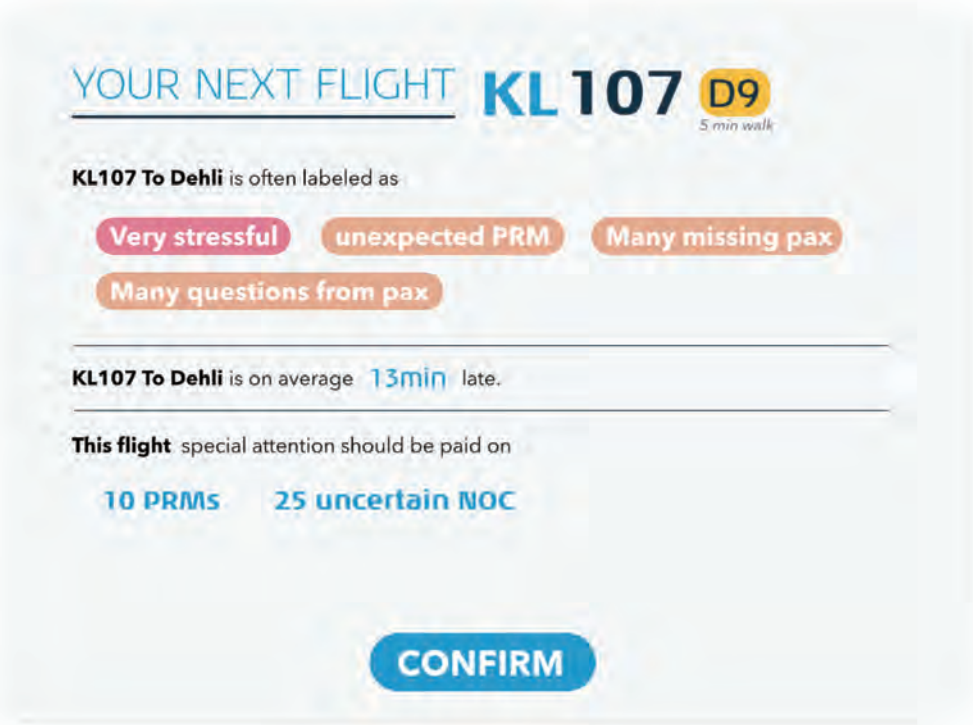
Flight number, Gate number
distance to gate

Information from previous rating:
- average stress level
- common issues

Information from previous data:
Time performance

Information from system analysis for this flight

Confirm button



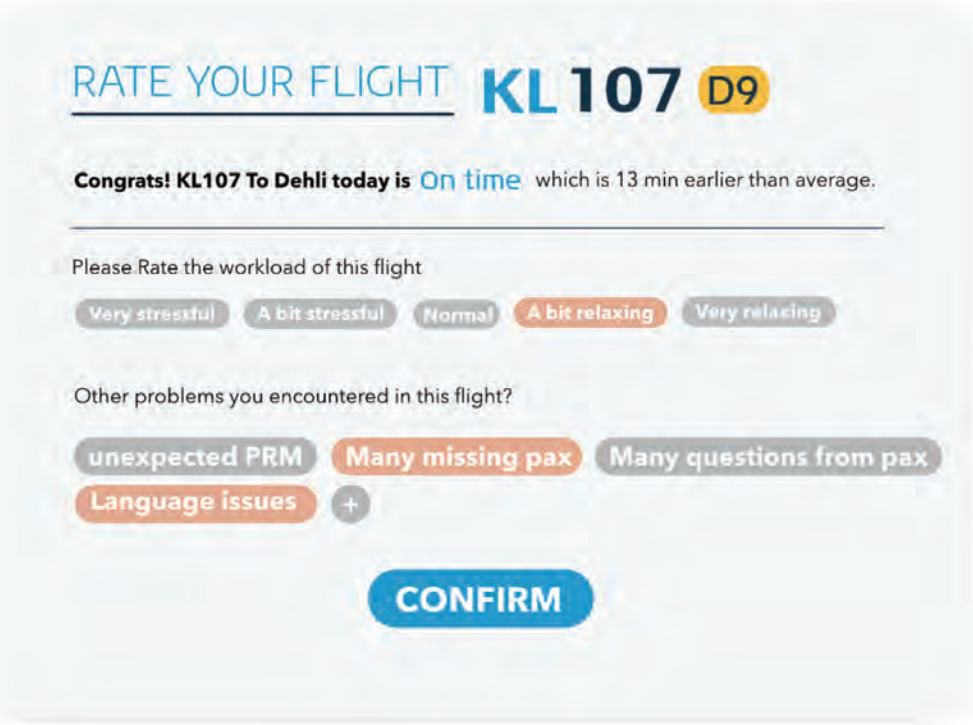
Brief a flight
(after a flight)

Information from real-time data:
Time performance

Rating for the flight:
- stress level today

- issues today

Confirm button



Main interface
(during a flight)

The main interface contains five parts, and they are independent from each other:

A. Group checklist
B. Flight information
C. Notification bar
D. Special group cards (operational dashboard)
E. Two float buttons for contacting

A. Group checklist

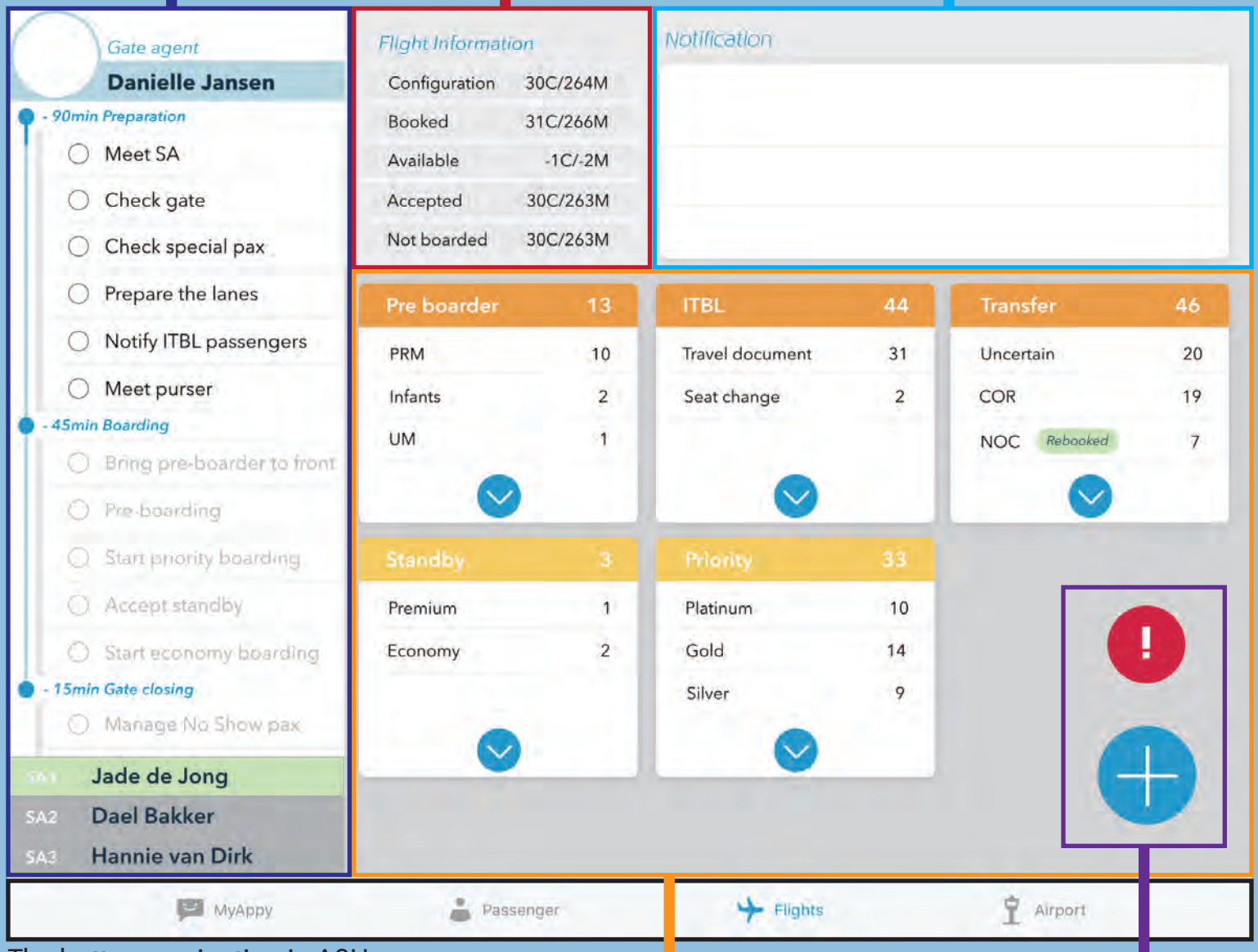
- checklist with timeline
- assign a task
- to do/ doing/ done
- automatic scroll

B. Flight information

- not interactive
- real-time update

C. Notification bar

- Pop-up reminder for important task
  - start boarding/manage missing pax
- From other departs
  - broken seat/ late crew rotation



The bottom navigation in A2H

D. Special group cards (operational dashboard)

- Card colors (orange/yellow/green/red)
- Card fold and unfold (information and action)
- Changing colors and positions over time

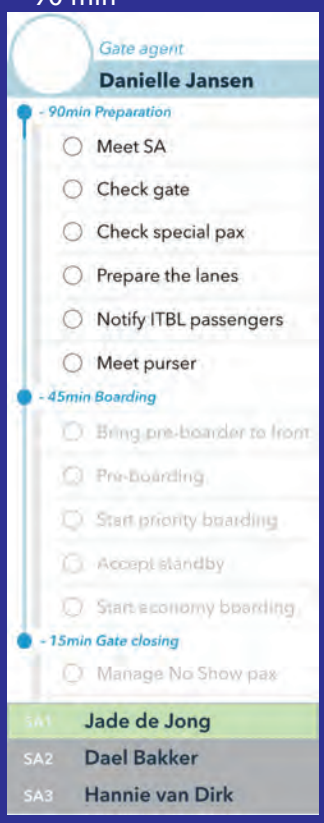
E. Float button

- Quick help
- Quick contact
  - TC/DAM
  - passengers

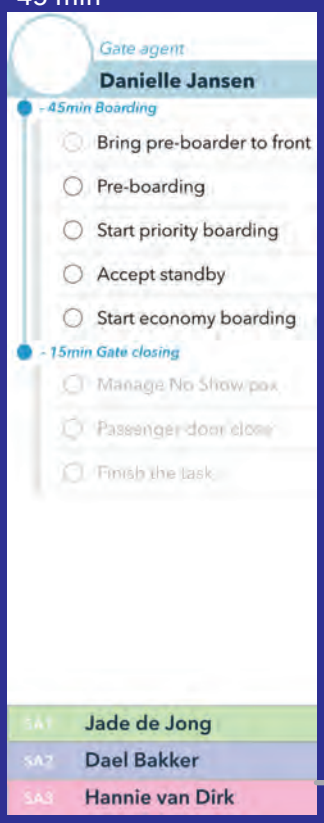
A. Group checklist

1. Automatic scroll down when time passed

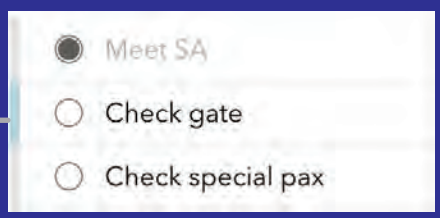
-90 min



-45 min



2. Shared state in the group of every task



3. Assigning a task (only GA)

By draging left GA can assign a task for herself or a SA



4. Everyone has a color

- The color also represent who is doing what.
- When the color is shown, the agent has confirmed the task.

B. Flight information

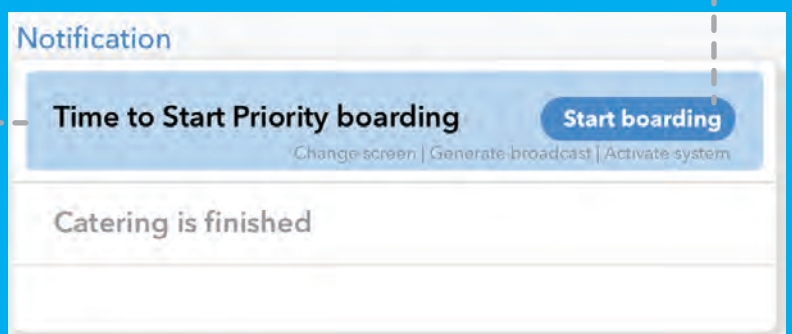
Flight Information	
Configuration	30C/264M
Booked	31C/266M
Available	-1C/-2M
Accepted	30C/263M
Not boarded	30C/263M

- not interactive
- the real-time data is refreshed automatically
- the information is same as in current A2H

C. Notification Bar

1. Pop-up reminder for important task
   - start priority boarding
   - start economy boarding
   - start managing missing passengers

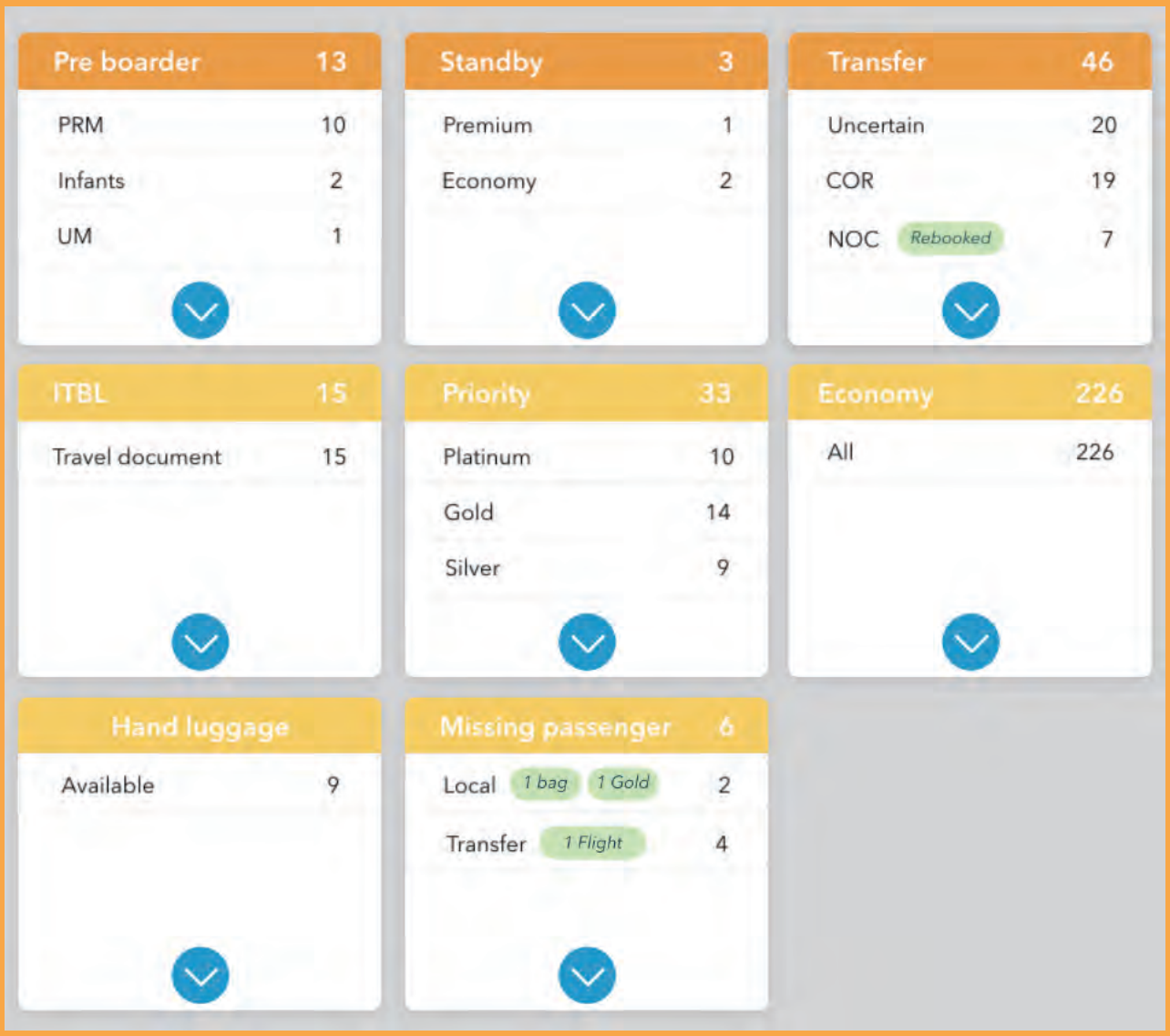
2. A button to start boarding
   - including changing screen
     generate broadcast
     and activate system



3. Important information from other departments
   - crew rotation on time/delay
   - broken seat

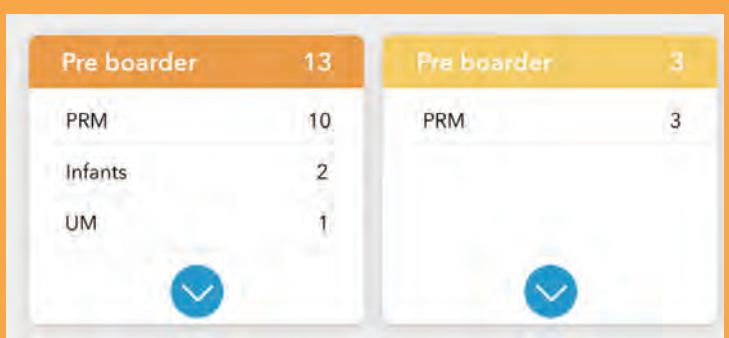
D. Special group cards (operational dashboard)

1. Cards type
   - In total there are eight types of cards as follows)
   - Every flight has its own issues, in this case, has different cards.
   - Cards also changes as time goes by, for "missing passenger" only appear 20min before departure



2. Cards States
   - A card could have four colors showing the state. According to the number and time, different colors provide different meanings. For example, the preboarder's card is shown below

PREPARATION

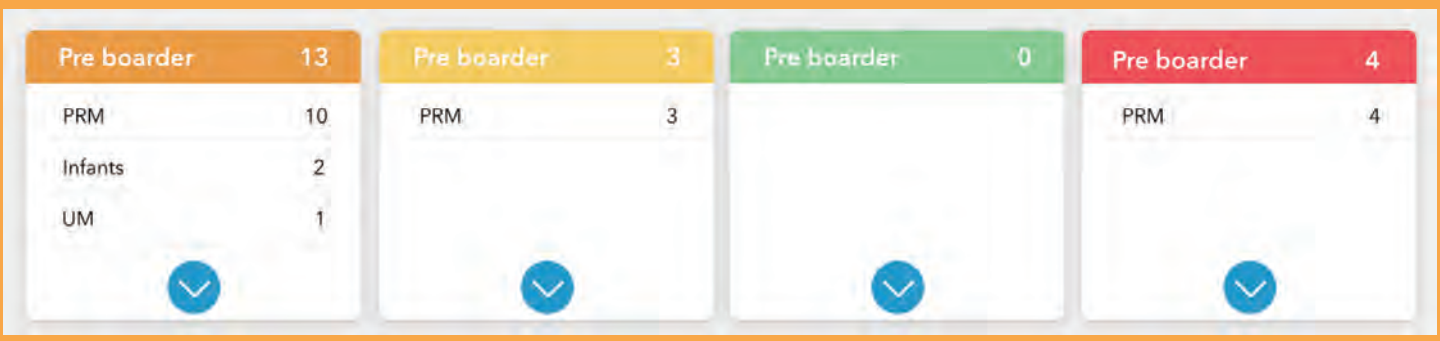


During preparation phase, only two colors are shown:

A. Orange for a large number, and need a lot special attention

B. Yellow for a small number, and need normal special attention

BOARDING



On time, a large number not boarded

On time, only a small number not boarded

On time, all boarded

Might cause delay, when it is 15min before departure

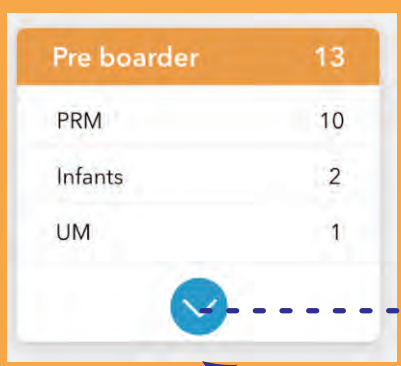
The colors are changing automatically according to the real-time data.

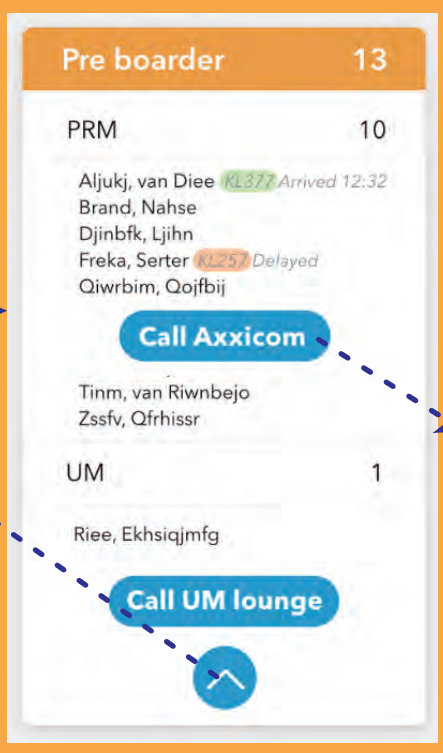
And also the sequence of cards.
Cards need more attention will be placed at the first. And a green card will be at the last.
So the sequence is : Red --- Orange --- Yellow --- Green

3. Cards Fold and unfold
   - Every card has two states, fold and unfold.

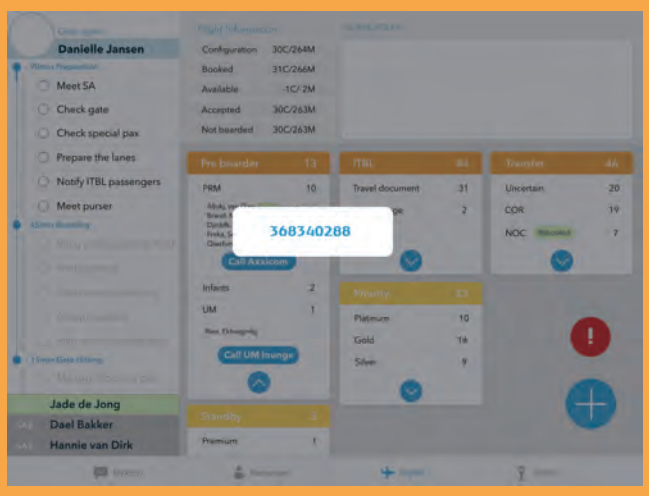
Folded Card
- only show most important information

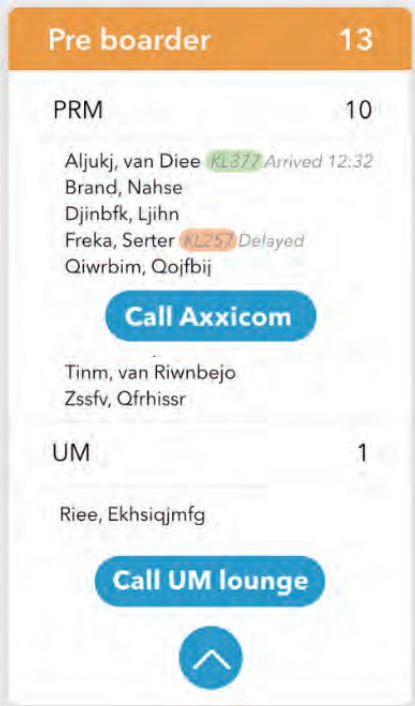
Unfolded Card
- show all information
- show action button





Every unfolded card provides different action buttons.
In this case, when tab the Call Axxicom, a phone number will pop up.

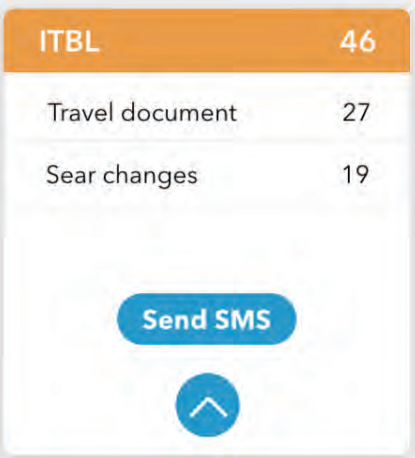




PREBOARDER

Information:
List of names
Transfer info

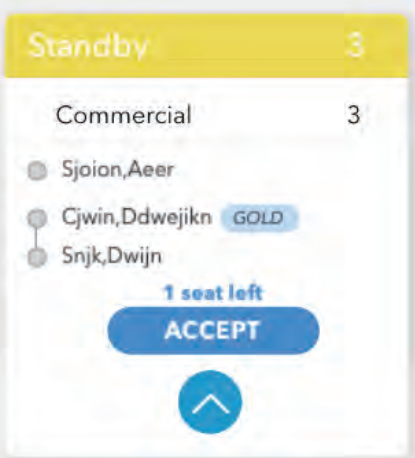
Action:
Call axxicom
Call Um lounge



ITBL

Information:
List of names

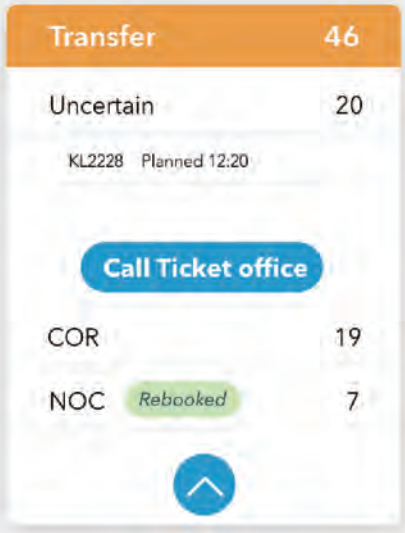
Action:
Send SMS



STANDBY

Information:
list of names
priority
companion
how many seats left

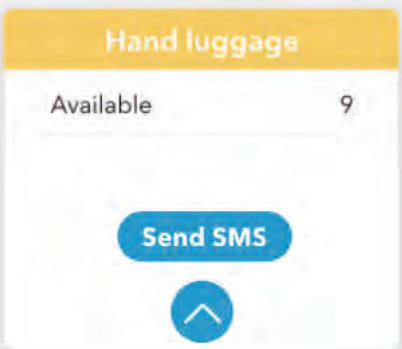
Action:
accept standby pax



TRANSFER

Information:
Flight info
Passenger list

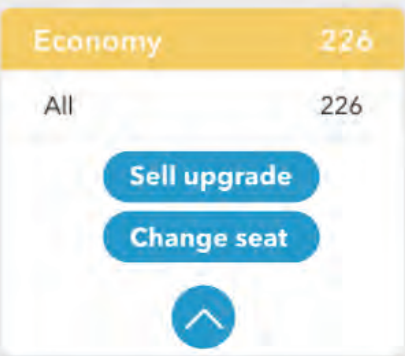
Action:
Call Ticket office



HAND BAGGAGE

Information:
No

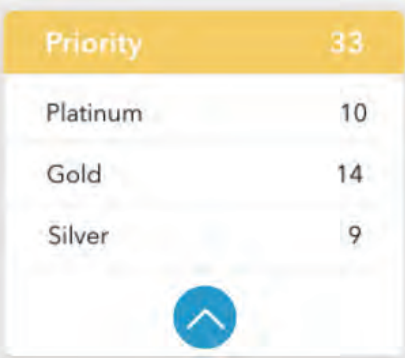
Action:
Send SMS



Economy

Information:
Passenger list

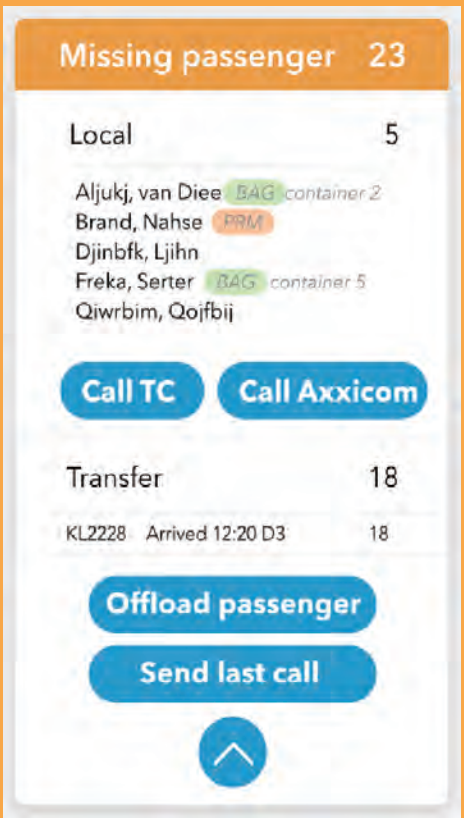
Action:
sell upgrade
change seat



PRIORITY

Information:
list of names

4. Overview of all unfoldes cards



MISSING PASSENGER

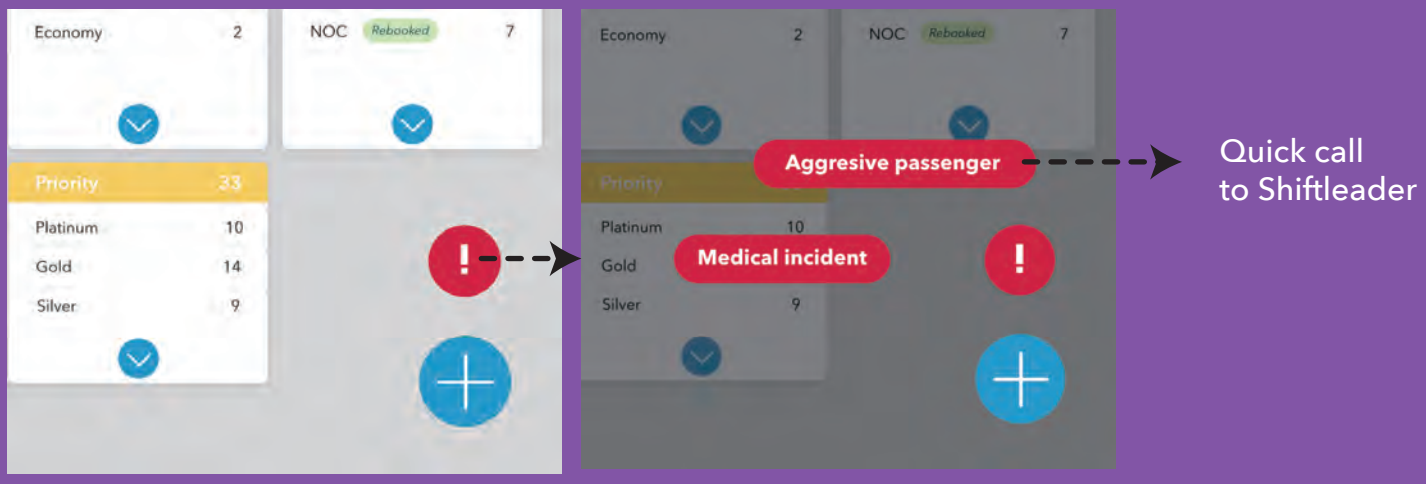
Information:
Local
- baggage container
- list of names
- overlap with other group: priority? PRM?

Transfer
- flight information and arrival gate
- list of names

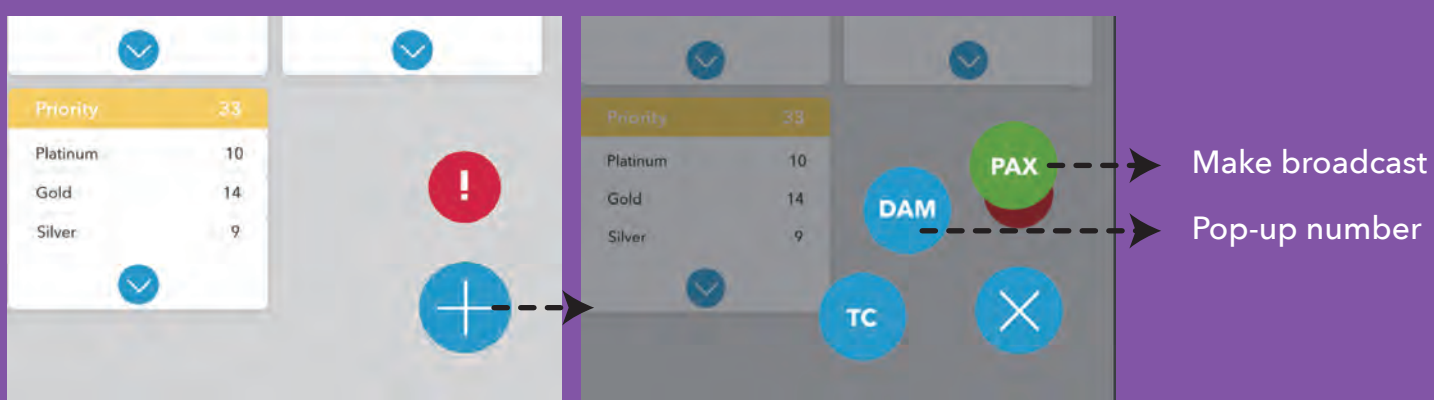
Action:
Call TC, DAM
Call other stakeholders if needed (Axxicom, premium lounge, etc.)
Offload passengers (choose who to offload)
Send last call

E. FLOAT buttons

1. Quick help



1. Quick Contact



CHAPTER 9.
Conclusions

This chapter will draw conclusions for the whole project, as well as a list of recommendation for the company.

9.1 Conclusions

The goal of this project is to explore the current process and tools during boarding, defining the needs and problems from stakeholders and come up with a future vision about digital tools in the future boarding process.
The initial problem definition was to digitize the boarding phase, in order to align with the vision of KLM. After exploring the context and process, the main problem was redefined as "The current process is too dependent on gate agents' expertise, and the current tools are passive and inefficient."
Looking from an outsider's view, the current boarding process is unstandardized. It is standardized in the manual, but in reality, every gate agent has their own way of working.
Another significant finding is every flight has different issues. And the issues also could change with time. Boarding is a complication process in real world, while literally it seems simple. It is unpredictable, and many stakeholders are involved. These two factors made the job complicated. Agents only with sufficient experience and expertise can manage.
While taking a deep look of the tools used in the process, passiveness and inefficiency are the main problems. For such a complicated task, it is a pity that the system does not provide any help to analyzing the statistics. All the analyzing was done by gate agents in their brain. The systems and interfaces are old. Gate agents need to go through several programs and make several clicks to take an action or search for some information.
Besides, an interesting finding was the gate agents do not perceive the digital tools a big issue. They were very used to the old interfaces and system and are familiar with the cumbersome interactions. The only issue they perceived about the tools is that they are too slow.

The vision was come up with based on the main problem, aiming at learning from gate agents' expertise and taking more responsibility by the digital tools. And the first horizon is to enhance individual and teamwork efficiency by a digital tool.
The most difficult part during ideation and iteration is the arrangement and choice of information. Current tools provide every detailed information, but it makes the work difficult. What information is more necessary and what could be hidden are hard to decide. After validating with experts and evaluation in the final user test, the results turned out very positively. Agents think it is very easy to understand and will help enhance their working efficient. Desired interaction characters were also improved with the design.

9.2 Recommendations

The recommendation for the company consists of two parts.
Firstly, according to all the research and analysis, a list of problems was made, as well as solutions. Since this is a project focusing roadmap and digital interface, solutions related to process and procedure, technology and organization were out of the scope of this project. They were listed as a part of recommendation for the company.
Secondly, due to the limitation of the project, there are some steps need to be taken before further design and implementation.

Recommendations for better boarding (solutions out of the scope)

About the technology

- The speed of current tools is very slow, especially on iPad, which has a large influence on work efficiency and user experience.

About the process and procedure

- Allow earlier ITBL passengers informing, also send the text message with reason. For passengers with travel document issues, ask them to go to any touchpoint instead go to the gate in the message.
- Allow sending a message to passengers for hand luggage limited flight, after they have checked-in. Both agents and passengers agreed it would be better to get the information earlier than at the gate.

Recommendations for further research and implementation

1. *A User test with more diverse participants.*

Due to time limitation, the participants of final test were recruited randomly. They had a similar working experience (more than 15 years). Therefore, they cannot represent all the ages and all the experience level. To get a more fruitful and reliable result, a large user test with more people and more diverse people is needed.

2. *Technical support*

This design, aiming at merging all the current tools with one interface in Appy2Help on iPad, requires some mandatory technical conditions:

- ***Fast network speed***: It is designed that many real-time information is updated automatically, and agents don't need to check by themselves. This should base on a stable and fast network spead, as well as the database. Otherwise the design is not reliable and agents will still check the old systems for accurate information.
- ***Availability to use Appy2Help to control other programs (API)***. According to former research, it will be available to use Appy2Help to get access to Altea. But for Airline Gate Client and DMC, they are

provided by Schiphol Airport. Checking the availability of all the systems is needed for further implementation.

3. Details refinement and validation

In the prototype, some details were made by assumption and did not validate by the real data. They should be checked and defined in further research.

- ***For the cards***, orange and yellow were designed to indicate two levels of special attention. The difference of the two levels was currently made by assumption: more than 15 PRM will need a lot of attention, and less than 15 PRM just need normal attention. The exact number is not certain and need further research.
- ***For the notification bar***, all the important notifications from other department could pop up on the top right. But from a technical and also organizational point of view, the availability is not sure. Is the back office or the crew rotation center has the access to send a test message for the gate agent? It should be validated with other departments.

Glossary

ALTEA	The main operating system of boarding
A2H	Appy2Help, An iPad application for ground staffs
DAM	Duty area manager
GA	Gate agent
ICA	Intercontinental flight
ITBL	Ineligible to board list
NOC	Transfer passengers cannot catch the next flight
NOC TNB	Transfer passengers whose baggage cannot catch the next flight
PAX	Passenger
PRM	Person with reduced mobility
SA	Service agent
TC	Team coordinator
UM	Unaccompanied minor

References

Hekkert, P. (2014). Vision in product design: a guidebook for innovators. Amsterdam: BIS.

Jaehn, F., & Neumann, S. (2015). Airplane boarding. European Journal of Operational Research, 244(2), 339–359. doi: 10.1016/j.ejor.2014.12.008

KLM (2018) Annual report KLM 2018. [PDF file]
Retrieved from https://annualreports.klm.com/KLM_Annual_Report_2018.pdf

KLM Brand Identity (2017)

KLM (2019) KLM company profile.
Retrieved from https://www.klm.com/travel/nl_en/corporate/company_profile.htm

KLM Customer Airport Vision (hub and international stations) (2018)

KLM Digital UX Guide (2017)

Mapping the Future. (n.d.). Concept Mapping for Planning and Evaluation, 175–180. doi: 10.4135/9781412983730.n9

Passenger Termial Today (2019) Passenger terminal world March 2019. [PDF file]
Retrieved from https://www.passengerterminaltoday.com/online-magazines/in-this-issue-march-2019.html

Passenger Termial Today (2019) Passenger terminal world January 2019. [PDF file]
Retrieved from https://www.passengerterminaltoday.com/online-magazines/in-this-issue-january-2019.html

Passenger Termial Today (2019) Passenger terminal world Showcase 2019. [PDF file]
Retrieved from https://www.passengerterminaltoday.com/online-magazines/passenger-terminal-world-showcase-2019.html

Shopify partners (2019) Mobile Design Trends in 2019.
Retrieved from https://www.shopify.com/partners/blog/mobile-design-trends.

Simonse, L.W.L. (2017) Design road mapping. BIS Publishers.

Teixeira, F., & Braga, C. (2019). UX Trends 2019 – UX Trends.
Retrieved from https://trends.uxdesign.cc/2019.

Top 10 Technology Trends of 2019. (2019).
Retrieved from https://www.kdnuggets.com/2019/02/top-10-technology-trends-2019.html.