A door-to-door baggage service with standardized bag

The impact of standardization
in a multi-stakeholder industry

master thesis

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TU Delft VANDERLANDE PASSME

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Preface

This thesis has been written to meet the requirements to graduate from the master Integrated Product Design at Delft University of Technology. The project has been commissioned by Vanderlande Industries B.V. and took place between March and September 2017.

When I found myself looking for a graduation project, one of my requirements was to include many stakeholders; various parties all with their own field of expertise and interests. My project had to be a puzzle, where some of the pieces still had to be discovered. Even though the topic of baggage did not sound very interesting at the beginning, the complexity of the aviation industry as a whole had my great interest. I greatly appreciate the opportunity I got at Vanderlande to dive into this complex puzzle and to create my own project. I would like to thank Martijn Roza and Robbert Dijkstra for helping me along the way. Martijn, thank you for the time you took to support me, to make sure that I kept moving forward as well as for your effort to make me feel welcome. Robbert, thank you for your help to get

my thoughts on the project organized and for your feedback on my writing.
Also, I would like to thank my other supervisors, Ruud van Heur and Katinka Bergema. Ruud, although we did not always start at the same page, your experience and insights during our discussions encouraged me to go one step further and to challenge myself to deliver the best. Katinka, you are great. Your character and work ethic are inspiring to me. Thank you for all your support; that whenever I felt like meeting, you created space in your busy schedules to help me out.

I would like to thank other colleagues at Vanderlande as well as the interviewees from several companies for providing me with their ideas and answering my questions. Special thanks to Peter Hoefkens, Robbert Dijks and Frithjof Wegener for sharing their expertise and views on the topic. Without their expertise, I would not have been able to complete this study.

Furthermore, I would like to thank friends and family who always support me. I would like to thank Kring, for your love, wisdom and questions. Maria and Lennart for getting married and Carine for the gezelligheid you bring to our home. Also Niek, Charlotte and Anne, thank you for reading through my thesis and providing me with your feedback. I would also like to thank Irene and Rosalie for giving me a family in Veghel, thank you for your joy and piano. Also, I would like to thank Alaitz and Tessa, for inspiration, drinking tea and making the endless hours at the faculty seem shorter.

Last, but most important, I'm thanking God for my parents. Papa and mama, thank you for giving me the opportunity to study, thank you for providing a loving family and a safe place to be me.

Enjoy!

Lisanne Boersema
Delft, September 19, 2017

Executive summary

This master thesis provides a feasibility study of a door-to-door (d2d) baggage service with standardized bag. Many stakeholders are involved in the aviation industry and in order to implement such a service the consequences and requirements for the industry must be clear. One of these stakeholders is Vanderlande, global market leader for logistic process automation at airports. The study was structured by describing a current, next and afternext phase of development for the service. The analysis of the current situation includes a trend analysis, function analysis, stakeholder analysis and a journey map of both passenger and baggage. Interviews with various stakeholders provides information for further description of the current situation.

The results of this study show a door-to-door service with standardized bag consisting of 9 components which are essential for the service. Within each of these components variables are defined and the relations between the variables are presented in an Interaction Loop.

The Interaction Loop reveals the relations within a d2d service and indicates how the components affect the passenger journey in the end. The Interaction Loop can be applied as a tool for different parties within the industry, to indicate what their (future) role within d2d services can be. Although the Interaction Loop has increased insight in the complex issue, there are still many variables and interaction to be found.

Based on the variables and relations presented in the Interaction Loop, requirements for a standardized bag could be determined. The strength of the Interaction Loop here is that the motivation for certain requirements became very clear. Hence, the value of each requirement can be defined.

Current d2d baggage services indicate that the industry is already moving into the next phase of development. This has consequences for the development of the afternext, since the afternext needs to be implemented in the next. When the next is already present, the aviation industry should act, steering the next towards the desired afternext.

Abbreviations

ACA	Airport Caron Accreditation
AGV	Automated Guided Vehicle
BaaS	Baggage as a Service
BHS	Baggage Handling System
CI	Check-in
d2d	door-to-door
DCS	Departure Control System
GDS	Global Distribution System
IATA	International Air Transport Association
OOG	Out of Gauge
PASSME	Personalised Airport Systems for Seamless Mobility and Experience
PAX	Passenger
Std.	Standardized
ULD	Unit Load Device

Glossary

(Source: Vanderlande)

Airside	Area of an airport terminal building with immediate access to the apron. Restricted area on an airport, restricted access for personnel and passengers.
Apron	Paved area on the airside of the terminal building where aircraft are maneuvered and parked together with handling services.
Batch	A collection of individual orders, products or data, which is treated as one entity to optimize an order picking, processing or production operation.
Batching	Batch of bags is a quantity or a number of bags at one time that will be loaded together
BHS	Provides the handling and control of all bags, excluding passenger hand baggage, from the baggage acceptance stations through to the aircraft stand and from the aircraft unloading to the delivery of the baggage to the passengers.
Bulk Hold	The area in an aircraft where bags are loose loaded (loaded individually), rather than in a Unit Load Device.
Gauge	Baggage with specifications above the allowed BHS products, in terms of dimensions, shape or weight.
Hub	A central sorting facility in which the parcels, coming in from the collecting depots, are sorted and shipped to the destination depots.
Landside	Non-restricted area on an airport. Free access for personnel and passengers.
Mishandled baggage	Baggage that is damaged, delayed, lost or pilfered.
Stack	A quantity of objects which are stored vertically.
Tail-to-tail	The transfer of baggage, freight and mail from aircraft to aircraft without an intermediate point.
ULD	A pallet or container used to load baggage, freight and mail on wide-body aircraft and specific narrow-body aircraft.

Contents

Introduction

Each day, an average of 100,000 flights are executed worldwide (IATA, 2016). The aviation industry is a complex industry and subject to ongoing changes. These changes are either imposed from outside or driven from within the industry. Part of the complexity is the number of parties involved. A challenge for the industry is to provide a seamless travel experience for the continues expanding market. Currently, airports experience capacity issues due to the increasing numbers of both passengers and baggage.

This research graduation project is a cooperation between Vanderlande Industries B.V. and Delft University of Technology (TU Delft), faculty of Industrial Design Engineering (IDE). This research contributes to the 'Personalised Airport for Seamless Mobility and Experience' (PASSME) research project, which is coordinated by TU Delft and funded by the EU's Horizon 2020 program. The PASSME project is about rethinking the airport experience to optimize process flow, reduce stress and enhance the passenger experience (PASSME, 2016a). PASSME aims at minimization of the effects of baggage related time within the passenger journey (PASSME, 2016b) and the improvement of the entire experience of the door-to-door passenger journey (DeLille, 2014).

One of the stakeholders in the aviation industry is Vanderlande. Vanderlande is market leader in the field of automating the baggage handling process. Their systems process yearly 3.2 billion pieces of luggage. Vanderlande is aiming at fast, efficient and reliable systems for transportation and sorting of baggage as well as for parcel and warehousing purposes.

In order to minimize the baggage related time within the passenger journey, PASSME is focusing on a door-to-door (d2d) baggage service where bags are picked up at the passenger's home and delivered at their final destination. Vanderlande suggest this would allow the use of standardized bags in the process. Through standardization the process of baggage handling could be further automated and optimized.

Since the aviation industry includes many stakeholders, pan-industry cooperation is required for the implementation of this service. However, the consequences of a standardized bag for the industry are not yet examined or qualified. Because of this lack of knowledge, the service is not implemented within the industry yet/ In order to address this problem, this master research focusses on the consequences of a door-to-door baggage service, using the standardized bag as an initial assumption.

After further introduction of the context of this research, this thesis describes three phases of development for the suggested service: a current, next and afternext situation. Each of these phases is further analyzed of which the results are presented in a for this research developed Interaction Loop. The Interaction Loop represents the synergy between the most relevant components of the industry concerning the issue. Relevance of components is determined by the degree by which it is either affected by or affecting a door-to-door service with standardized bag.

The last part of the research presents the steps to be taken within the industry to further develop the service to resolve capacity issues at airports and enhance the passenger experience.

Chapter 1

Context

Introduction

Where the aviation industry is including many parties and different fields of expertise, this first chapter will give a furter overview to the context of this research.

Vanderlande
At first, a brief introduction of the company, is given. Although multiple industries are part of their product portfolio, whitin the context of this research, Vanderlande's aim is to optimize baggage handling systems.

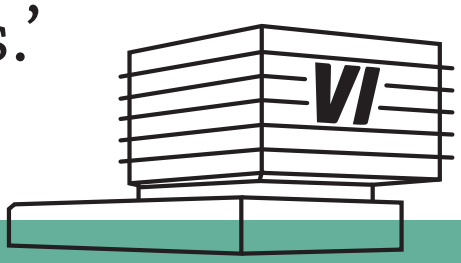
Industry challenges
Furthermore this chapter includes current industry challenges which form the argument to introduce a door-to-door service within the industry.

Door-to-door
The next sections introduces current door-to-door (d2d) initativesas well as their current limitations. Furthermore, this part indicates why door-to-door services are interesting for Vanderlande.

Automation
The last part of this chapter explains why Vanderlande is focussing on process automation and how this can be achieved within the context of a d2d service. It also gives some examples of standardization within the current process.

All togheter, this context description constitutes the base from which the research question will evolve.

‘Our vision is to be the worldwide leader in automated material handling solutions.’



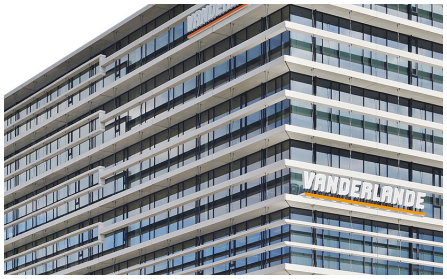
VANDERLANDE is the global market leader for logistic process automation at airports. With a wide range of system solutions, they want to increase efficiency, offer high operational effectiveness, reliability and careful baggage handling (Vanderlande, 2017). FIGURE 1 shows some facts and figures as presented in Vanderlande’s 2016 annual report. Additionally, some highlights from the company’s history are presented on the right page.

Figure 1: Facts and figures; Vanderlande Annual Report 2016

1949 The company is founded in 1949 by Eddie van der Lande, at first refurbishing and later producing machines for the textile industry.

1963 A partnership with the American company Rapistan Incorporated lead towards the development and building of customised transport systems. This marked the start of a successful global organisation

1988 NPM Capital acquired a majority of the company's shares. The company expanded on international scale and became an independent Dutch organisation



1989 The company name Rapistan Lande is changed to Vanderlande Industries

2017 Toyota Industries Corporation (TICO) acquires Vanderlande Indsutries.

The company information and history presented indicate Vanderlande's years of expertise on logistics worldwide. Where the aviation industry is changing, as presented in the following chapters, Vanderlande needs to be on top of these changes to move along or even initiate development from their own business.

Industry challenges

In November 2015, the International Air Transport Association (IATA) predicted that passenger numbers will grow with an average of 3.8% per year, reaching 7 billion passengers in 2034 (IATA, 2015). Due to this forcasted growth the air tranportation industry is facing capacity issues. The challenges that accompany this passenger growth, related to airport capacity, baggage handling and passenger satisfaction will by adressed in this chapter.

Capacity issues

Where airports used to be points of arrival and departure, today they are complex, multifunctional travel centres where non-aeronautical revenues even cover half of the total revenues (Vanderlande, internal blog, F. van Duren, 2017). The existing airport infrastructure is not sufficient to deal with the growth forecasted. Besides, space to expand is often limited (PASSME, 2016c) due to the related cost, a lack of available space to expand or regulations which do not allow expanding. Also, with the growing number of passengers safety becomes harder to guarantee. Therefore, it is important to reconsider the current use of airport space and optimize the available area.

The airport capacity is depended on a whole range of factors. It is for example related to the airspace, the runways and the passenger througput in terminals. These factors are among others restricted by the aforementioned regulations e.g. the allowed number of flights in the surrounding area, as well as the available terminal space, the amount of security checkpoints, the required distance between arriving and departing aircrafts and the number of bags the baggage system can process.

Where the number of passengers increases, the amount of baggage is increasing as well. Studies from 2015 show that almost one in five passengers only takes carry-on bags but the majority checks in an average of 1.2 bags (SITA, 2016). This results in capacity issues which can mainly be found in baggage and check-in halls. Currently, baggage systems and check-in desks at most airports are already operating at their peaks or even above (PASSME, 2016c).

Based on some interviews, throughout this research the airport capacity for passenger throughput will be defined as depended on 3 factors: volume, space and time. As said before, the volumes at airports are increasing, but there is limited space to expand. The third factor, the amount of time that passengers spend at an airport should also be considered. The amount of time passengers spent at an airport is also related to the baggage they take to the airports:

when researching the bag-factor at Amsterdam Schiphol Airport, Royal HaskoningDHV found that a passenger traveling with baggage requires extra space up to factor 1.5-2.0 and walks at a significantly slower pace which requires extra space as well (Royal HaskoningDHV, 2015).

For baggage handling at airports the capacity is defined as the number of bags (volume) that can travel through the baggage systems in a given amount of time. As will become clear in "BAGGAGE HANDLING" ON PAGE 49, there is a difference between the required time for a bag to be handled throughout the systems and the actual time a bag is handled.

Bag mishandling

Next to the capacity issues, another challenge the baggage industry is facing is bag mishandling. When checked baggage is delayed, damaged, pilfered, lost or stolen it is referred to as mishandled (SITA, 09 April 2013). According to SITA , a company that provides IT services to the air transport industry, the rate of mishandled bags was 5.73 per thousand passengers in 2016. Which cost the industry around US$2.1 billion (SITA, 2017).

FIGURE 2 shows the link between increasing passenger numbers and the mishandled bag rate. Since 2007 the number of mishandled bags is showing a downward trend, due to industry initiatives and improvement of bag handling (SITA, 2016). In 2016, delayed bags accounted for 77% of all mishandled bags, followed by 16% for damaged or pilfered bags and 7% for lost or stolen bags, as shown in FIGURE 3 (SITA, 2017). Reasons for delayed bags as indicted by SITA can be seen in FIGURE 4.

Reducing the amount of damaged and mishandled pieces will not only save the industry a lot of money, it additionally results in higher customer satisfaction for airlines; since passengers do not want to experience the stress of their bags being delayed (SITA, 2017).

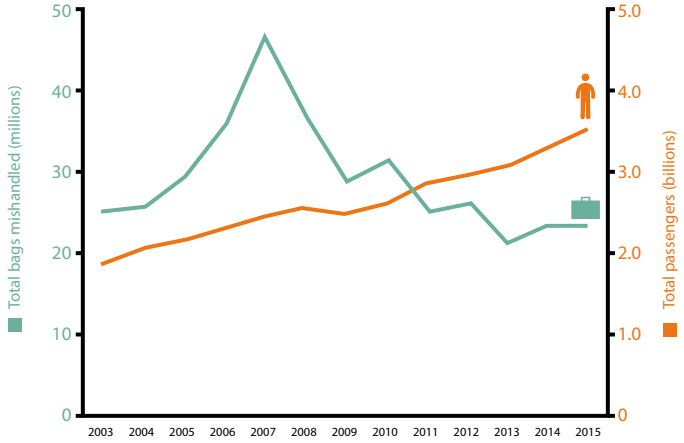


Figure 2: Passenger growth with mishandled bags rate decrease (SITA, 2016)

Figure 3: Delayed, damages or lost bags, 2016 (SITA, 2017)

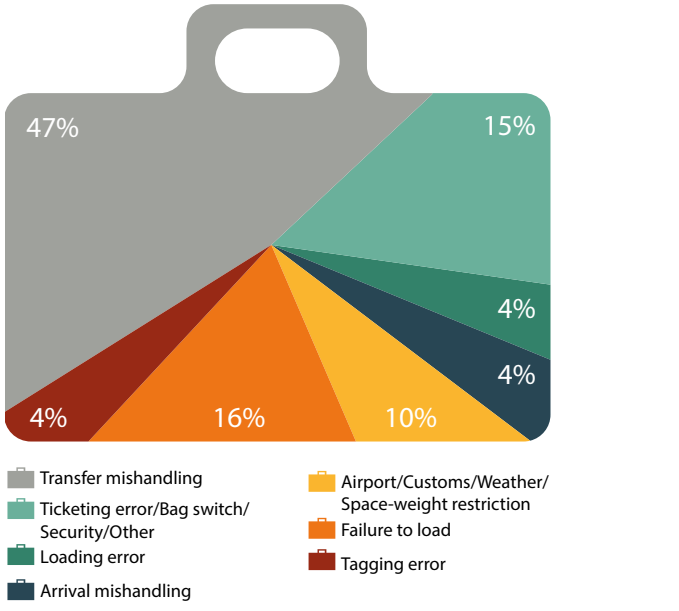


Figure 4: Reasons for delayed bags in 2016 (SITA, 2017)

Passenger experience

As for every industry, customer satisfaction is an important measure in the aviation industry. For Vanderlande the customer is on one hand the airport who will purchase their systems and on the other operators who will use it. However, in the end every industry action should serve the passenger (PAX) who is the final customer.

Therefore, it is important to understand where passenger experience positive or negative emotions during their journey, since this will influence their level of satisfaction. Research by SITA, shown in FIGURE 5, indicates that from the different steps of the passenger's journey, security, bag collection, passport control and bag drop have the largest percentage of passenger experiencing negative emotions. Research by IATA also shows that the longer passengers must wait, their level of satisfaction decreases (IATA).

Conclusion

Airports are facing capacity issues due to increasing passenger numbers. More passengers also means more baggage resulting in capacity issues in baggage and check-in halls. Since 2007 the mishandled bag rate is showing a downward trend but the number of mishandled bags has still cost the industry US$2.1 billion in 2016 and has a negative impact on the passenger experience. The four major causes of negative emotions during the passenger's journey include three that are related to baggage.

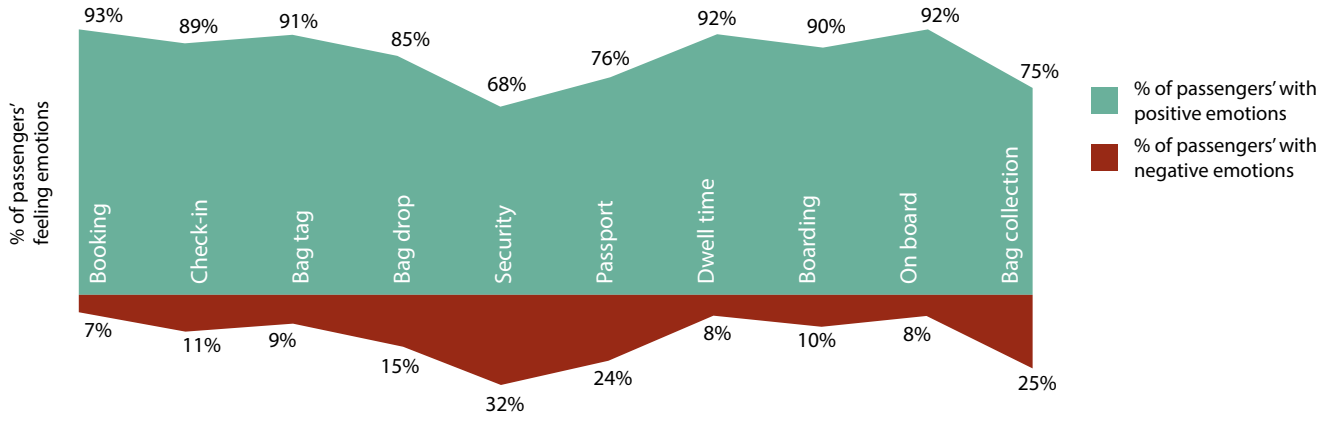


Figure 5: Emotional extremes of the PAX journey in 2016 (SITA, 2017)

Door-to-door baggage

The challenges adressed in the previous chapter form the base on which this research is build, since there would be no need for change when the industry would not be facing any challenges. This chapter will present an opportunity that could possibly solve capacity and bag mishandling issues.

When keeping the forecasted growth rate and the subsequent capacity issues at airports in mind the use of available space for airports needs to be reconsidered. The question rises what the main function of an airport is, or should be and how facilities will serve this function; what are the required operations and what are additional benefits? Functions such as check-in and baggage facilities could be removed from the airport to deal with the capacity issues. A reduction of in-airport bag handling and less check-in desk will create space for passenger throughput or commercial revenue.

To reduce the required infrastructure for baggage handling at airports, a more reliable and efficient process to transport baggage is desired. Due to emerging technologies, as further explained in "trends" on page 60, ARUP's Future of Air Travel research initiative stated that taking your luggage to the airport and waiting around a carousel could be a thing of the past (ARUP, 2016). Suggesting that bags do not need to accompany the passenger along their journey. Additionally this could enhance the previous mentioned passenger safety.

As a result of previous research within the PASSME group, FIGURE 6 shows an overview of the possible future baggage journeys expected to play a major role in the aviation industry. The image also shows the point of stress, related to baggage and experienced by the passenger during their journey. The top and bottom streams of the overview represent a door-to-door (d2d) service where baggage is transported from the passenger's home to their final destination. The two scenarios include transportation via the airport and bypassing the airport and are the ones to be further developed and delivered by PASSME, commissioned by the EU.

Current d2d and limitations

The scenario that baggage is transported bypassing the airport is currently provided by for example TravelLight. TravelLight started with transporting odd-size baggage (i.e. golf sets, bikes, ski and snowboards) using the current parcel network of TNT; serving as an interface between passengers, and the logistic provider. Where customers experienced the convenience of sending their odd-size baggage by mail, the demand raise for transporting normal bags as well. TNT indicates that one of their challenges include the pick-up and delivery times, (passengers require time-slots outside office hours) and the transfer of liability (D. van der Noll, personal communication, May 9, 2017).

Delivering a d2d service where baggage is transported via the airport is not so much happing yet. One of the issues the industry is facing is at check-in, although PostNL and AirPortr (UK) are currently able of this in cooperation with respectively Corendon Airlines and British Airways. Additionally, regulations requires that passengers are identified with their bags and must travel in the same aircraft as their bags. On the other end of the airport journey, the bag must travel through customs together with the passenger, therefore requiring the passenger to pick-up the bags from the carrousel himself.

FIGURE 7 shows an overview of several (partly) d2d initiatives currently available at the market, both in the Netherlands, Europe and worldwide. As

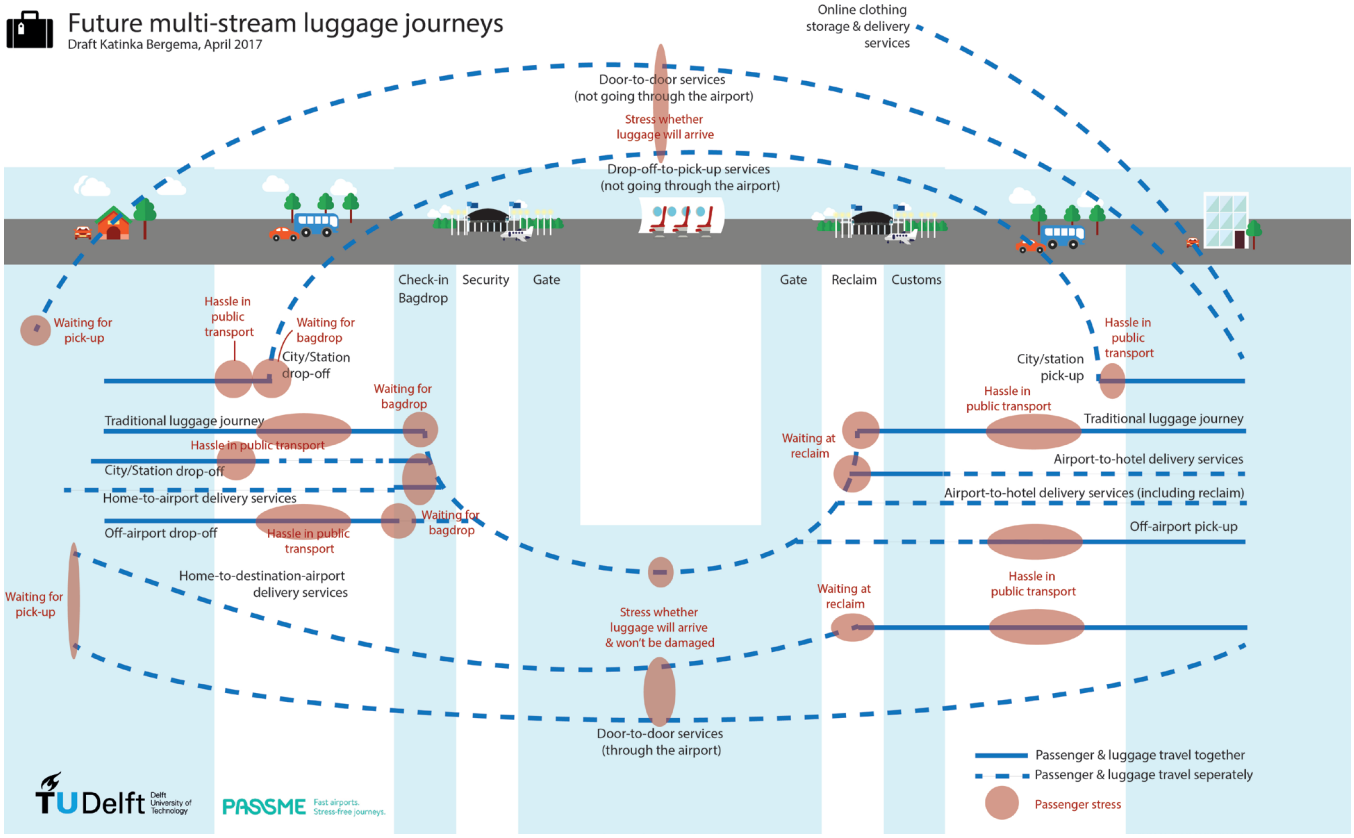


Figure 6: Alternative journeys with passenger stress (PASSME, 2017)

said, PostNL, offers a service in the Netherlands in cooperation with Corendon Airlines where baggage is transported from home to the airport (Corendon, 2017) and TravelLight offers a d2d service within Europe. For example Luggage Forward offers worldwide d2d luggage shipping, mostly (80%) using UPS, FedEx or DHL networks (Luggage Forward, 2017) and Dufl takes a completely different approach and offers a service where your clothes are stored, cleaned, packed, send and picked-up within the U.S. and some selected locations worldwide (Dufl, 2017). These d2d baggage services, could eventually lead to bag free terminals, this would also be beneficial from a security point of view.

Why is a d2d baggage service interesting for Vanderlande?

At airports a d2d baggage service could results in different bag arrival patterns and locations. This will influence the way baggage is handled throughout the systems. This will be further explained in "Baggage handling" on page 49. As can be seen from the examples, current baggage services make use of parcel logstic networks, which is Vanderlande's business as well. When baggage is transported not only via the BHS but also the postal systems, it will be interesting for Vanderlande to research where these two market segments meet. The next chapter will describe another important aspect of Vanderlande's business, namely process automation. It will show how a d2d baggage service could enable further automation of the process by means of a standardized bag.

Conclusion

There are multiple examples of door-to-door baggage service available on the market. However, a d2d service through the airport is not so much happening yet. For PASSME d2d services (via the airport) are one of the focus point for further research. For Vanderlande it is interesting to research where their separate market segments are coming together.

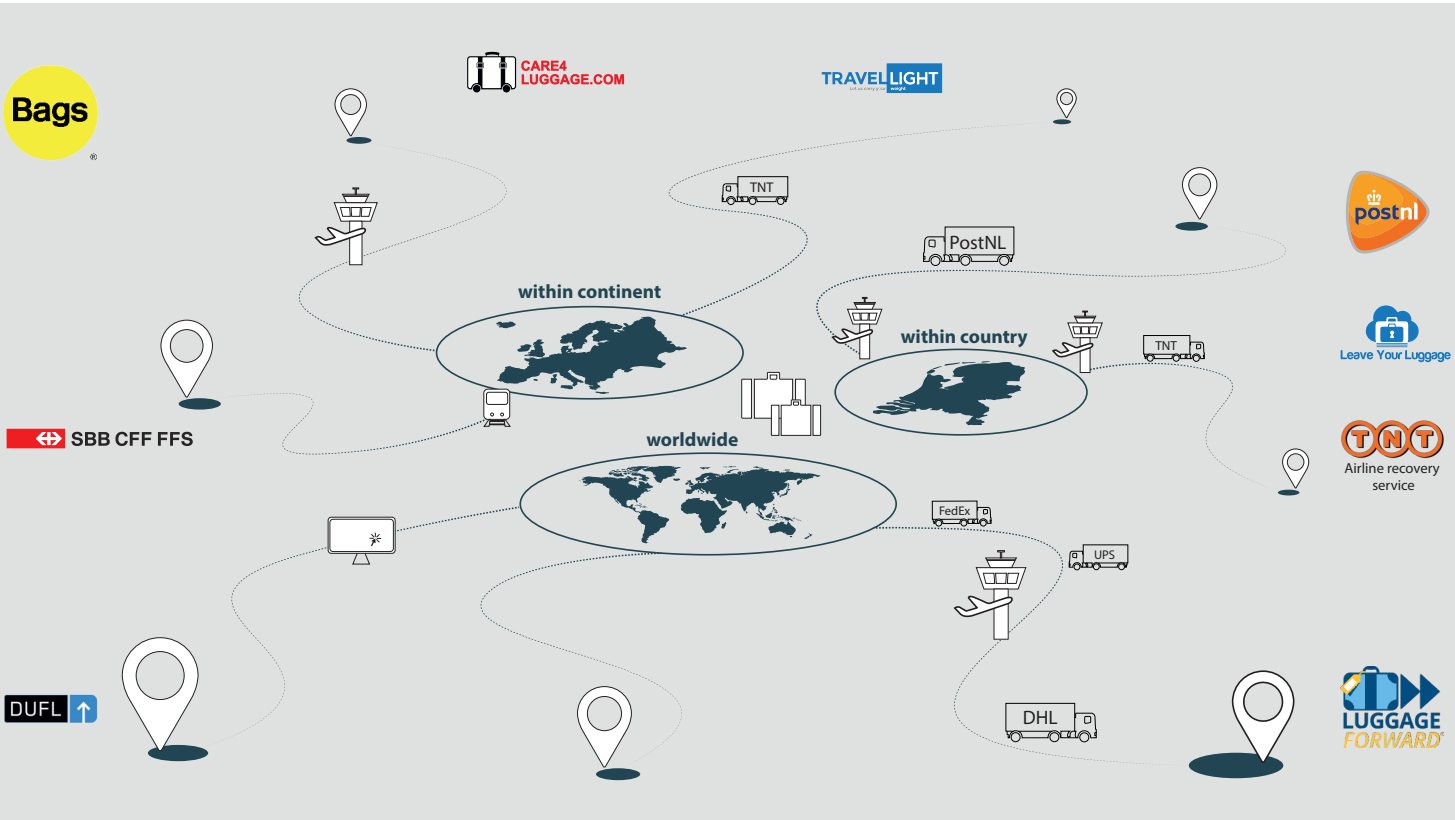


Figure 7: Current d2d initiatives

Automation

Accompanied by Vanderlande's vision to be world leader in automated material handling solutions, investment in automated baggage at airports is among others driven by the passenger growth worldwide. And therewith, the need to facilitate more transfer flights with shorter connection times. These developments require high capacity baggage handling systems and accurate track-and-trace of bags (Vanderlande, 2017).

Figure 8: Standardized suitcases

Current bags are a limiting factor in system efficiency and current baggage processes due to the diverse collection of bags with multiple shapes, materials and sizes. Handles, straps and wheels could get stuck in the systems, resulting in bag jams, which means system downtime. Vanderlande aims to improve overall system availability by a reduction of the number of mishandled bags.

Regarding mishandling, Vanderlande indicates that most errors happen during manual interaction with baggage. Automating a process lead towards less manual handling, i.e. less errors since decision are made more accurate and consistent than human operators. Therefore, it increases system efficiency. One way of automation can be found through Vanderlande's high-speed baggage conveying system, called TUBTRAX, presented in FIGURE 9. Here bags are carried by an assigned tub. By introducing this tub, Vanderlande created a system where the bag and tub form a universal carrier where only the weight differs

Figure 9: TUBTRAX conveying system (Source: Vanderlande)

which can therefore be transported by the system more efficiently.

Current bags are also not space-efficient. When for instance stored in a Unit Load Device (ULD), as can be seen in FIGURE 10, it involves transporting a lot of air, i.e. unused space. ULDs are used to enable the loading and unloading of bigger aircrafts by consolidated the bags. These standard preloaded containers enable automated loading and decrease loading time, however ULDs require extra fuel for the aircraft; since extra weight requires extra fuel.

When the luggage is picked up at the passenger's home and delivered at the final destination, i.e. d2d transportation, passengers do not have to drag their bags themselves anymore. Where Vanderlande is working on process automation, it would be benefical to standardize the bag, since it increases the efficiency of their systems. A standard bag would take the standardized tub even one step further.
Benefits of automation through standardized bags are optimization of system availability, reduced (labour) costs, improvement of process quality by preventing bag jams (since there are no jam sensitive bags)and more efficient use of space (Roza, 2017). Additionally, automation and therewith less manual handling will improve employees' working conditions and reduce health related costs, since there would be less need to lift 25kg bags all day (Vanderlande, 2017). Furthermore, it would improve bag security with less hands on the bag (e.g. less possibilities for pilfering).

Conclusion

The previous proposed d2d service could facilitate standardization of bags. This will lead to higher process automations resulting among others in more efficient systems and less mishandled bags.

Figure 10: Unit Load Device (Source: Vanderlande)

Chapter 2

Research Design

Research Question

From the previous chapter, it has become clear that Vanderlande's goal is to optimize their BHS and current bags are a limiting factor to optimize the BHS. A door-to-door (d2d) baggage service, where baggage is transported from the passenger's home to their final destination, is one of the future streams researched by PASSME to reduce airport capacity issues, which is beneficial considered the passenger growth forecasted. This d2d baggage service could enable standardization of bags, which will lead to process automation and therefore higher system efficiency. However, the focus on service level and passenger satisfaction need to be kept in mind.

When introducing a d2d baggage service with a standardized bag of course other parties and systems are affected by it as well. Vanderlande indicates that there are many stakeholders part of the current baggage handling process and each party is having its own interest. When implementing a standardized bag to help the whole industry to operate more efficient and reliable the complete context must be clear. This context includes among others baggage flows, stakeholder interests and stakeholder requirements. On the other hand, a standardized d2d service will also have consequences for the industry.

Before this d2d service with standardized bag can be realized, it is important to understand both the requirements and consequences of this standardized bag within the industry. Therefore, the research question is as follows:

When moving towards an optimal baggage handling system (BHS) for a door-to-door (d2d) baggage service with a standardized bag,

(1) what are the requirements from the process and the stakeholders within the process on the bag

and

(2) what are the consequences of standardization for the system and the stakeholders?

The standardized bag is hereby taken as a starting point. Figure 11 shows a visual representation of this research question. The interaction between the requirements and the consequences is the goal of this research.

Potential benefits for passengers

As indicated before, every industry action should in the end serve the passenger who is the final customer. When no advantages for passengers could be found in advance, it is not likely the service will be realized. Therefore the following list gives an initial indication of potential passenger benefits for a d2d service with standardized bag.

- No storage of case at home
- No dragging bags (through crowded places)
- Les damaged and lost, stolen or missing bags
- No line for bag drop
- No waiting at carrousel for pick-up
- Higher bag security (less human interference)

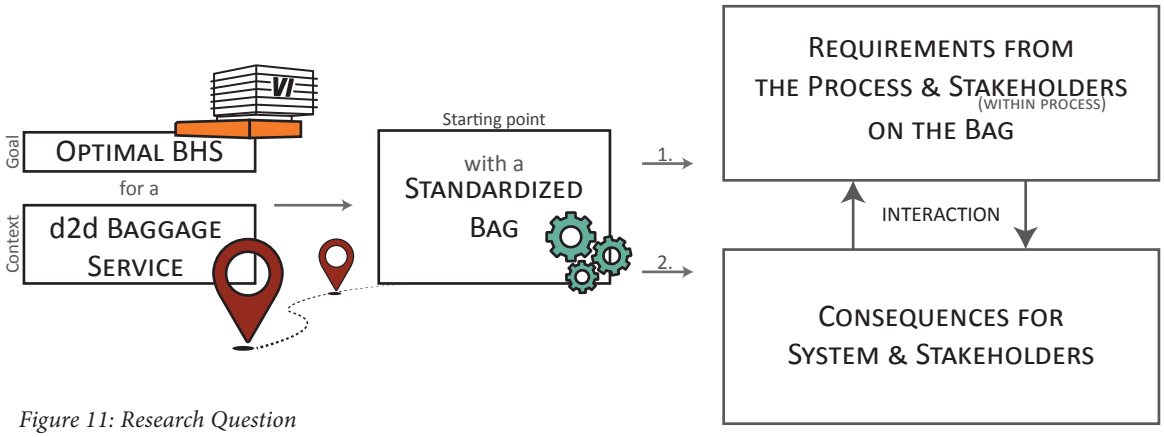


Figure 11: Research Question

Method

The aim of this research is *to define the interactions between requirements from process and stakeholders and consequences for system and stakeholders when introducing a d2d service with standardized bag*. Therefore it must be clear whom these stakeholders are. A key characteristic of services is that they are coproduced by people, and that they create value during their use (Polaine, et al. 2013). Therefore, it is important to understand which stakeholders coproduce the d2d service with standardized bag, and what value it will bring to both passenger and other stakeholders from the industry. In order to get this understanding semi-structured interviews with eight external parties are executed:

Airport • Logistic provider • Bag manufacturer • Ground handler • Baggage service provider • Public transport • Airline

To goal of these interviews was versatile: to understand their core business, their position in the industry and their interest in a d2d service possibly with standardized bag.

The interviews are used as a qualitative data collection method. To prepare for these interviews, interview guides were made including industry general and company specific questions. After each interview the interview guide was updated. One example of the interview guides can be found in Appendix A.

Since the standardized bag is defined as a starting point for this research, counterfactual reasoning (What if "standardized bag") was used to understand what the effect of this standardized bag could be for different stakeholders. The interviews were recorded and transcribed. In two cases a summary of the transcription was sent to the interviewee to allow corrections and additions. The data was interpreted which results in a description of relationships. Furthermore, an understanding of the core business has been used to describe current passenger and baggage journeys as well as possible future journeys. An overview with conclusion for each of the interviews is included in Appendix B.

The parties that have been interviewed can be found on the next page. The interviews took place between March and May 2017 on several locations in the Netherlands. Each interview took around 1h-1,5h.

During this research the interviews have been an important mean for data gathering, as well as for gaining a first understanding of the context of the aviation industry. Based on the interviews the research evolved in different phases as will be explained in the next chapter. Within each of these phases there were several other methodologies used to acquire the right information and generate insights from the analyses. These methods are presented per phase in the next chapter and explained in more detail in the corresponding chapters as presented in the following list:

- Journey mapping; in "PASSENGER JOURNEY" ON PAGE 36
- Stakeholder map; in "STAKEHOLDERS" ON PAGE 44
- Function analysis; in "BAGGAGE HANDLING" ON PAGE 49
- Trend analysis; in "TRENDS" ON PAGE 60

Development phases

A d2d service is not something new, respected the examples given of parties who are already providing this (see Figure 7 on page 23). These examples of d2d services are built within the current network and processes. However, the current parcel network is not build for large quantities of bags (D. van der Noll, personal communication, May 9, 2017) and, as indicated before, a d2d process through the airport is limited by regulations such as custom clearance.

During the interviews, it became clear that a d2d service with standardized bag cannot be easily implemented within the current network, even more within the current network of d2d services. To be able to implement a standardized bag in a future d2d service, three phases of development will be described based on a case study as presented by Orlikowski, (2002): a current situation, a next situation and an afternext situation.

The current situation is described without the presence of d2d services, being the traditional way of transporting baggage. The next situation is defined as a door-to-door baggage stream and the afternext situation is envisioned as a d2d service with standardized bag, which was the initial assumption for this research.

The three phase are defined for this research to help the industry to move forward and successfully implement the afternext within the next. Based on the analysis of the current situation, a vision for the afternext will make clear which action should be taken for every stakeholder into the next phase of d2d services to easily implement the afternext situation being a d2d service with standardized bag. Therefore, after a description of the current a jump towards the afternext will be made. When envisioning an afternext situation, actions towards the development and testing of the next situation can be taken.

Figure 12: Development phases

Current

A description of the current situation is given by means of a passenger and baggage journey, a stakeholder map, a function analysis of baggage handling systems and a trend analysis of trends that are seen withinin the aviation industry. These methods for analysis are sortly described at the start of the corresponding chapter, more detailed descriptions can be found in the Delft Design Guide (2016).

This description of the current situation will conclude with listing important design inputs for a standardized d2d service in three categories namely; passenger, network and system. After the current the step to the afternext is made, bypassing the next development phase.

Afternext

The analysis of the current situation is used as input to create a vision for the afternext situation. Lloyd et al. (2006) presented a vision as "a view on something to come". Stating that a vision on interaction, product and service levels will predict future human-product/ service relationships.
Based on the vision created for the afternext an interaction loop model is designed. This model is based on a model as presented in a study by Van Oorschot et al. (2013).

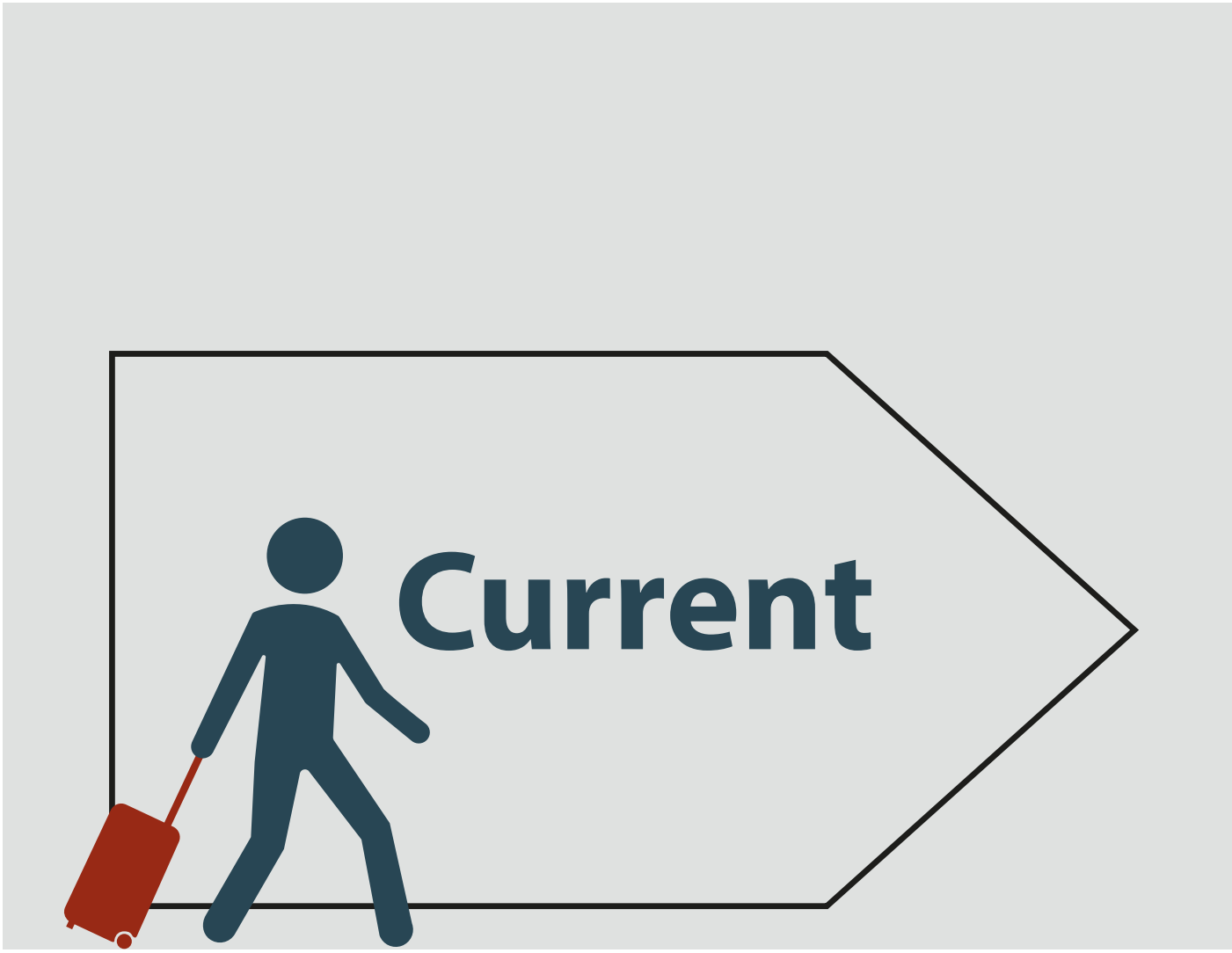
The afternext will first be based on the scenario that the baggage is traveling through the airport, since there appeared to be more parties involved who make the process more complex.

Next

After further development, analysis and verification of the afternext, action to be taken within the next will appear. Key challenges or boundaries that are foreseen within afternext situation can be described to be able to resolve or act on them. These can be seen as opportunities for development.

The icons from FIGURE 12 are used as a reading guide and repeated throughout the report to indicated the phase that is discussed on that specific page. Starting with the current situation.

Chapter 3



Introduction

The goal of this chapter is to explain all important aspects of the current aviation industry which will possibly influence the design of the afternext service.

Journeys

The first part of the current gives a visual representation of the passenger's journey. Everyone who has travelled per aircraft has probably experienced a similar kind of journey as presented in FIGURE 13 ON PAGE 37. For the continuation of this research the steps of the passenger journey which involve baggage are particularly interesting. Next to the passenger journey the baggage journey can be found. For passengers this is the more unfamiliar part of traveling. What happens when the bags are dropped off at the airport and the kind of processes supporting the journey of the bag are represented in FIGURE 14 ON PAGE 42. A detailed description of the baggage handling process can be found in the baggage handling section which is presented after the stakeholder section.

Stakeholders

As mentioned before, the current process of baggage handling includes many stakeholders. Based on the interviews a stakeholder map was created, showing what kind of interactions stakeholders share. These stakeholder interactions are often part of passenger services and even though services are intangible and invisible, there is still evidence that the service exists. Shostack (1982) distinguished two types of service evidence: peripheral and essential evidence. “Peripheral evidence refers to the tangible elements consumers can possess but that have little independent value, (e.g. tickets for airline services). Essential evidence, (e.g. aircraft), has an important role in the evaluation of the services purchased but cannot be owned by consumers.” (Secomandi and Snelders, 2011). The evidence of the stakeholder interactions are included in the stakeholder map as can be found in FIGURE 17 ON PAGE 46.

Baggage handling

When it has become clear which parties are involved in the passenger and baggage journeys, the baggage handling process will be furter explained by means of a function analysis, presented in "BAGGAGE HANDLING" ON PAGE 49.

Trends

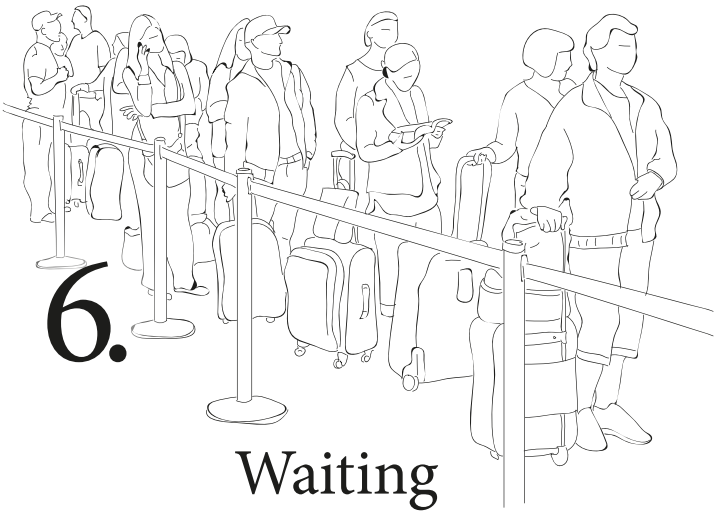
The last section of the current will include a trends analysis. First the trends that are seen within the aviation industry are combined in a drawing (FIGURE 42 ON PAGE 58) after which they are explained in further detail.

Current

Passenger journey

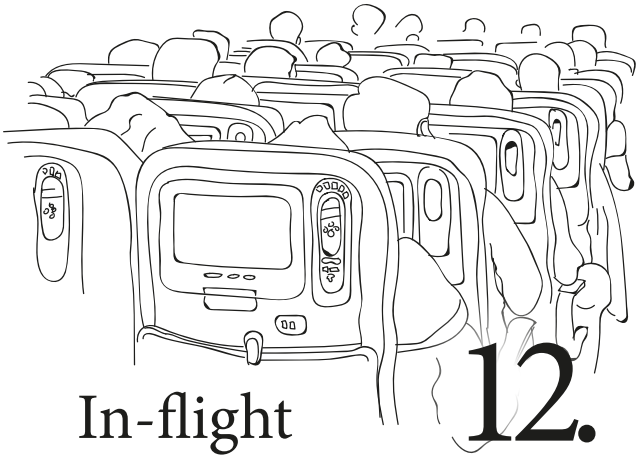
The overview presented on these pages show the main steps of the current passenger journey. As presented in the Delft Design Guide (2016) a journey map is a graphic representation of the stages a customer goes through, in this case the passenger. During each stage passengers experience emotions, goals, interaction and barriers, which could be included in the journey map. This method helps to design products and services that will add value for users and companies providing them.

During this project the passenger journey map is first of all used to gain an understanding of the complete process a passenger goes through while traveling. In "Stakeholders" on page 44 it will become clear what interactions passengers have.



6. Waiting

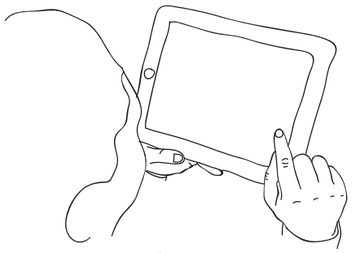
Baggage in overhead bins 11.



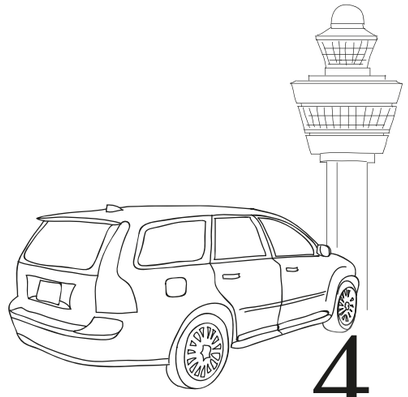
In-flight 12.

1. Search
and book

2. Packing

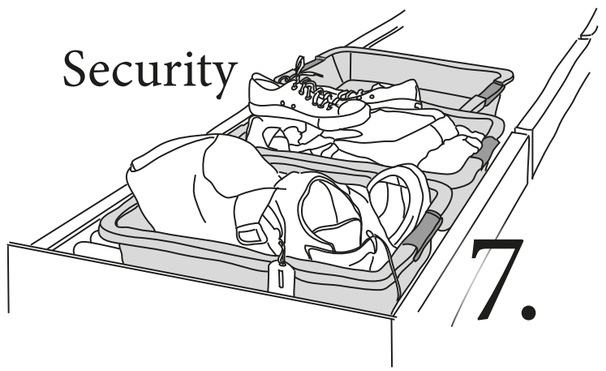


Online
check-in 3.



4. Transport
to airport

Desk check-in 5.
and bag drop

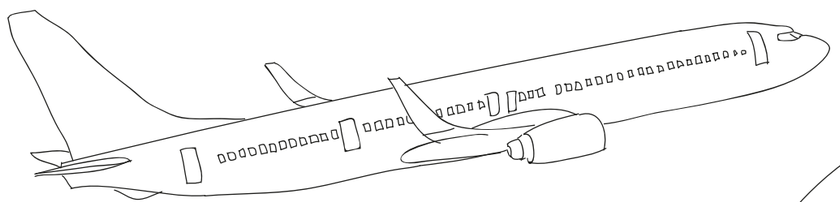


Security 7.

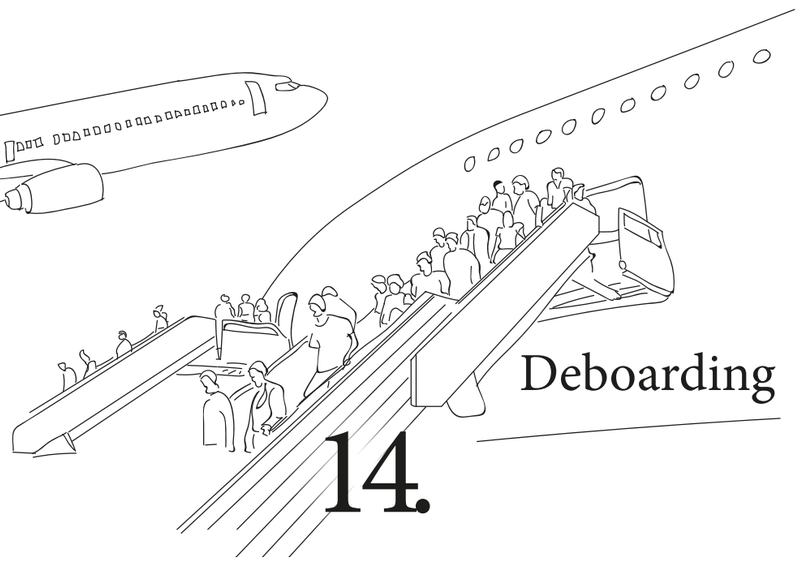
Shopping 8.

Waiting
(gate) 9.

Boarding 10.



Transport
through air
13.



Deboarding
14.

15. Reclaim

Leave airport
and continue journey

16.

Figure 13: Current passenger journey

Hold baggage

The steps within the passenger journey related to hold baggage are most interesting for the continuation of this research, since these steps might change when introducing a d2d service. As can be seen from the images in Figure 13 there are five steps in the passenger journey that are directly related to hold baggage:

2. Packing
4. Transportation to airport
5. Desk check-in and bag drop
15. Reclaim
16. Leave airport and continue journey

Some of these steps also include waiting before the corresponding action can be executed. For example, at reclaim you have to wait untill the bags are unloaded from the aircraft and loaded onto the reclaim conveyer. Whether positive or negative, these steps of the journey will change when introducing an afternext service. Also check-in and bag drop often include waiting, especially during airport peak hours.

Some other steps are indirectly related to hold baggage. These include boarding (10), de-boarding (14) and the time passengers spent between bag-drop and boarding (6-9). These will be further explained in the next section where the baggage journey is presented.

Passenger satisfaction

This project includes both product design (standardized bag) and service design (d2d) elements. Where products are tangible and visible, services are the opposite. Airlines can for instance be identified as service providers, due to the large number of intangible elements. According to Edvardsson and Olsson (1996) "it is the customer's total perception of the outcome which 'is the service'". This indicates why it is important for the industry to focus on passenger satisfaction: their perception will determine the service. Since the passenger is the final customer of the afternext service, their current journey is important to understand the possible impact of the afternext.

However, while the passenger is at the center of the research topic, further passenger research has not been executed in this research since to focus is on the baggage handling. Information that was needed was taken from previous PASSME research. Also the journey in Figure 13 is created based on previous research by PASSME as well as common knowledge.

Conclusion

The passenger journey includes several steps that are related to hold baggage. These steps are again related to most of the passenger's waiting time at the airport.

Although the passenger is the final customer, and the focus on passenger satisfaction is important for the whole aviation industry, no further passenger research has been included in this study.

Baggage journey

Baggage is having a journey of its own. But most passengers have no idea what happens to their bags when dropped-off at the airport. Figure 14 on the next page represents the baggage journey in sixteen steps. For this overview a general process is described. However, it might be clear that the process may differ per bag (e.g. mishandeld bags) or per airport (e.g. airport size as will be further explained in "Baggage handling" on page 49).

The steps of the baggage journey as presented in figure 14 are explained by means of a function analysis in more detail in "Baggage handling" on page 49. Since the journey does not always start at home, e.g. return journey, the start of the journey is referred to as origin and the end of the journey as destination.

Baggage journey

After the passenger has dropped his luggage at the airport, a whole range of processes will follow. Five main process steps can be identified from the drawings presented in FIGURE 14:

5. Scanning
7. Screening
8. Sorting
9. Storage
11. Make-up

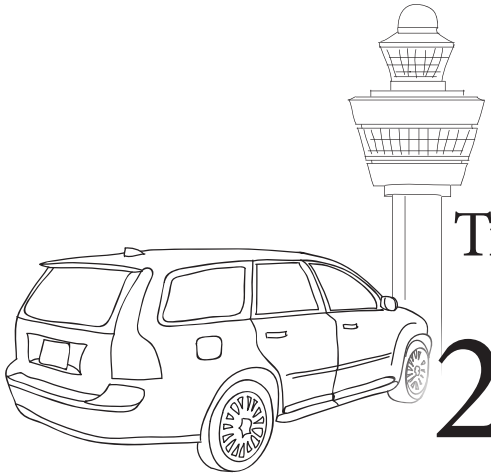
Between each of the steps bags are transported by means of conveyors or carriers (such as a TUB).
As said, each step will be explained in depth in "BAGGAGE HANDLING" ON PAGE 49.

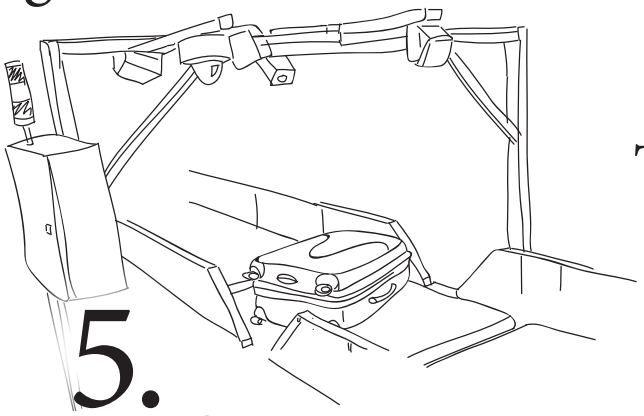
It was previously said that some steps of the passenger journey are indirectly related to the baggage journey, for instance, after passenger have dropped-off their baggage. When the passenger is waiting, going through security or shopping at the airport, bags should be stored somewhere. Therefore the airport needs some sort of buffer in the system, since not every bag will be handled directly. Especially when passengers arrive early (or in case of a long transfer), there is on one hand more time for handling, on the other hand it requires extra space.

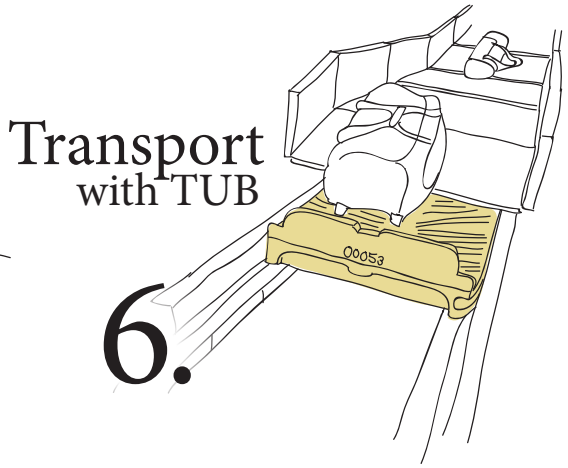
Another important step, directly related to the passenger's journey is at boarding. Regulations require that passengers and their bags must travel in the same aircraft. Therefore, a bag is only loaded onto the aircraft when it is confirmed that the passenger is boarding as well. Therewith, step 13 of the baggage journey (loading into aircraft) is indirectly related to step 10 (boarding) of the passenger journey.

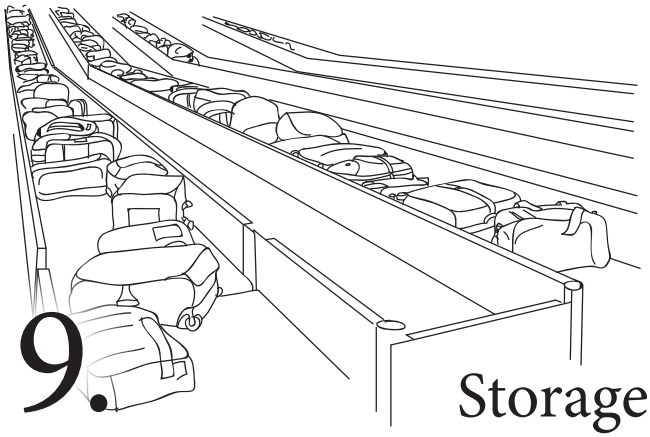
Conclusion

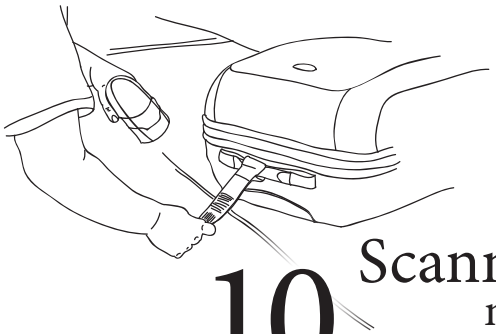
Most of the baggage journey is invisible or unknown to passengers. However, passenger and baggage journeys are closely related. This could be either direct or indirect. Five main process steps are identefied within the baggage journey which will be explained later on.

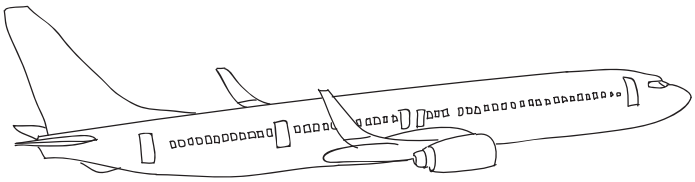












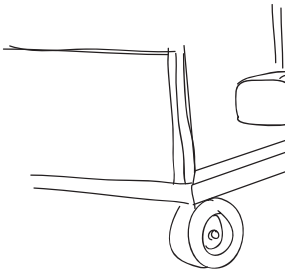
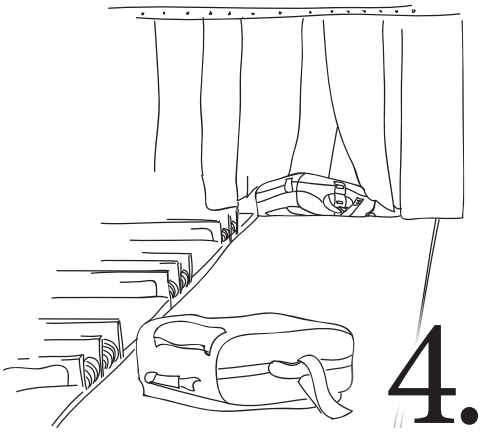


Figure 14: Current baggage journey

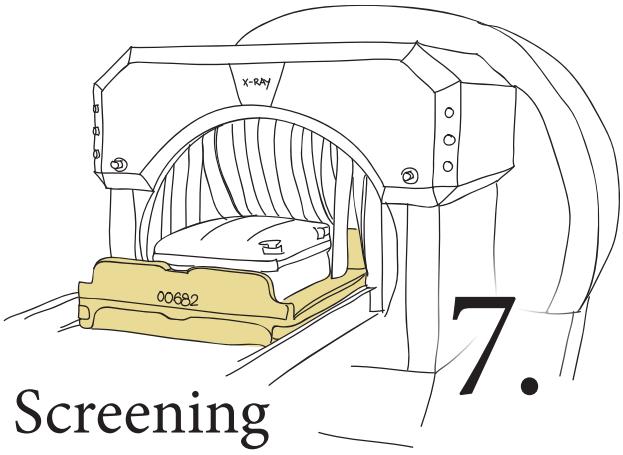
Tagging

3.



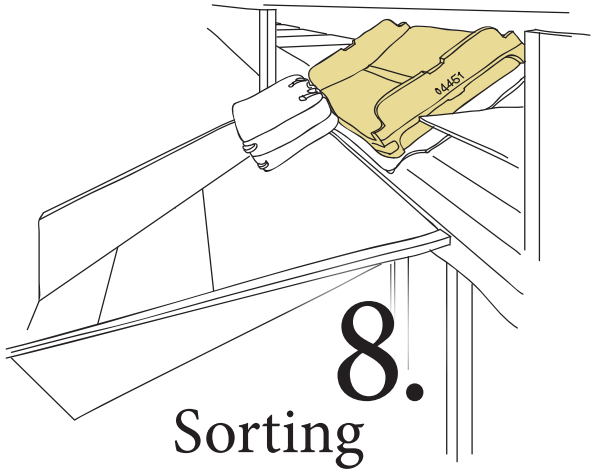
4.

Feeding
into system



7.

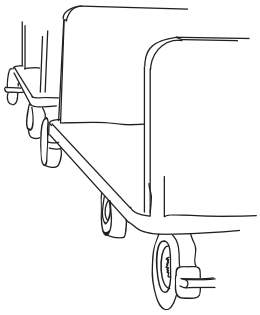
Screening



8.

Sorting

11.



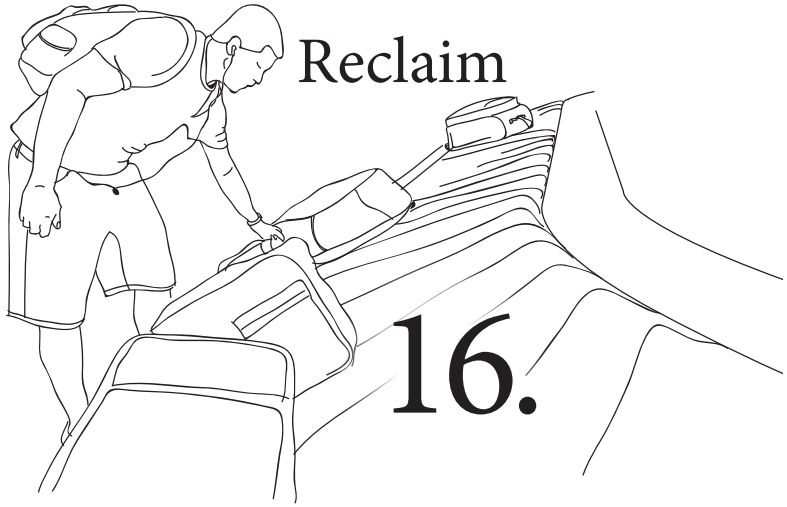
Make-up
trolley

Transport
to aircraft

12.

Unloading
aircraft

15.



Reclaim

16.

STAKEHOLDERS

During each step of the passenger journey, passengers have multiple interactions with several stakeholders involved in the process. In 1963, the concept of stakeholder was described by the Stanford Research Institute as "those groups without whose support the organization would cease to exist" (Friedman, Miles, 2006). In 1984 stakeholder was further defined by Freeman as "can affect or is affected by the achievement of the organization's objective" (Freeman, 2010). Based on these definitions, stakeholders are in this research within the context of a d2d service, referred to as the parties who support, facilitate, affect or are affected by the specific steps of the passenger journey, thus have an interest in the d2d service. Through stakeholder mapping (FIGURE 16), based on Morelli (2009), the stakeholders identified during the

Figure 15: Stakeholder map related to the passenger and baggage journeys

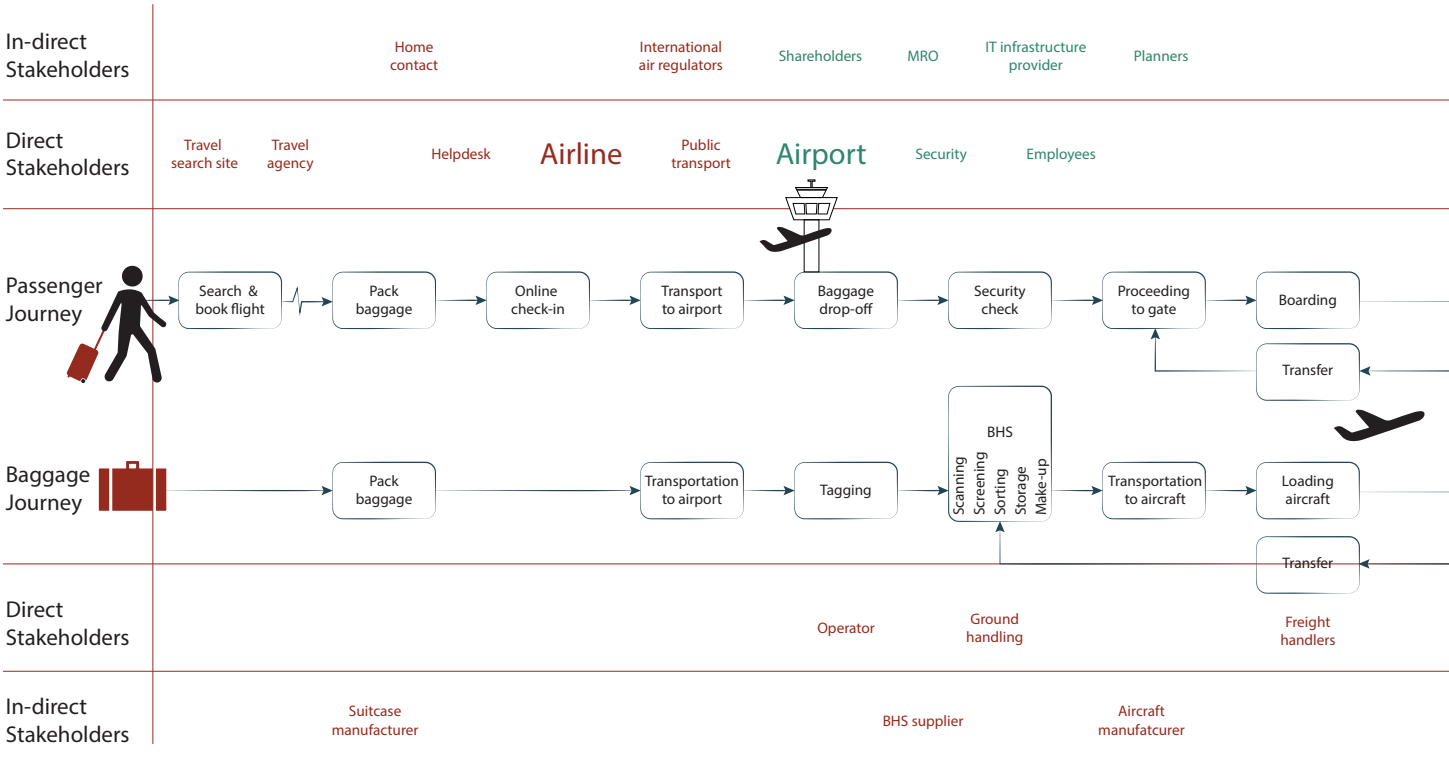
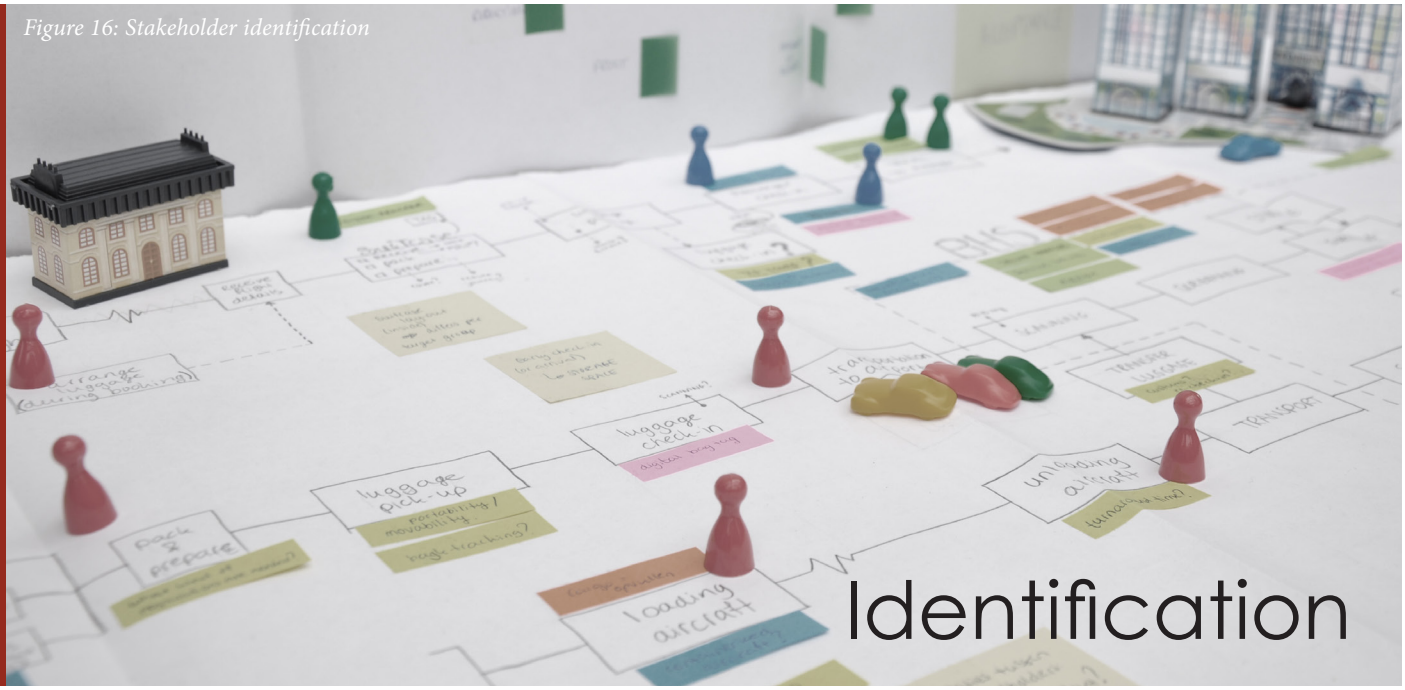
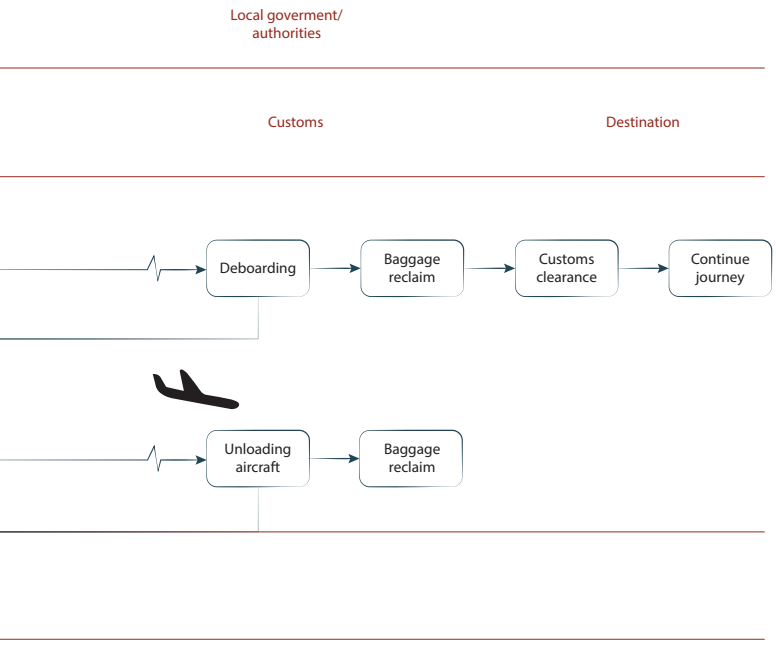


Figure 16: Stakeholder identification



interviews can be found in FIGURE 15. A distinction has been made between direct stakeholders and indirect stakeholders, that have either direct or indirect passenger or bag contact. The stakeholders presented in green are related to the airport.
Stakeholders that are reoccurring throughout the journey are only mentioned once, however all passenger journey stakeholders are either direct or indirect present in the baggage journey as well. In general, important stakeholders are customers, suppliers, transport companies, consumer organisations and legislators.

The stakeholders that are most interesting for this research are explained further in the next paragraph "INTERACTIONS" ON PAGE 46.



Fragmented process

Accooding to BaaS (2016), the current process of baggage handling is fragmented over parties, which makes the process inefficient and time consuming. Vanderlande also indicates that the variety of stakeholders makes the baggage handling process more inefficient. An example of this fragmented baggage handling process is given below.

Vanderlande's direct customer is the airport who acquire their BHS. With that, the airport becomes the owner of the BHS. A passenger books his flights with an airline and the airlines becomes responsible of the transportation of their passengers' baggage. However, airlines hire (ground) handlers to process the baggage and these handlers are operating the BHS. Ground handlers do not have contracts with airports, however they do have operational agreements. And finally, both airline and airport do not know how much baggage (weight) and types of baggage they can expect until passengers check-in their bags.

Stakeholder Interactions

The passenger and baggage journeys are linear processes as shown in the previous sections. Figure 15 on page 44 showed which stakeholders are part of each step in the process. However, the stakeholders not only interact with the baggage or passengers during the process but stakeholders also have mutual interactions. Each of these interactions can be described differently and together they frame a complex network. Based on the stakeholder interviews (see "Method" on page 30) figure 17 shows this complex network and the interaction among stakeholders currently taking part in the process. The interactions are further specified in figure 18 to figure 21. Just as the linear overviews, the passengers are always seen as within their origin and therefrom traveling to their destination.

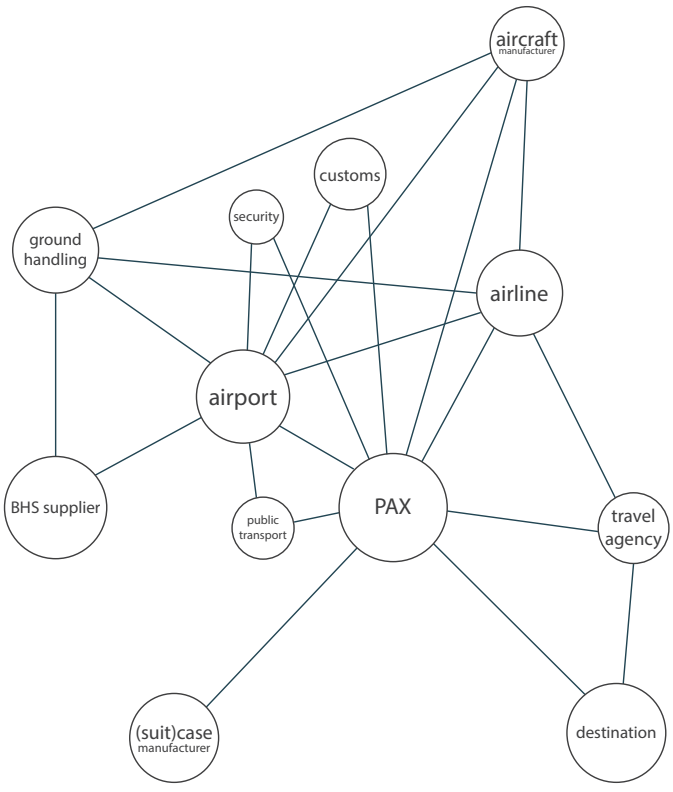


Figure 17: Stakeholder network

Within this overview, security and customs are presented as separate stakeholders. However, they could also be seen as part of the airport, whereby customs is a separate entity, operating independently. One stakeholder, not presented in the overview, but having major impact on the whole industry are legislators and authorities. They can be seen as an umbrella party, interacting with every party presented. Adding all these interactions to the model would make the overview more complex to read. However, they should not be neglected.

The parties presented in this overview are the ones that are likely to be affected by a d2d service, can influence the service or are expected to be needed when developing the service. Of course, there are other parties involved, of which some are mentioned in figure 16 on page 45. These parties are mostly inlcuded in one of the presented stakeholders, if not they do not directly add to the goal of this research.

Type of interactions

As said, each interaction between the various stakeholders can be described differently. The coloured lines in the images on the right page indicate whether the interaction is represented by either physical goods (figure 18), physical space (figure 19) personal encounter (figure 20) or digital services (figure 21). This does not mean that the interactions are limited to the ones displayed, however, these are the most important or present ones.

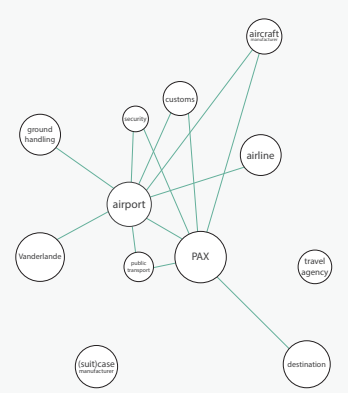


Figure 19: Stakeholder network, physical space

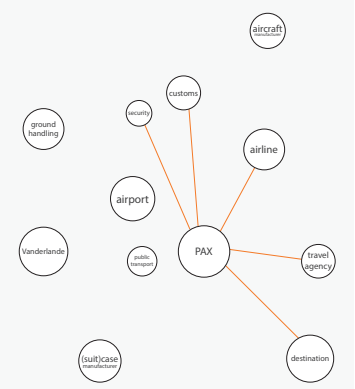


Figure 20: Stakeholder network, personal encounter

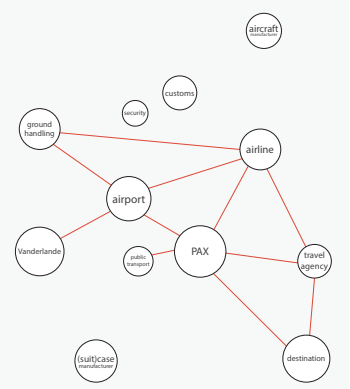


Figure 21: Stakeholder network, digital services

Physical goods are defined as products or services you can buy. FIGURE 18 shows the products (aircraft, BHS, suitcase) and evidence of services (ticket) which are shared. The service between airport and travel agency are not presented here, these interactions are a little more complex since the airport and travel agency services are not nececarraly paid for directly by passengers, but are often indirectly included in tickets. Some airport services however, such as parking could be included but are less important for the continuation of this research.

FIGURE 19 indicates interaction based on physical space. Physical space is defined as something you can experience. These interactions can mainly be found around the airport.

The personal encounters, presented in FIGURE 20, are based on the interactions passengers have during their journey. Therefore these interactions can only be found around the passengers. Since they are the final customers it is most interesting to see by whom their journey experience is affected.

The last typ of interactions can be found in FIGURE 21 and represent digital interactions. Of the digital interactions shown, the most (passenger) data exchange happens between airline and airport.

When designing a service in such a network it is important to manage and shape the relationships between stakeholders so all can win continuously over a long period of time.

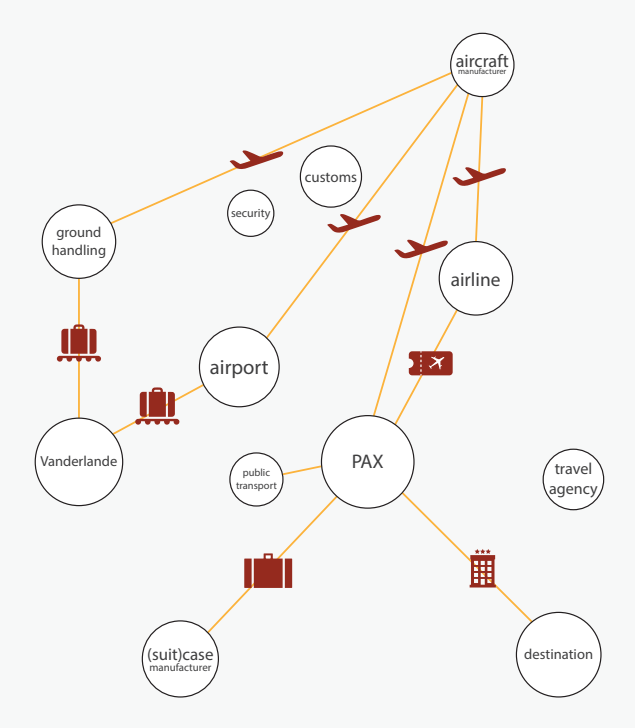


Figure 18: Stakeholder network, physical goods

Conclusion

There are many stakeholders part of both the passenger journey as well as the baggage journey. The stakeholders do not only interact with the passenger or the baggage, they also have mutual interactions. There are different type of interactions of which four have been shown. Between some parties, multiple types of interactions can be described. When introducing the afternext service, some of these interactions will change or disappear, also new ones will appear.

Baggage handling

When taking a closer look at current baggage handling processes at airports several steps can be identified, being: scanning, screening, sorting, storage and make-up. Each step has its own function and to be able to (re)design a d2d process it must be clear which functions the system currently fulfils and why these functions are necessary. As presented in the Delft Design Guide (2016) a function analysis is a method for analysing and developing the function structure of an existing product or new product concept.
Products are designed to fulfill certain needs, the functions analysis helps to describe the intended functions of the product and identify the corrosponding need. In this chapter a detailed description of the baggage handling journey as presented earlier in figure 14 on page 42 can be found. Schedules of the function analysis can be found in appendix c. Since the information presented in this chapter is based on personal communication within Vanderlande as well as internal company documents, no further references are given, except when indicted otherwise.

Main process functions

Every baggage handling system requires check-in (Figure 14.3) and flight make-up (Figure 14.11), respectively the place where bags enter the system and leave the system. The function of the whole BHS is considered to ensure the right bags on the right flight in time. This asks for right handling and right handling can therefore be seen as a prerequisite for the whole BHS. To enable right handling the bag is first identified by scanning the bag. To ensure the right bag on the right flight the BHS also requires sorting of bags (Figure 14.8). Not every process step is dedicated to the main function; namely the screening process does not add to this. But due to among other regulations this step cannot be neglected. Therefore, BHS have a multilevel screening process (Figure 14.7). When bags arrive early into the system, they will be stored until further handling, hence the storage function of the BHS (Figure 14.9). Throughout the system, between these process steps, bags are transported by means of conveyor belts or bins such as Vanderlande's TUBs (Figure 14.6). A function analysis gives the opportunity to evaluate all these process steps and see where it can be modified and changed in the case of a d2d process with standardized bag, both time and location wise. Vanderlande's challenge is to incorporate these functions and processes while still optimizing the passenger experience.

In this chapter every process step will be explained, as well as some additional themes such as aircraft types.

Check-in and Scanning

When entering the handling system, a bag is scanned to identify the bag to ensure right handling. Throughout the process the bag is scanned again which results in the bag's track-and-trace. To ensure identification of the bag a tag is required. The moment of scanning can be executed either manual (FIGURE 25) or automatic (FIGURE 26).

Baggage handling includes a high level of manual labour. However, baggage should be exposed to manual handling for a minimum amount of time, since this would reduce the mishandled bag rate and improve bag security. Currently, next to moments of manual scanning the conveyability of a bag is mostly checked by operators (FIGURE 27). This conveyability check happens at the check-in desk being the frontend of the BHS. The conveyability of a bag is an important measure to prevent system jams (downtime) and damage to both bags and systems. When this step is automated, a 3D scan of the bag is made to analyse and assess dimensions and characteristics such as wheels, handles and straps. At the frontend of the system, the weight of the bag is registered as well. This information is important to settle overweight, which will be further explained further down this chapter.

Based on the conveyability check, bags are separated within several categories of operations. These categories are defined by IATA in their Baggage Identification Chart (IATA Resolution 743b). This chart is included in APPENDIX D-1. In addittion, APPENDIX D-2 shows which number from the chart fits which type of baggage. The categories are presented on the right page.

Changing functions

Current check-in (CI) functions are changing. Where the CI used to be a physical desk where the passenger confirmed his booking and arrival at the airport, now passengers are checked in online. The point where passenger and luggage are separated is not necessarily at a CI desk anymore. From the former CI function one important thing remains: the exchange of information, being: the gate, seat number and the exact weight of luggage.

System capacity

When entering the system, it is also important to know whether the bag is urgent or non-urgent. Airports need to deal with unpredictable passenger arrival patterns as well as irregular flight arrivals and with that also an irregular number of transfer bags. FIGURE 22 shows a typical bag arrival pattern. At check-in, time critical bags, also referred to as 'hot' bags need to be separated from the normal (warm) and early (cold) bags and transported to the aircraft right away.

Systems are currently designed for redundancy, since the design capacity of the system is the peak, although it is beneficial to have a continuous system supply. This can be achieved by peak shaving, i.e. to spread baggage over a longer period of time. This would also improve the availability of the BHS, which is an important measure since as less downtime as possible is required.

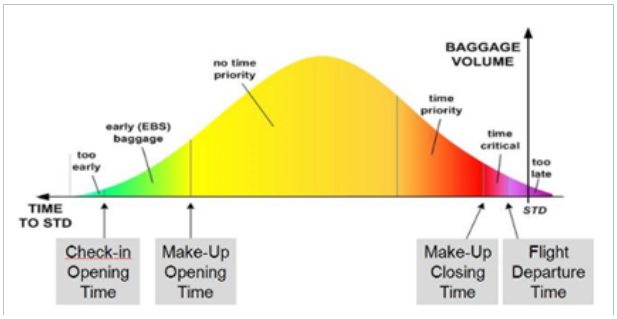


Figure 22: Bag arrival pattern (Source: Vanderlande)

Figure 23: Normal conveyor (Source: Vanderlande)

Figure 24: High speed stransportation system (Source: Vanderlande)

Categories of conveyability

1. Standard baggage; bags that can be handled on all equipment in the BHS. This baggage can be transported over normal conveyors (Figure 23) and high-speed transportation systems (Figure 24). There are a few requirements regarding the positioning of the bag: at check-in, baggage is presented in the upright position (Figure 14.3), after this point, the bag must be in laying position to be transported by the main part of the BHS. Bags on wheels for instance are unstable and cause problems on decline and incline conveyors (i.e. conveyors between two elevation levels).

2. Potential problem baggage; these items could cause problems and need to pass by an operator. With a bit of extra care this baggage can be handled automated, i.e. as standard baggage. For example, it is important that loose straps are tied to the bag to prevent them from getting stuck in the system resulting in bag jams and damaged bags. A rucksack for instance with long straps can be handled as normal if the straps are tied together. Another possibility is to place the bag in a bin.

3. Out of Gauge (OOG) baggage; bags that can be handled only on special equipment (wider) in dedicated OOG lines. These lines are dimensioned to allow for larger bags and go direct from the entry point to the handling point, without additional sorting. Typical examples of OOG baggage are TV sets, tubes, wheelchairs, skis / snowboards, baby carriages, golf bags and surfboards. Items such as a wheelchair or carriages need to be folded properly before it can be send via an OOG line; they cannot be transported on their wheels.

4. Non-conveyable baggage; bags that cannot be handled by the BHS. Baggage with certain dimensions, shapes or other characteristics are revered to as non-conveyable. This type of baggage must be manually handled by operators. Typical examples are bikes, footballs, live animals and fishing rods.

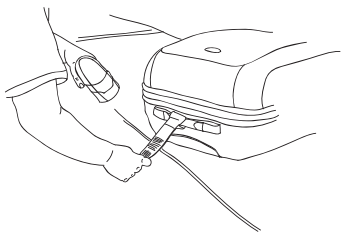


Figure 25: Manual scanning of bag

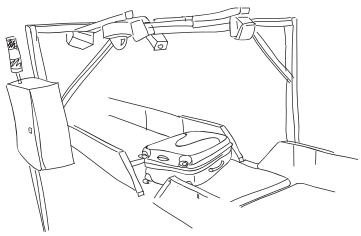


Figure 26: Automatic scanning of bag

Figure 27: Operator at check-in desk

Screening

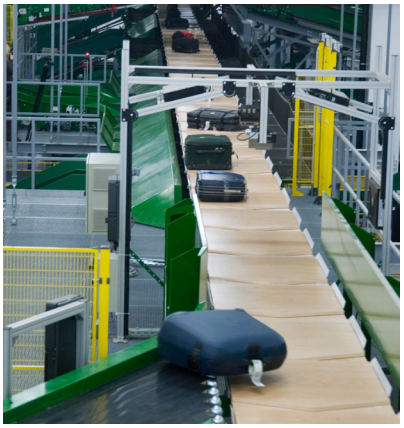
After check-in and scanning bags are screened. The main function of the screening process is to guarantee security. After a bag is screened and detected as safe it means the bag is cleared. The screening of hold baggage can be done either by hand or using x-ray machines (FIGURE 28). There are several levels of screening. 70% of the bags is cleared based on the first scan of an x-ray machine. The bags which cannot be cleared yet will be further analysed and in the end accepted or removed from the system.

As indicated before, for security reasons it is required that bags travel in the same plane as the corresponding passenger. It could be discussed that when screening is 100% safe, the bag does not have to travel in the same plane as the passenger.

Sorting

The sorting process is based on certain sorting criteria which again refer to the time they have left to make-up (hot, warm, cold). Also no-reads (meaning there is a problem with handling) and other exceptions are separated (see APPENDIX D). The earlier presented manual scanning (FIGURE 25) as presented in figure is for example executed with these no-reads.

Warm bags (i.e. with a short time to make-up) are separated in transfer and terminating bags and subsequently by flight and class. Another category of baggage is crew baggage. They have their own check-in and carousels. However, sometimes their bags travel over the same systems as passenger bags. When loading the aircraft, it is important that at arrival these bags from the crew can be unloaded first.



This group of images show different solutions Vanderlande offers for the sorting of bags. The two images on top show the infeed of bags on a sorter. The bottom tree images show the outfeed of bags in chutes after which the bags are further transported through the systems.
(Source: Vanderlande)

Figure 31: Batch storage in lanes (Source: Vanderlande)

Figure 32: Individual storage in cranes (Source: Vanderlande)

Storage

The main function of the storage process is to supply the make-up process. However, it comes with a beneficial function that it increases flexibility within the control of the system supply.

There are several reasons for storing baggage:

- Cold bags; which are bags that either checked in early (make-up position is not opened yet, see FIGURE 22), transfer bags with a long connection time (see "TRANSFER BAGGAGE" ON PAGE 55) or bags from flights that are delayed;
- When there is a problem with the identification of a bag;
- Customs or security requires storage.

FIGURE 30 shows one way of storage, i.e. storage of a batch of bags in lanes. A batch of bags are bags that are grouped and will be loaded together. This will be further explained in the section about the make-up process. Where the traditional way of storage in lanes requires recirculation of bags and system to run continuously at full power, there is also an option for individual, random storage in cranes. This system runs only when needed and supports individual retrieval from the storage which is beneficial since there is no need for grouping by flights. This maximizes the flexibility and the control of the system. This storage system could therefore also be used for more than cold bags (i.e. temporary storage of warm bags).

From the individual storage, the bags can be retrieved and batched based on characteristics such as weight. Individual storage also facilitates automated loading and enables ergonomic handling.

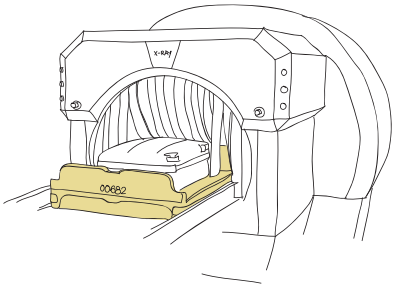


Figure 28: X-ray machine for bag screening

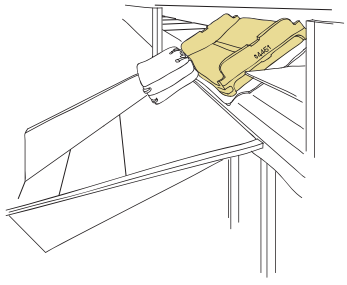


Figure 29: Unloading TUB in chute, sorting bag

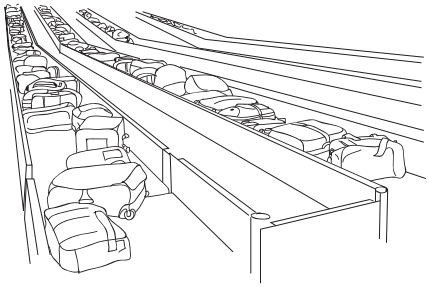


Figure 30: Batch storage of bags in lanes

Make-up

Currently the whole baggage handling is working towards the make-up process (FIGURE 33), which is the last process of the BHS. Here the bags are loaded onto a container (ULD, see FIGURE 10 ON PAGE 25), dolly or cart after which it is transported to the apron.

The current make-up process is based on a "push" process, where every bag is urgent. It would be beneficial to move towards a pull systems: when there is space, a bag is retrieved. This would mean that bags are stored and requested by make-up resources when needed. (Or when a batch is ready, the batch can be pulled by the handler to make-up.) An important aspect of make-up is that it creates a buffer. When the BHS would not create a buffer, bags should be loaded onto a plane just as fast as they are dropped off by passengers in the terminal.

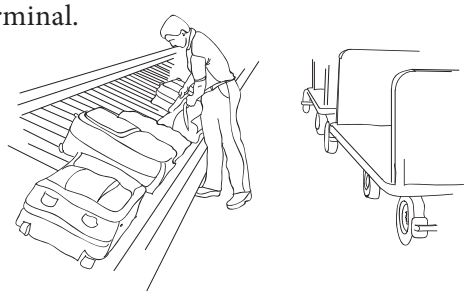


Figure 33: Make-up process; loading of bags onto a cart

Unit load devices

There are many types of unit load devices, each with different shape and dimenions as well as specific functions such as refrigerators. The type of ULD that is used is depended on the aircraft type as well as the goods that need to be transported. An ULD fulfils several functions, these functions are listed below.

- Individual items ar assemblied together. The loading of a single unit makes aircraft loading faster.
- The ULDs are locked within the aircraft. Therewith it becomes a part of the aircraft to prevent moving around.
- ULDs enable automated loading.
- It maximise the use of an aircraft hold space
- It offers a better protection for baggage (compared with a bulk load)
- It increases bag security, since there is no unauthorized access when ULD is closed

However, ULDs are expensive assets. According to IATA (2017) ULD is the number 1 cause of aircraft damage among all ground operation equipment. And repairing ULDs after damage by incorrect handling cost the industry $330 million annually.
Also, ULDs bring extra weight to the aircraft, which means extra fuel. For example, an A380-800 aircraft fits 38 ULD3s. The tare weight of a ULD3 tare weight is 82 kg. Removing these ULDs would save a weight of 6114 kg.

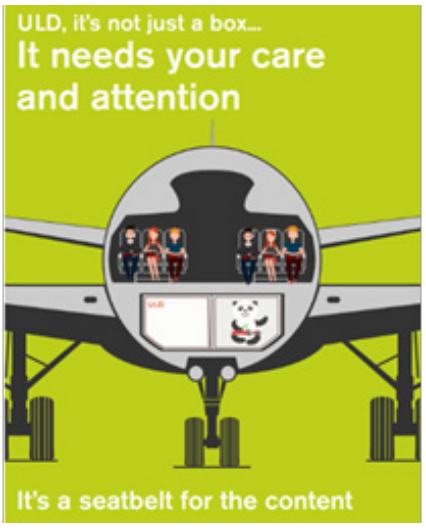


Figure 34: poster of a ULD campaign (Source: IATA)

Aircrafts

There are different types of aircrafts which can be categorized in two; namely, containerized and non-containerized, also referred to as wide bodies and narrow bodies. Both types transport baggage in a different way, as can be derived from their category-name:

- Wide bodies: containers & bulk holds
- Narrow bodies: bulk holds

The aircraft's weight an balance is an important measure, especially for take-off. For the load factor an average of the (expected) weight is taken, since it is not clear untill check-in how much baggage passengers take. Even uptill boarding the weight may change. As said before, extra baggage leads to extra fuel, of which both are impacting the weight and balance of the aircraft. Cargo, in pre-loaded containers or pallets, are used for filling up passenger flights.

Another important measure regarding aircrafts is the turnaround time, i.e. the time it takes to make an aircraft ready again for take-off. Since every minute an aircraft is on the ground will cost the airline money, turnarounds are as short as possible. Turnaround times are dependent on (un)loading of passengers, baggage and cargo, catering, (re)fueling, maintenance checks and possibly cleaning.

Transfer Baggage

The way of handling transfer baggage is dependent on the connection time. There are again several categories of handling:

1. Tail-to-tail
2. Short connection (hot)
3. Normal connection (warm)
4. Long connection (cold)
5. (Extra-long connection (super cold))

In the case of tail-to-tail handling, there is not enough time to feed the baggage into the BHS after unloading the aircraft. Since the connection flight is departing earlier than the time the bags need to travel through the systems. In such case, bags can be separated at unloading and directly transferred to the apron from where the connection flight will depart. In case of a cold and super-cold connection bags can go into storage, when available at the airport.

Airport

Airports are devided into two areas, being landside and airside. The landside includes for instance the departure halls. When passengers and bags have passed security or screening they are referred to as cleared and become airside. Since the rise of self check-in and bag drop, the function of the landside becomes less relevant.

Regarding the size of airports, around the world airports are often referred to as regional, international or hub. However, this does not relate to the actual size. Therefore, IATA has categorized airports as follows:

XS = pax < 1 mio
S = pax 1 mio – 5 mio
M = pax 5 mio – 10 mio
L = pax 10 mio – 35 mio
XL = pax > 35 mio

Parcel process

For a d2d service with standardized bag it is also relevant to take a look at current parcel and postal processes. A typical transportation process of an international parcel can be described as follows:

First mile (pick-up); where goods enter into the transport network.
Ground depot; local facility where inbound and outbound operations are performed for that specific area. For example, a ground depot handles all parcels for a specific part of a city.
Ground hub; regional facility. Here, transfering freight from one depot to another is organized. However, it also includes depot services for that area.
Air hub; freight is collected from a hub by trucks and transported to the airhub. Subsequently parcels are loaded onto a cargo flight, however it may also be loaded onto passenger flights.
Air-hub;
Ground hub;
Ground depot;
Last mile (delivery); the focus of the last mile is on the period the parcel leaves the transport network. It can be either delivered or stored until picked-up by the receiver.

It may be clear that, depended on pick-up and delivery locations some of these steps are skipped. For example, the process could look like: first mile - ground depot - last mile.

The main function of hubs is to receive bulk freight of parcels and transfer it in order to be delivered to the final destination. The functions of hubs and depots include unloading and reloading of freight.
A similar kind of sortation process as can be seen in the baggage industry can be applied here: parcels are consolidated wtih equal (final) destinations.

There are several types of networks of which the hub-and-spoke network (FIGURE 35) and spider-web network (FIGURE 36) are the most interesting related to this research. The hub-and-spoke model minimizes the number of connections needed, however it requires every depot to be at a similar distance (time) from the depot. Spider-web network are suited for larger areas, however they require high volumes to be effective. Other networks are direct-service networks (FIGURE 37), multi-stop networks (FIGURE 38) or a combination of the networks mentioned (FIGURE 39).

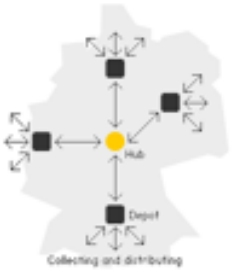


Figure 35: hub-and-spoke network (Source: Vanderlande)

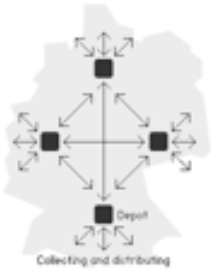


Figure 36: spider-web (depot-) network (Source: Vanderlande)

Figure 37: direct-service network (Source: Vanderlande)

Figure 38: multi-stop network (Source: Vanderlande)

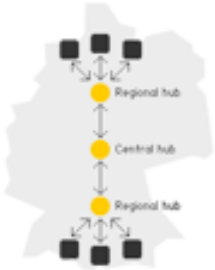


Figure 39: hub-and-spoke network with sub-hubs (Source: Vanderlande)

Figure 40: Outbound process (Source: Vanderlande)

Figure 41: Parcel sorter (Source: Vanderlande)

Conclusion

The main steps of baggage handling include scanning, screening, sorting, storage and make-up. Current airport and BHS functions, such as check-in are changing. This is also influencing the current terminal and baggage handling areas at airports. Not every step in the process of baggage handling contributes to the main function of the systems, but are additional processes (storage) or required by regulations (screening).

Manual operations during the baggage handling process cause mishandled bags, therefore the manual handling should be reduced as much as possible.
Bags are categorized in four categories, aircrafts are devided mainly in two and every aircraft uses different types of ULDs to fit their baggage and cargo. This makes the process complex and inefficient.

Also the unpredictability of the number of passenger and their baggage, the amount of weight and the arrival of passengers, baggage and flights (for transfer) make the process inefficient. Therewith, bags become urgent and demand for immediate handling (push). It is beneficial to move towards a pull system where bags are handled when there is space. This would change the sorting, storage and make-up processes of the BHS as well as the loading of the aircraft.

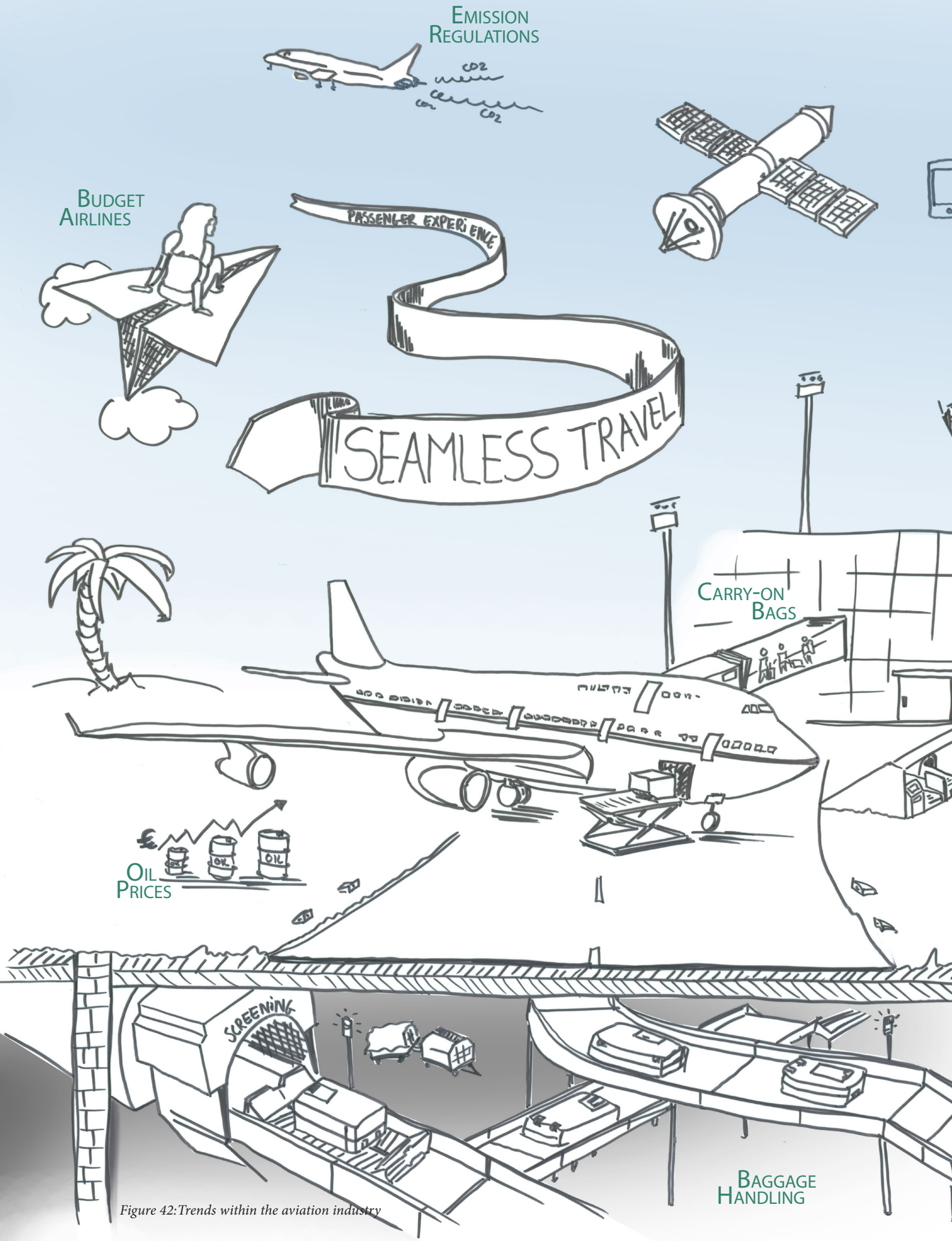
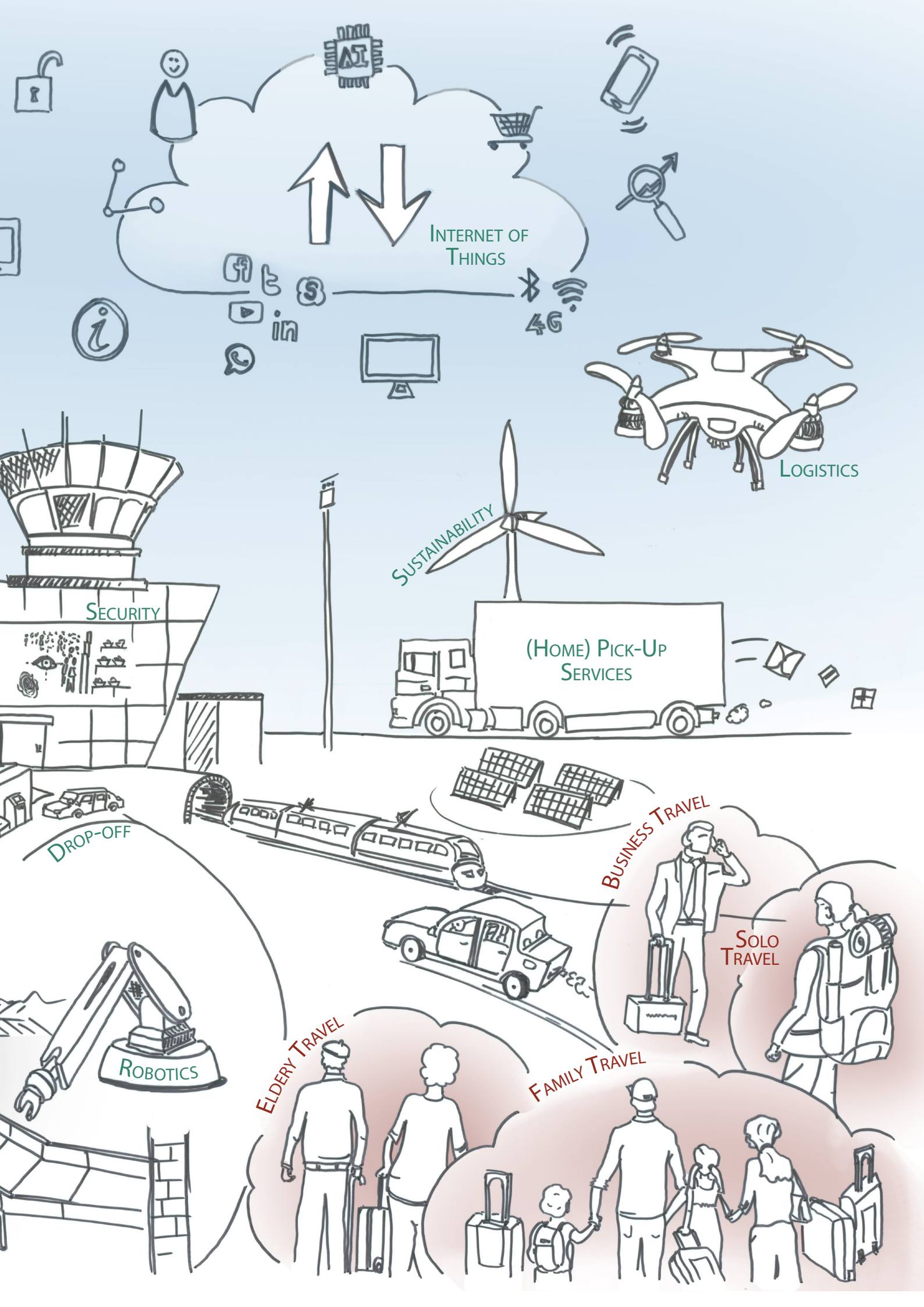


Figure 42:Trends within the aviation industry


AI
INTERNET OF THINGS
4G
LOGISTICS
SUSTAINABILITY
SECURITY
(HOME) PICK-UP SERVICES
DROP-OFF
BUSINESS TRAVEL
SOLO TRAVEL
ROBOTICS
ELDERY TRAVEL
FAMILY TRAVEL

TRENDS
within the aviation industry

The drawing on the previous page (FIGURE 42) gives an indication of the world around air-travelling. It represent the trends that are currently influencing the aviation industry. From page 61 onwards the trends are described in more detail. An analysis of the trends was done according to the acronym DEPEST; demographic, economic, political, ecologic, social-cultural and technologic trends. These different type of trends are categorized and presented within certain themes, such as types of passengers, logistic and baggage handling.

Passengers

When starting at the bottom right of the drawing several groups of travellers can be found. Each group will have its own characteristics and habits.

- For years, statistics have shown the aging of society (United Nations, 2015). And due to globalization, traveling elderly enjoying their retirement abroad are an important target group within the aviation industry.
- Since air transportation becomes more common, also more families choose air transportation as the desired way of traveling to their holiday destination. This group is partly covered by the so-called millennials, born in the 80s and 90s, which are confident with technology, have money to spend and see air traveling as unexceptional.
- Research by the Visa Global Travel Intentions also show that the number of solo travellers is rising. Where it covered 15% in 2013, it increased to 24% in 2015 (Festa, 2016).
- The last group of travellers showed in the drawing are the business travellers who work abroad and travel by plane.

Regarding a d2d baggage service, families and elderly are expected to be interesting target groups to focus on (Ervast, 2017)

Passenger experience

One of the trends as mentioned in the 'Baggage as a Service' (BaaS) report is the enhancement of passenger experience (BaaS, 2016). Where the focus used to be on passenger experience, the conversation is now shifting towards seamless travel: a personalized travel experience where there is no disruption is what passengers expect (Vanderlande, internal blog, F. van Duren, 2017). With the rise of big data, the quality of human prediction, when measured over time, can be improved and theore, passengers may require this level of personalization. Data analysis will result in 3 types of information which should be used to understand the passenger and personalize his experience: Insight (real-time data analysis), trends (aftertime data analysis) and predictions (beforetime data analysis) (Hinssen, 2015). However, budget airlines, who deliver lower service levels, will win in popularity (Brasser, 2015).

Co-utilising

From the bottom left in the drawing, travellers move themselves to the airport. Traditional means to travel to the airport are personal and public transportation. However, in the past few years, shared economy transportation, e.g. Uber, has taken a lift. Uber and Airbnb are the most well-known businesses concerning shared economy, but the trend of sharing can be found in almost any market segment. Not-owning but renting or co-utilising goods and products is not only driven by sustainability (waste through not using your products), but also by the realisation that you can earn something with it yourself. Since this trend can be found in almost any market segment, passengers are likely willing to share certain products as well; however, the question rises what products and under which circumstances or conditions.

Sustainability

Climate change will result in more regulations concerning emission. Airports have to deal with restrictions from surroundings concerning to the maximum amount of flights per day, related to noise and emission levels. (ACA, annual report, 2016). At some airports airlines are charged for the emission per aircraft. Theore, aircraft manufacturers are forced to reduce the emission and make the aircraft as sustainable as possible. Other extra cost for airlines, which will be charged to the passenger in the end, are the increasing oil prices. The amount of fuel needed for a flight is related to the weight of the aircraft. Weight reduction is therefore an important focus for aircraft manufacturers and airlines to cut costs.

Also the focus on environmental effects of flying are increasing. For example by using biofuel for aircrafts and alternative energy sources the carbon footprint is reduced (IATA, 2017)

Connectedness

Technologic innovations are growing at a great rate within the aviation industry and are driven by data services and connectivity. By 2020, 80% of the world's population will own a smartphone (Ericsson, 2015). Already in 2014, According to the SITA IT Survey 2014, 81% of passengers carried a smartphone (SITA, 2014). Marketing departments are already focusing on 'mobile first' and in 15 year e-commerce will be unexceptional (R. Houben, personal communication, April 4, 2017). Interaction between airlines and their customers will be focused more and more around mobile devices as well. Wireless technologies are used to enhance the passenger's experience at airports, e.g. Bluetooth Low Energy (BLE) used by beacons located at airport to guide and inform passengers through their mobile devices.

Logistics

The aforementioned developments this will result in less physical interaction, accompanied by the rise of customer facing technologies such as (self-learning) robotics. The future logistic supply chain will be fast and self-managed due to automation technology, artificial intelligence (AI), robots as well as wearables (Forbes, 2017). And just as in every industry, these technologies are becoming commonplace in air transport as well. Autonomous technology not only reduces cost by replacing man, but also in material reduction and fuel cost (within logistics).

Another aspect of logistics are pick-up and delivery services. These can be found all around; just look at the many logistic providers driving through a street throughout the day. When a bag is delayed, most airlines will make sure that it is delivered at your place as soon as possible (e.g. Airline Recovery Service, TNT). However, when passengers can choose between several last-mile services, such as same day and next day deliveries, 67% of them will select the slowest and cheapest method of deliver" (Cerasis, 2016).

Trends such as Amazon testing with last-mile delivery by drones and Rolls Royce planning to launch autonomous cargo ships by 2030 (Forbes, 2017) are framing the future logistic supply chain. This will all result in less physical interaction between customers, (service) providers and packages.

Baggage handling

Concerning the capacity issues at airports, a reduction of the number of bags in terminals is required. Remote (self) bag-drop points are seen as one of the solutions for this. In 2016, 60% of airlines and airports already implemented assisted bag-drop (SITA, 2017).

Airlines will have to provide the Department of Transportation with their total number of mishandled bags and total number of checked bags. Previously, they were only required to report the number of mishandled bags, which were compared to the overall number of passengers. The aim is to ensure passengers are better informed about the likelihood that their bag will arrive with them or that it is delayed (SITA, 2017)

Passengers want to be informed and demand control (SITA, 2015). In 2018, every IATA-member airline (which represent 83% of total scheduled traffic (SITA, 2017)) should be able to provide four points of bag tracking; being check-in, loading, transfer and arrival (IATA Resolution 753). Next to improved customer satisfaction, bag tracking will also result in other opportunities for the air transport industry as defined by SITA. For example, reducing fraud, enabling proactive reporting, speeding up aircraft readiness for departure and facilitating the automation of baggage processes (SITA, 2017). This tracking and sharing of data with customers can already be found in many logistic industries.

Conclusion

Since airtravel becomes available for more people, the types of passengers are changing and every passenger has different expectations. Through data analysis, these expectation can be taken into account to optimize and personalize the passenger experience. Other technologic innovations are affecting the aviation industry as well. Shared economy is growing and society wants to be connected, informed and in control. Regarding baggage handling, passengers want to be informed about when their bags will arrive. Logistic indutries, therefore, provide track-and-trace information to their customers. Within the world of logistics, automation technology including (self-learning) robotics, will continue to grow, resulting in less physical interactions. Both between the industry and its customers as well as employees within the industry and the logistic systems or processes.

Conclusions

Where the benefits of a d2d service are clearly visible for airports as presented in chapter "Door-to-door baggage" on page 21, the other stakeholders cannot be neglected; most importantly the passenger. And where every stakeholder has a different customer, together they should create as much value as possible for the passenger. A well designed d2d service-network will contribute to a hassle-free, seamless travel experience which will lower the passenger's anxiety. Additionally it could solve capacity issues and reduce cost within the aviation industry.

In this chapter the current situation has been described based on:

- the passenger journey (page 36)
- the functions analysis of the BHS (page 49) accompanied by a baggage journey (page 40)
- the stakeholder analysis (page 44)
- the trend analysis (page 60)

Passengers currently experience stress during baggage related steps of their journey. For the aviation industry, it is important to focus on passenger satisfaction. That also applies for companies such as Vanderlande (system suppliers), even though their direct customer is not the passenger. Airports should focus on intuitive throughput to increase process speed and capacity to enhance the passenger's experience.

When introducing a d2d service it is important that the speed of transport, process and delivery is relevant to the travel time of the passenger. Related to it, passengers want to be connected and informed, hence the track-and-trace of logistic providers.

The current baggage handling process includes multiple manual steps, being one of the causes for mishandled bags. Mishandled bags not only cause high costs, it also affects the passenger experience. The mishandled bag rate will decrease by improved traceability of baggage within the baggage handling system.

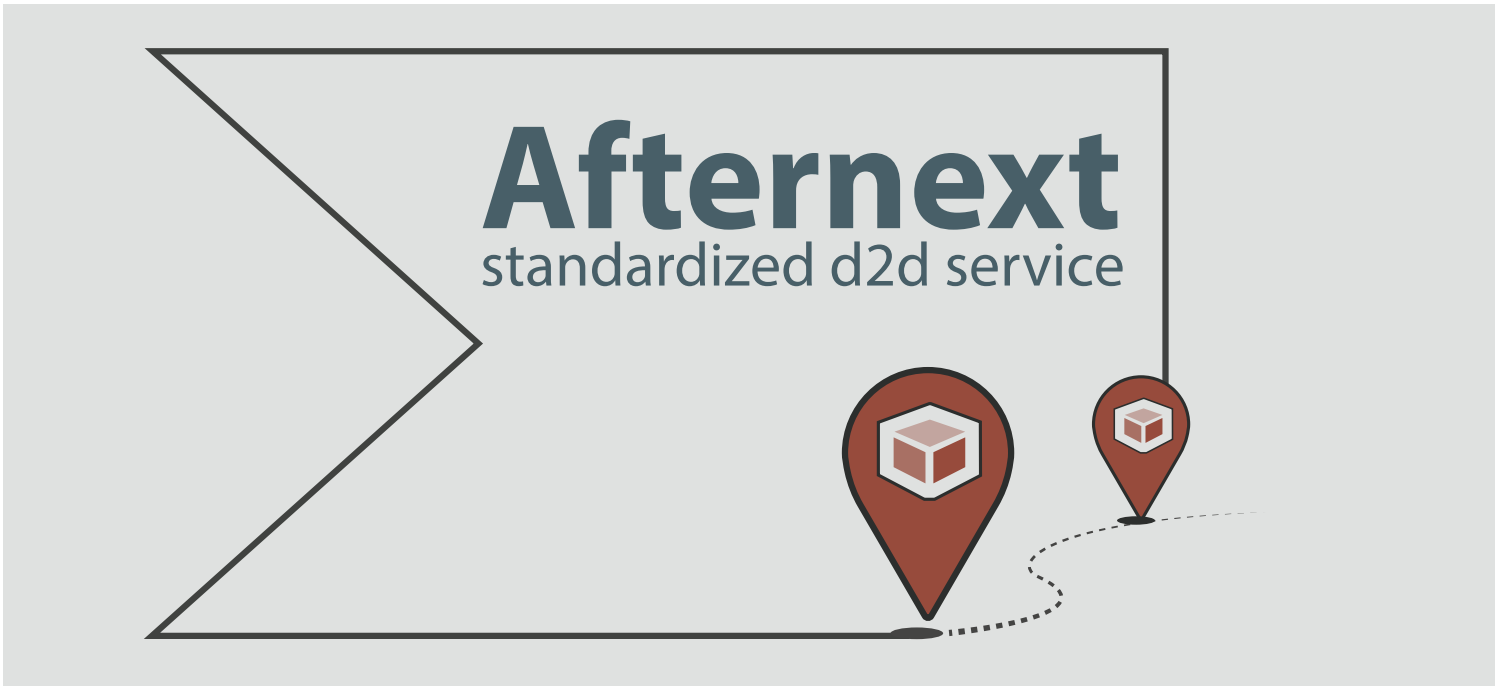
Cost reduction within the baggage handling process can be found through automation. For both airport and airline, it is important that bag volumes are clear as early in the process as possible: for the capacity of the BHS, the aircraft's weight and balance and the number of check-in and bag drop facilities. Operational cost could be improved by a reduction of system jams and less downtime, whereby the overall system availability will improve.

According to the presented journeys and trends, some assumptions can be made regarding the relevance of process steps within the future service. For instance due to the changing of the current check-in functions. It is beneficial to move towards a pull system where bags are retrieved when there is space available, this would also affect the current sorting and storage systems.

Screening is currently an important step, due to security regulations. However, this process step does not directly add to the main function of baggage handling and could possibly be changed in the future. Apart from regulations, security is also important for passengers and airports.

The current passenger journey and the current process of baggage handling includes many parties. These stakeholders not only influence the passenger experience while interacting with the passenger and baggage journeys, they also have mutual interactions. The relationships within the network will change when introducing the afternext d2d service with standardized bag.

Chapter 4



Introduction

In the previous chapter the current situation was central. The information displayed there is the foundation for this next chapter. It was explained before that the next situation would be skipped to build on the afternext first, after which the next can be discussed. This chapter about the afternext will contain the following:

- a vision for the afternext service
- possible afternext journeys for both passenger and baggage
- the afternext service's core components
- development of an Interaction Loop

This Interaction Loop will show how different components of the afternext service are connected and influencing each other. Based on these interactions some requirements for the standardized suitcase are emerging. While designing the afternext it became clear that there are many scenario's possible within the afternext. Some of these scenarios will be explained in detail. Eventually, the goal of this chapter is to indicate what the afternext could look like. The conceptual stage of the interaction loop can be used as an input to define steps that could be taken in the 'next', since a well-planned system will make the adoption intuitive and simplified.

A VISION FOR THE AFTERNEXT

Based on the analysis of the current passenger and luggage journeys, the handling systems and trends that are seen within the aviation industry, a vision for the afternext was created. The vision is first of all defined to give direction to the continuation of this research and gives an indication of what the afternext could look like.

The vision exist of 4 elements:

- The afternext service is a platform that serves as an interface between parties. On one side of the platform there is the demand from passengers to get their bags transported, the other side of the platform includes logistic parties who offer transportation (as explained later on, airlines are also seen as logistic parties).
- As indicated in the trend analysis, the world of logistics is changing. New forms of transport, some which are yet to be discoverd, will enter the market. To ensure development within the afternext the platform should have an adaptive structure which allows new forms of transport.
- The service should be scalable; both to the number of passengers and their bags as well as the number of logistic parties. When only a limited

number of passengers or airlines are connected to the platform it will start with the transportation of a small number of standardized bags, transported d2d, maybe even from only one city. When the service (network) grows, the platform should be scaled up, allowing more bags and more providers.
• Within the platform goods and products as well as data is shared and exchanged.

A metaphor for this vision can be found in the pay by card (or phone) service/platform:

• on one hand there are companies; they need to be registered as a company (e.g. at the chamber of commerce) as well as at a bank (business) and after they have invesed in a pin device they are able to make use of the pin network;
• on the other hand there are customer; they are registered at a bank as well (private) and receive a card and account.

Via the service platform, these two parties are able to exchange goods (money) and data.

This would mean that parties within the afternext service (e.g. logistic providers) must register and maybe make a (small) investment. An example of a service that fits within this vision:

A passenger is connected or a member of the platform. The passenger indicates that his bags should be transported from A to B. The passenger will be able to indicate pick-up and delivery times, locations and price range. The preferences of the passenger are presented to the logistic parties within the network of parties that are connected to the platform. The party that is able to meet the passengers needs will be picked. This could also be a combination of parties.

The goal of this afternext d2d service, when designed from scratch could for instance be 'an increase of the number of bags', therewith not committing to a large-scale network from the beginning. In that way adaption to requirements from the network (incl. passenger) is possible.

Future passenger journey

Based on previous research by Marie (2016) (Appendix E) a suggestion for the PAX journey in case of a d2d service with standardized bag can already be made. FIGURE 43 shows this journey with some baggage related steps. For this overview, the assumption is made that the passenger will not own the standardized bag, therefore the step 'receive bag' is included. Passenger will apply for the service during the booking of a flight with the airline or with a travel agency as intermediary. After the luggage is picked up, the passenger will travel to the airport, possibly with public transportation. At the airport, no baggage related steps are included, but the passenger might still carry hand luggage. When arriving at the final destination the passenger will receive and accept the baggage which has already been delivered to the destination address provided by the passenger. TNT indicates that, in the current parcel delivery, this last step of acceptance is very important since there must be a transfer of liability (D. van der Noll, personal communication, May 9, 2017). Hence this step is considered in the future d2d service as well.

Marie (2016) suggested that in case of a d2d service (without standardized bag) a preparation package is send to the passenger; a package to ensure right and secure handling including information, tag, address sticker and sealing. In case of a standardized bag, this

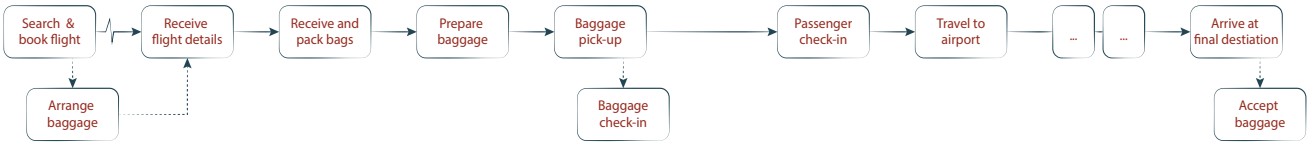
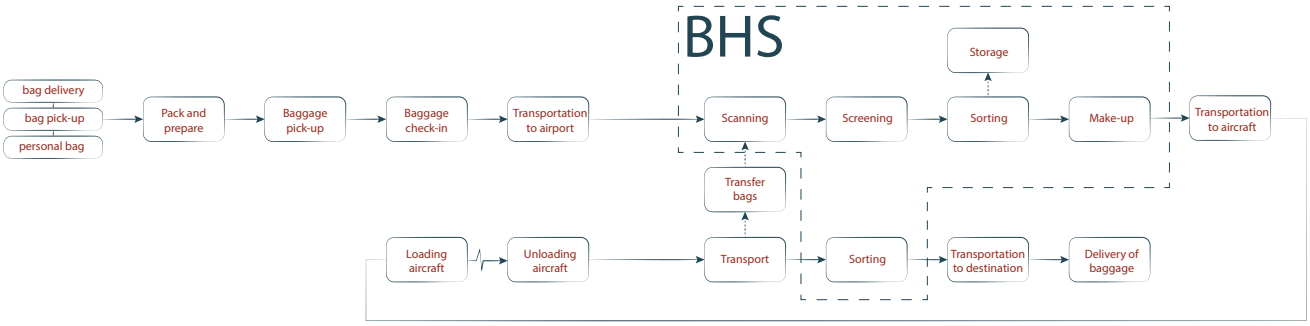


Figure 43: Passenger journey in case of the afternext situation

Figure 44: Baggage journey in case of the afternext situation



step will change. Therefore, the overview presents a 'prepare' step which is not further defined yet but still indicates there is an important aspect to it that should be considered in the afternext service.

Future baggage journey

Next to the passenger, the baggage has a journey of its own. The current steps of the baggage journey are presented in FIGURE 14 on the previous page. However, when moving towards a d2d service, the baggage is transported separately from the passenger to the airport. Based on the d2d passenger journey as described by Marie (2016). This could possibly lead towards a journey as schematically represented in FIGURE 44. This image also shows what is earlier defined as BHS; the moment the baggage is entering the airport it will be feed into the BHS, after which the baggage is travelling through the airport's BHS to be loaded onto the aircraft.

When regulations do not require bags to be transported in the same aircraft as passengers anymore. It will be possible to handle baggage as cargo which offers a range of possibilities. For example a passenger flight only takes pre-loaded cargo containers or pallets and cargo flights who take passenger baggage. Or even passenger flights without a hold for baggage but with an additional floor for chairs.

Source: KLM

Core components

Based on the predefined vision created for the afternext and the current situation described, nine components have been identified that comprise the core of the service. Without these components, there will not be a service. As mentioned before the afternext is based on the scenario that baggage is traveling through the airport. The scenario is represented in FIGURE 45. However, there are other scenarios possible as well.

The nine components are presented in FIGURE 46. In this image, the components are presented as gears. This indicates how they are all related. When starting to rotate one of the gears all the others will follow.

However, they will all rotate at a different speed. Also, there is a certain inertia within the gear system since not every gear starts rotating at the same moment as the first gear. When two components start rotating it could also cause a countermovement and the system could get stuck. Therefore, it is important that the parties represented by the components are cooperating to make the afternext happen. The order and size of the gears is randomly chosen. Each component will be explained in the following section.

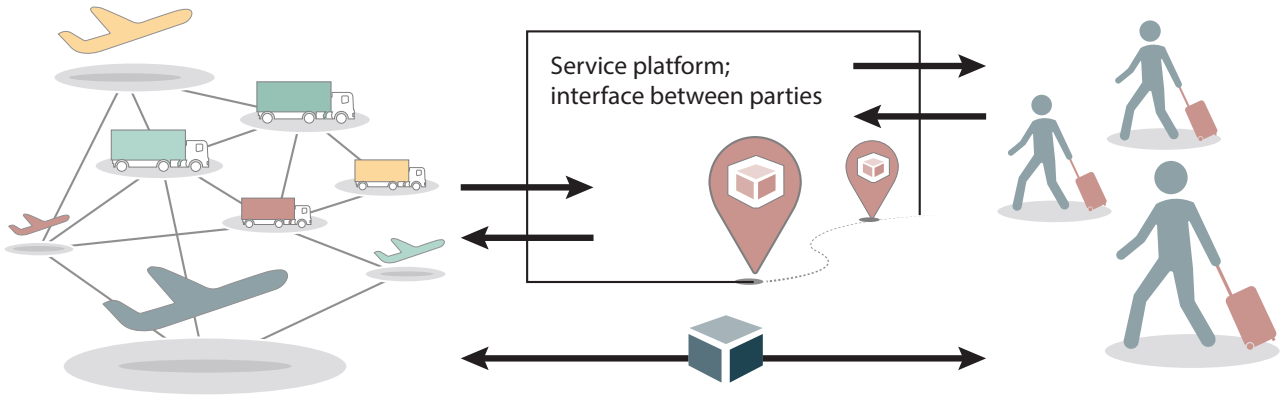


Figure 45: Service platform as an interface between parties

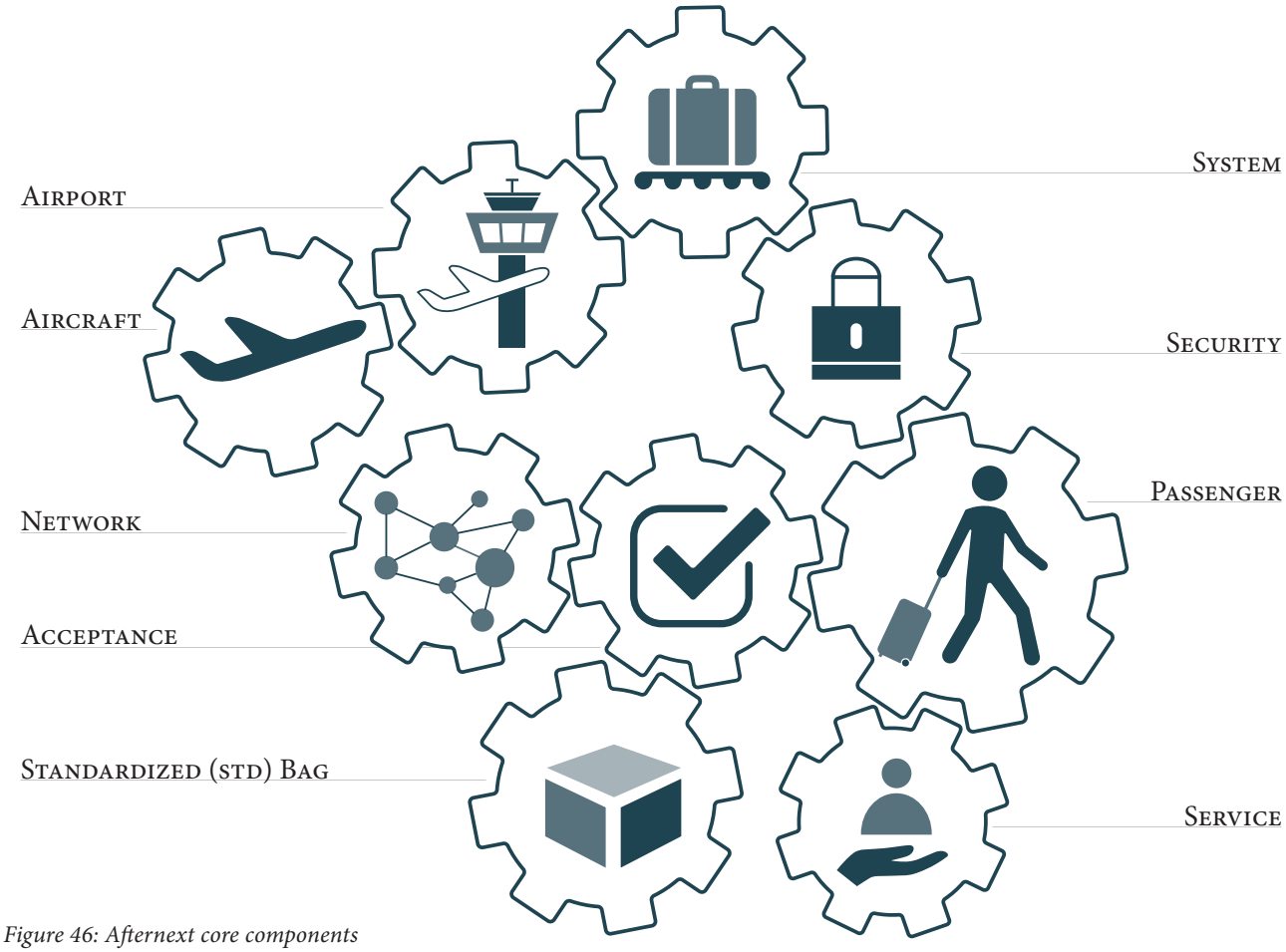


Figure 46: Afternext core components

Service

According to the predefined vision, the service will be a (IT) platform where data is shared between parties. The service will have a front end and back end. the front end is related to the passenger, the back end to the logistic parties responsible of transporting bags.

An important aspect of the service is the service level, i.e. that what customers may expect when engaging with the service. A service level indicates the performance of a service and should therefore be measurable. For example, a helpdesk could settle 7 phone calls within the given time span. When the service level was set at 10 phone calls within that same time span, the performance would be 70%.

Since there is no service yet, no service level can be measured. However, it is important to define what the desired service level is and how to measure this. Besides, all the elements needed for this desired service level should be indicated. These elements will also define the service level agreement (SLA) with parties who want to be part of the platform.

Passenger

The passenger is the one traveling and instead of taking personal belongings along the way, it will be pick-up and delivered at the requested place. The passenger must be connected to the platform to send his/her belongings through the network. Without customers who are willing to send their belongings there will not be a service.

Network

This component stands for all the parties connected to the platform to facilitate the transport of the standardized bag. The road network providers are referred to as logistic providers, the air network providers are the airlines.
Also, transportation by water or rail could be included as part of the network. Especially concerning the adaptive structure of the platform as presented in the vision.

Where the front end of the service should radiate ease of use for passenger, the logistic network behind can be complex. Just as the current network, the afternext network will entail a physical stream (bags), a data stream as well as a financial stream. Stakeholders in this network should keep in mind that the goal of the network is a positive customer experience, since that would make them willing to pay for the service. Therefore pan-industry cooperation and collaboration is needed.

Airport

The airport component represents both the airports and logistic ground-hubs. They facilitate the actual means of transportation (see next component). The transfer of bags between (different) network parties happens at this point as well. The airport not only has a network function, since the passenger is traveling through the airport as well. Passengers have certain physical and digital touchpoints with the airport which might change because of this service and new interaction between airport and standardized bag will emerge. On-airport contact points will contribute to the passenger's experience; however, airport access, parking, security, shopping, restaurants and gates are not hold-luggage related. For the airport, it is important to identify if and how they can still contribute to the perception of service level even when the baggage journey is completely separated from the passenger's journey.

Aircraft

The aircraft component represents all the means of transport used and owned by the logistic parties within the network. In the given scenario, this includes aircraft and trucks. Considering the aircraft, it could both include passenger flights and cargo flights. The question is how the development of the service will or can influence aircraft designs.

It is important to remember that the vision is part of the afternext and new forms of transport could enter the logistic network. Therefore, the network is not limited to the ones mentioned but for example boats and trains could be included in this component. That would also mean that the previous explained component Airport would include ports and train stations and similar logistic facilitators.

Std. Bag

The standardized bag is an important component within the afternext service since the afternext service is defines as 'a d2d service with standardized bag'. However, it is not specified yet what this standardized bag should look like or what form it could take. The bag will be a case for passenger's personal belongings. Many requirements for this bag can be defined, either from a passenger point of view, a service, system or network point of view.

There are several possible scenarios for the ownership of the bag, this may be with the passenger, a (separate) party in the network, or the platform. In case of the platform, it would not merely be a IT-platform anymore.

System

The system component is defined as what is needed by the logistic providers to transport the standardized bags, next to the means of transport represented by the aircraft and airport component. In the current situation, this would refer to the steps of the baggage handling process as identified in "BAGGAGE HANDLING" ON PAGE 49 (scanning, screening, sorting, storage, make-up, transport) and similar steps of parcel handling systems. However, as will become clear later on, these process steps might disappear, based on how the d2d service and the standardized bag are designed.
When the Std. bag is traveling through the airport, this component will at least include the following:

- Empty Std. bag storage systems
- Transportation from home or destination to the airport and vice versa, possibly making use of systems such as parcel logistic systems
- Transportation through the airport, possibly comparable with current baggage handling systems
- Loading and unloading aircraft represented by manual or automatic ground handling systems
- IT systems

Furthermore, considering this to be the afternext scenario, there are (future) forms of transportation that fit in multiple afternext components, such as an Automated Guided Vehicle (AGV). An AGV would now be considered part of the systems but could fit the aircraft component as well as means of transportation. The same counts for drones. They could either be part of the system component but imaging it would pick-up bags from the passenger's backyard in the future it would fit the aircraft component as well.

Other future luggage streams as researched by PASSME (see FIGURE 6 ON PAGE 22) could also be considered part of the adaptive, scalable platform. For the systems component of the afternext this would include remote pick-up and drop-off systems where luggage can be retrieved on demand. When these points are for instance placed at airport parking, stations, a supermarket or hotel, transportation from and to these points should be organized.

Acceptance

The acceptance component is a slightly different component than the ones mentioned before. It entails to types of acceptance which are both needed to introduce the service. First, passengers need to accept the service. When they do not accept the service, there are no bags to transport. Passengers will experience anxiety to hand over bags at the door, since it contains personal belongings. When considering acceptation of a standardized bag in the afternext, it needs to become normal to travel without luggage in the next. Also, the network need to accept the service. When the network does not accept the service, there are no parties to transport the bags.

Security

Finally, the last but indispensable component is security. When the service is not secure at any given point, the service will not be accepted and cannot be executed. The security is applicable to both the passenger and the network behind the platform. Part of the network security is liability during transport.
Other specific elements of security will be defined in the next chapter.

Before the interactions between all the components are explained, the next chapter shows how the model that describes the interactions has been established.

ITERATIONS

Now that the vision for the afternext and the most important components are clear within the given scenario, a reflection on the research question was made: What initial question was stated and what was defined as the goal of the research? The visualization of the research question is again presented in FIGURE 47. The goal of the research can be found within the dashed line.

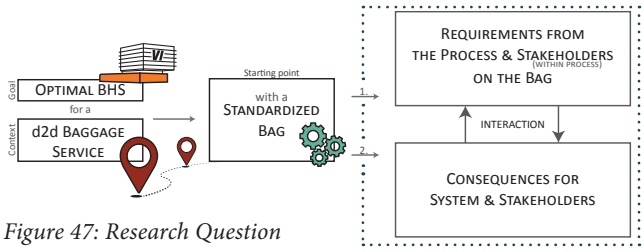


Figure 47: Research Question

Thus, what is the interaction between consequences and requirements of a standardized bag within the context of a d2d baggage service. The description of the current gives many input to start describing these interactions within the envisioned afternext. However, a clear way to present them has still to be found. First, a description of the interactions started off with a table in which the components were plotted against each other. However, this overview became very complex and chaotic. Some research has been done to find a suitable way to describe such relations. The model that is presented in this chapter is based on a model presented in a study by Van Oorschot et al. (2013), and is from now on referred to as the Interaction Loop.

The development of the model happened in different stages as showed in FIGURE 50 TO FIGURE 52 ON PAGE 79. The stages of the model were discussed with experts from different departments within Vanderlande. These discussions resulted in updating, changing and improving the interactions displayed.
In the Interaction Loop the results of this research are presented.

Figure 49: Designing the Interaction Loop

Reading the Interaction Loop

Within the Interaction Loop variables can be found. Each variable fits one or multiple components as defined and explained before. These components are represented by coloured areas as presented later on in FIGURE 55 ON PAGE 83. The relation between the variables are given by an arrow with a plus or minus. This plus or minus indicates what the relation between the variables is and not whether the variable is positive or negative.

The variables have a cause-action relation. The plus or minus represent a relation with a polarity: when the cause increases and the effect increases as well, the relation is indicated with a plus. Also, when both the cause and effect decrease a plus is presented. But, when the one is decreasing and the other increasing a minus is presented. Examples are presented on the next page.

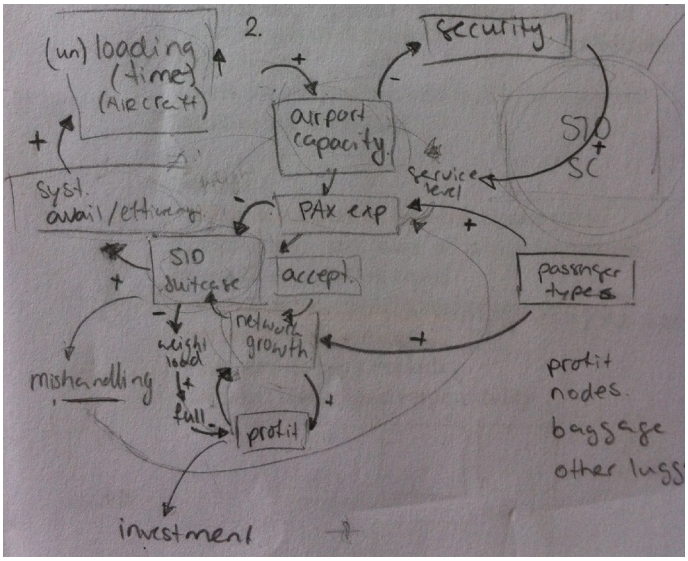


Figure 50: Interaction Loop, first test

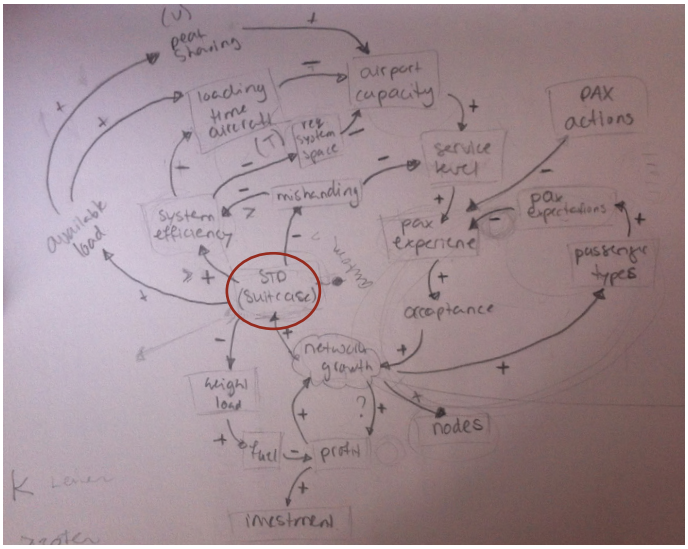


Figure 51: Interaction Loop, fit components

1st iteration

The first model, shown in FIGURE 50, was one of the first try-outs to find whether this kind of model would actually add value. Within the second one, FIGURE 51, some big steps have been made, trying to fit in as many of the 9 components as possible. Since it would be most interesting when all components would fit the model in the same level.

For example (see red circle in FIGURE 51):
Increase of standardized bags will decrease bag mishandling, therefore the service level will increase. Both interactions receive a minus.

With this try-out, a few things became clear:

- The pluses and minuses make the model hard the understand. The consideration toe represent the relations in a specific way: is the indication of the relationships intuitve or content driven
- Security does not fit the model in the same level as the other components.
- The variables are incomparable quantities
- There is a certain inertia in the whole model. Meaning, some cause-effect relations are direct, some are only visible over time. Moreover, some effects would only happen when the cause is having a certain weight.
- It is possible to find interactions that are potential affecting the afternext service in a negative way. For example: When network is growing the number of passenger types is increasing and therefore the number of passenger expectations is increasing which could lead to a decrease of passenger experience since it becomes harder to meet the expectation. These are important to take into account when developing the next and afternext.

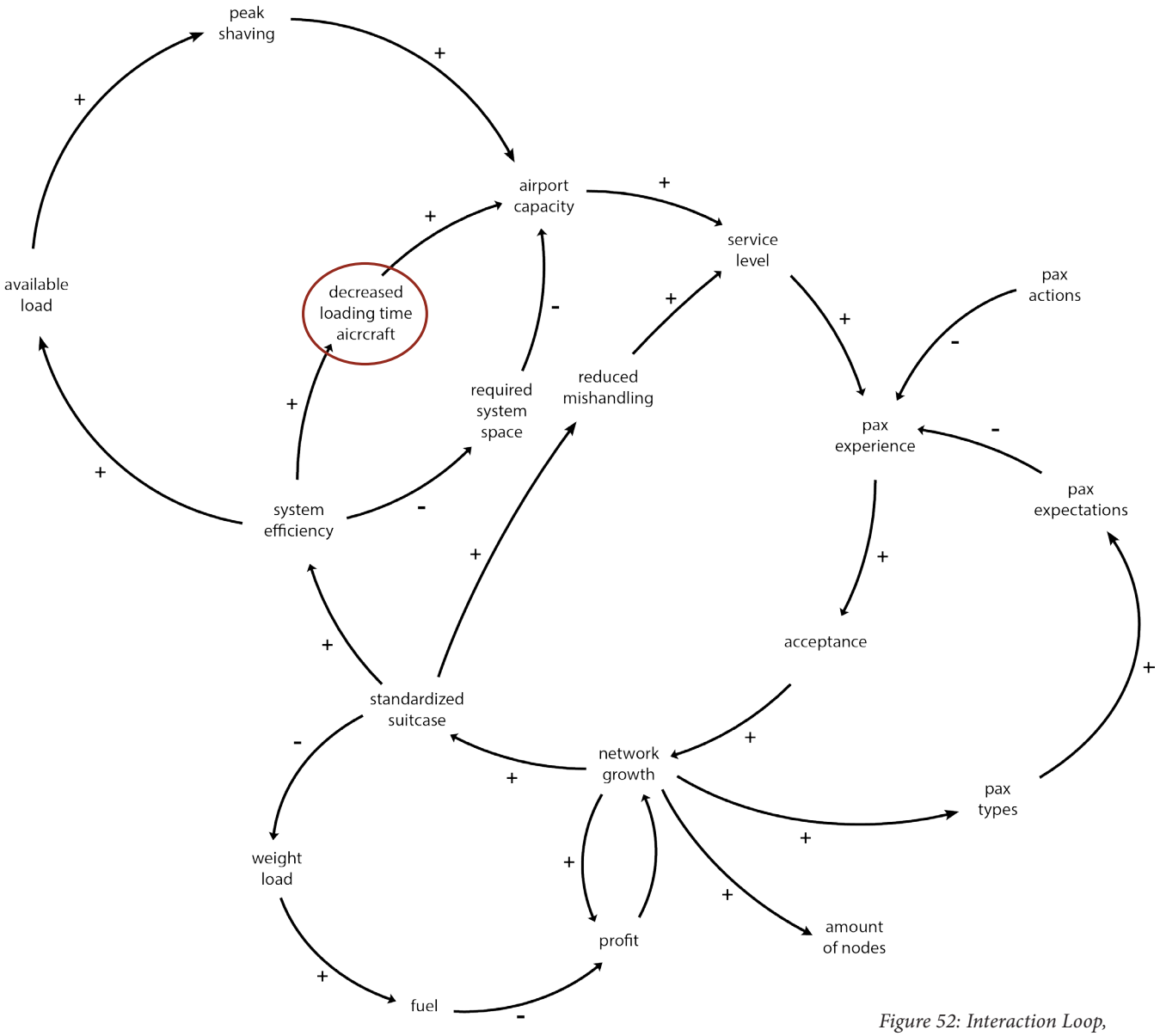


Figure 52: Interaction Loop, variables definition

2nd iteration

One of the possible solutions to make the pluses and minuses more clear was tried in the next model. Here the variables are all defined in a positive way. For example (see red circle in FIGURE 52): loading time aircraft became decreased loading time aircraft. However, when reviewing this it became harder to define the variables as a variable: thus, having the possibility to increase or decrease. Also, the pluses and minuses became less clear.

Another solution was changing the pluses and minuses to < and > or give them a different colour corresponding the relations given. However, this also did not subsequently increase the readability of the model.

3rd iteration

Up till this iteration, the security component has not been included in the model, since it did not seemed to fit the model just as the other components, variables and relations. There had to be found a way to include security in the model. The challenges here was the conditionality of the component. Of course, the level of security can increase and decrease as well. But in the end, if any aspect of the afternext is not secure, there will be no afternext. Therefore, the security component can be found in the final model being a Yes/No relation.

Since the first model only included big steps between variables where the interactions could be explained in many ways. The next step was to get more detailed variables and relations per afternext component. One of the examples can be found in FIGURE 54 (and FIGURE 49.

During this phase of developing the model it became clear that (apart from the component security which already had been defined different than the other components) for most components a specific aspect/ variable was most important or interesting. These are listed below according to the components:

Airport – Capacity
System – Efficiency
Service – Performance
Passenger – Experience

Furthermore, the components acceptance and network are defined into two parts according to the earlier presented description of the component:

Acceptance: Passenger & Network
Network: Airlines & Logistic Providers

Besides all the components given, there is one more aspect that has a lot of influence but which is hard to control: legislative parties. Whether they determine regulations about emission, the maximum number of flights allowed, bag screening requirements, import and export duties or that bags must travel in the same aircraft as the passenger, the exact influence is hard to determine. However, it may be clear that the influence is highly present. Since there are multiple interactions imaginable, but they are hard to control, these legislative parties are not included in this model. Further research should indicate where specific influence can be found and what the effect is.

During the last iteration of the model it became clear that it was visually difficult to include the interactions between the standardized bag and the other components. Also, the standardized bag was not only an input for certain variables (enabler), at some place in the model requirements for the standardized bag appeared. However, these interactions and requirements were hard to relate directly to the component area. Therefore, this component is not represented by one of the areas mentioned but will appear differently in the model. This will be further explained in "CHAPTER 6: STANDARDIZED BAG".

After discussing the model with various persons both from within Vanderlande as wel as designers from outside the industry, a few things became clear:

- The model needs a clear explanation
- The model should have a start point to increase readability
- It should be clear to which components the variables belong
- The goal of the model should be explained clearly before discussing it with stakeholders

It also became clear that there are still many links missing in the model and that it could be further improved. Therefore, this model should be seen as a conceptual model that indicates how all the different aviation areas are connected. Since there are different explanations possible (per variable and interaction) each arrow in the Interaction Loop is discussed separately. When quantifying such a model, variables with multiple relations have higher influence on the model

Based on these iterations there is a concept model determined which can be found in FIGURE 58. Each of the interactions between the variables are given in the following section.

Figure 53: Structuring information by making clusters

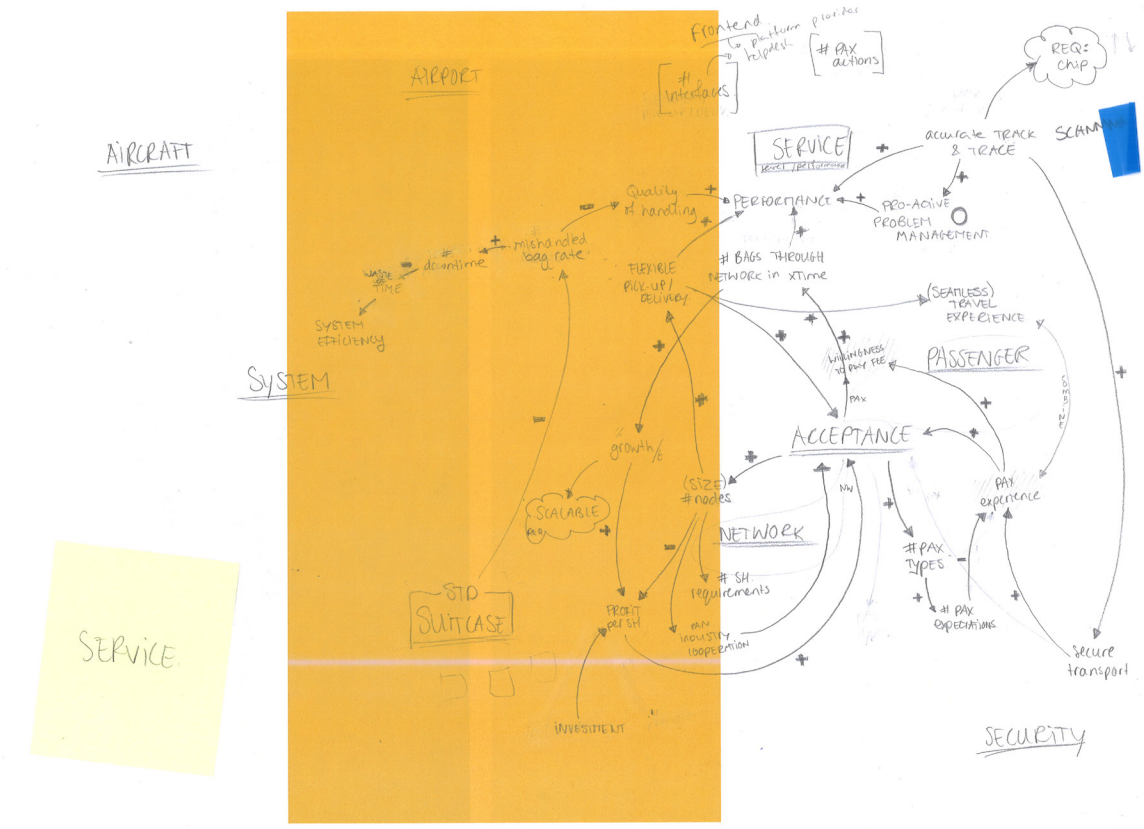


Figure 54: Developing the 'service' component of the Interaction Loop

Interaction Loop

The d2d baggage service with standardized bag now consist of a service platform serving as an interface between several parties. Furthermore, there are 9 components defined which are indispensable in the service. The components are represented by coloured areas as shown in FIGURE 55. A full scale version of the Interaction Loop is included on PAGE 96. The relations are represented by arrows with a plus or a minus.

Front end and back end

The interaction model can be divided into two parts, which could be referred to as the front end and back end of the afternext service. To make the distinction clear it is important to imagine the baggage service disconnected from the passenger's journey.

The right side of the model constitues the front end components of the service, namely the passenger, the service and acceptance components. The left side of the service represents the back end, including the system, the aircraft and the airport. These are the components which service customers do not necessarily see when using the service. The network component is represented in both the front end and the back end of the service since it involves customer interaction (e.g. pick-up and delivery) and back end operations (e.g. transport). As said before, the component security is a prerequisite for the whole service, therefore not directly related to neither front end or back end. However, it has a direct relation with acceptance and can therefore be found in the bottom right of the model.

The disconnection of passenger journey and d2d service might be confusing for some of the components. For example, from a d2d service point of view, the airport is a back end component. From the passenger's journey, it is a front end component (since the passenger is clearly interacting with the airport). When the interactions within the model are explained in more detail, it will become clear that, even though the two journeys are separated, they still influence each other.

The standardized bag is not presented in the model yet, but will be elaborated on in "CHAPTER 6: STANDARDIZED BAG" ON PAGE 106.
The following paragraphs will explain the interaction model in more detail, starting with the front end of the model.

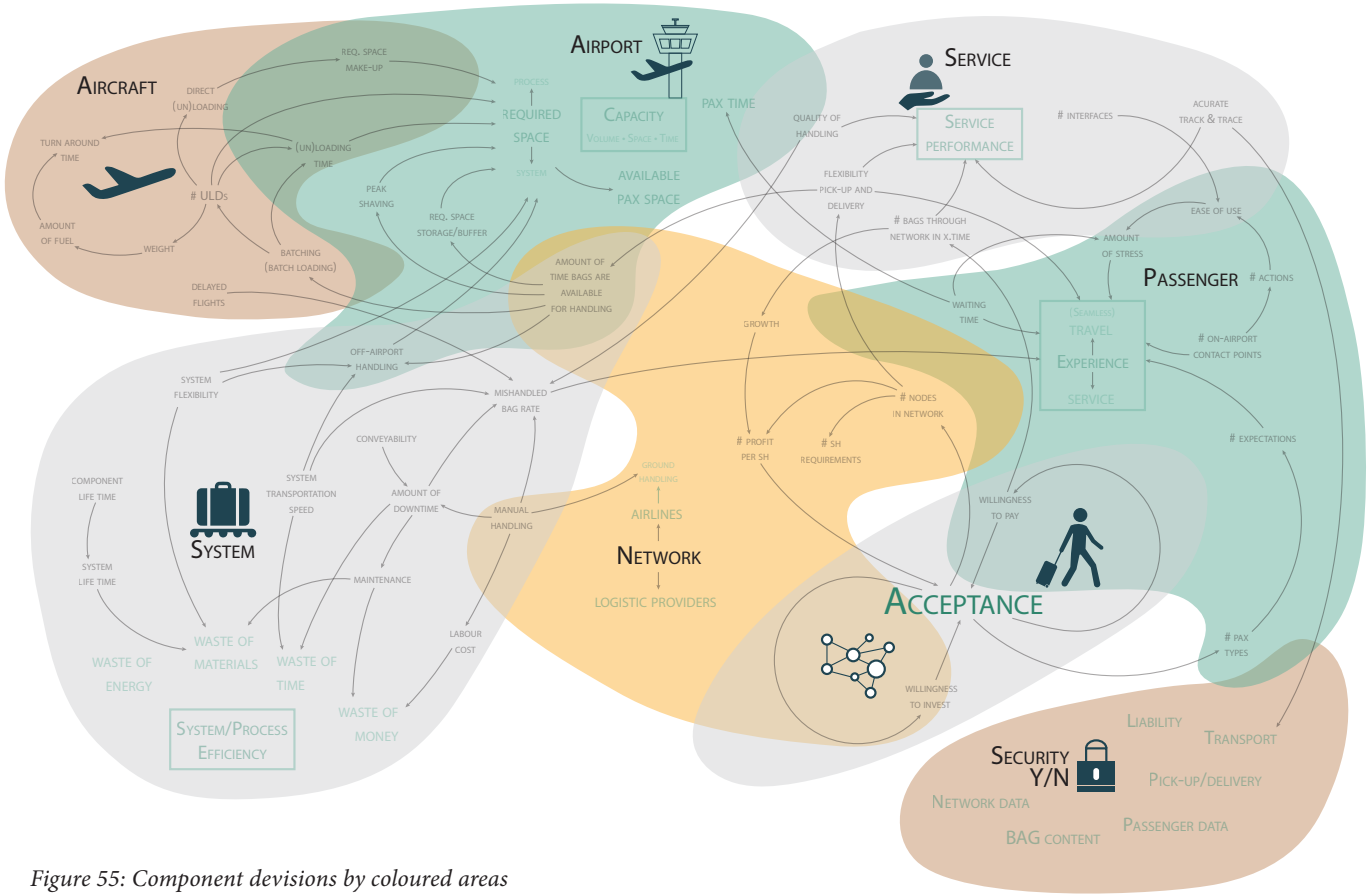


Figure 55: Component devisions by coloured areas

Component relations

The green interaction lines between the front end part of the components, shown in FIGURE 56, indicate that there is also a direct relation between the main variables of the components. These green lines can be explained as follows:

> When the airport capacity, related to the passenger throughput, and the service performance are increasing, the passenger experience will increase as well. Subsequently the passenger acceptance increases when the experience increases.
> Also when the security increases the acceptence of both passenger and network increases.

The four green arrows presented in FIGURE 56 are therewith representing positive relations between the main variable of the components.

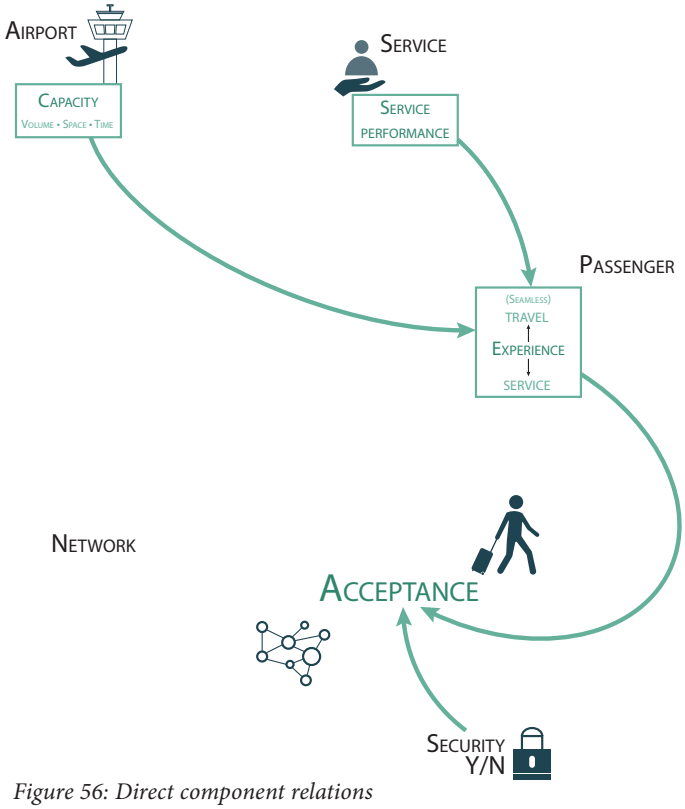


Figure 56: Direct component relations

VARIABLES

To be able to explain the interaction loop in detail, the model has been devided into several blocks, as can be seen in FIGURE 57. Each block and every variable within the block will be discussed separate from the other blocks. Block 1 to 6 represent the front end of the afternext service, block 7 to 11 represent the back end.

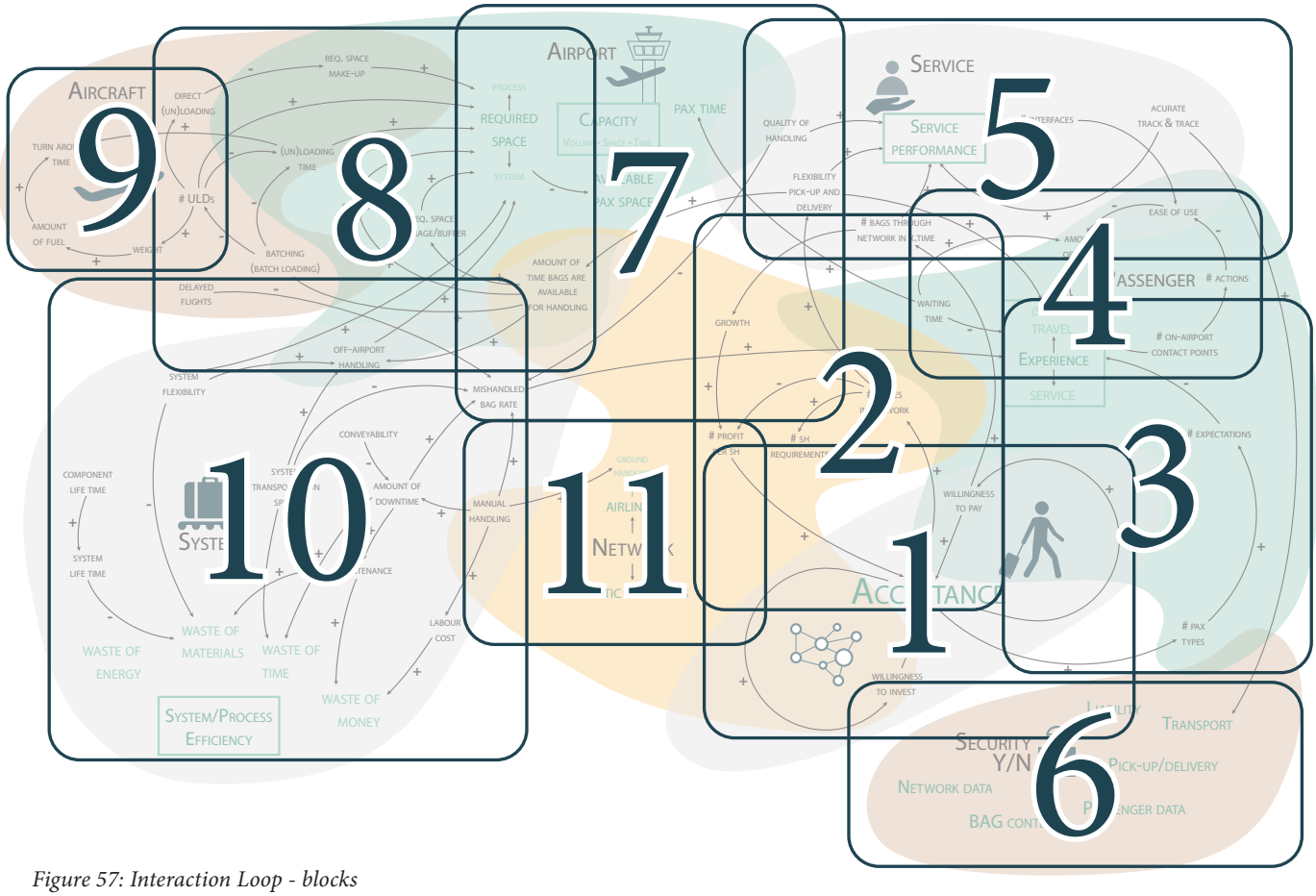
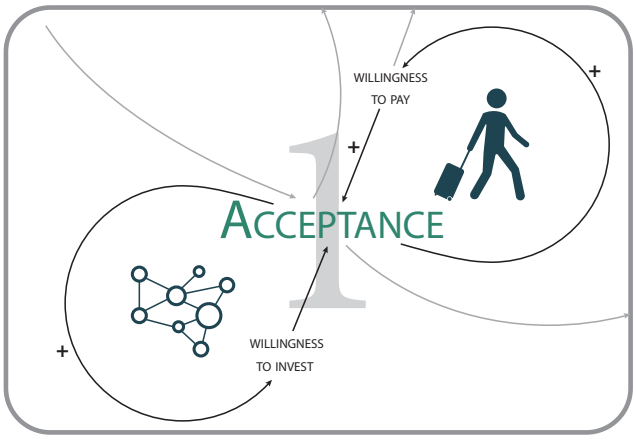


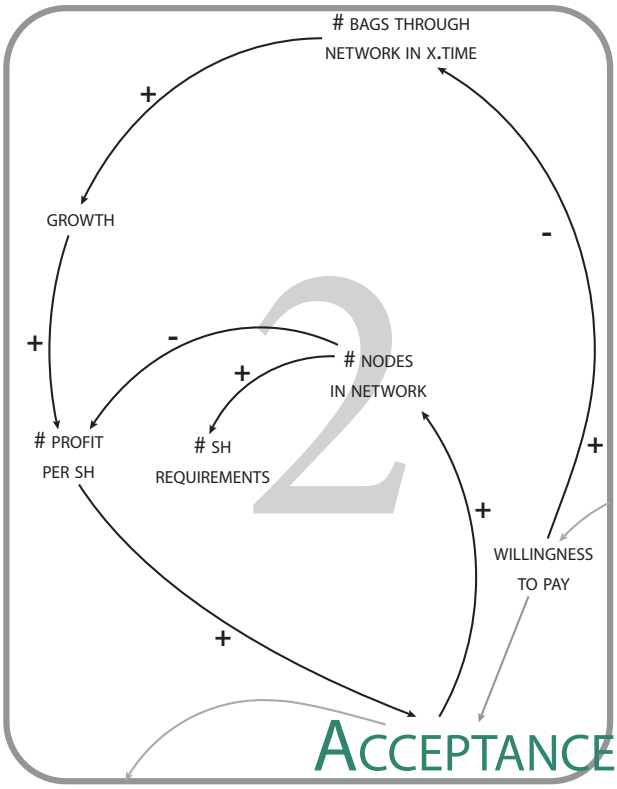
Figure 57: Interaction Loop - blocks

Front End



1.
For the component acceptance, an interesting loop is defined as can be seen in the first block. As explained before the acceptance is twofold; passenger acceptance and network acceptance. When the passenger acceptance increases their willingness to pay for the service increases. Also, when the network acceptance increases the willingness to invest increases. These two types of acceptance also strengthen each other, since the network acceptance increases when the passenger acceptance increases and vice versa. Hence the loop presented by the arrows.

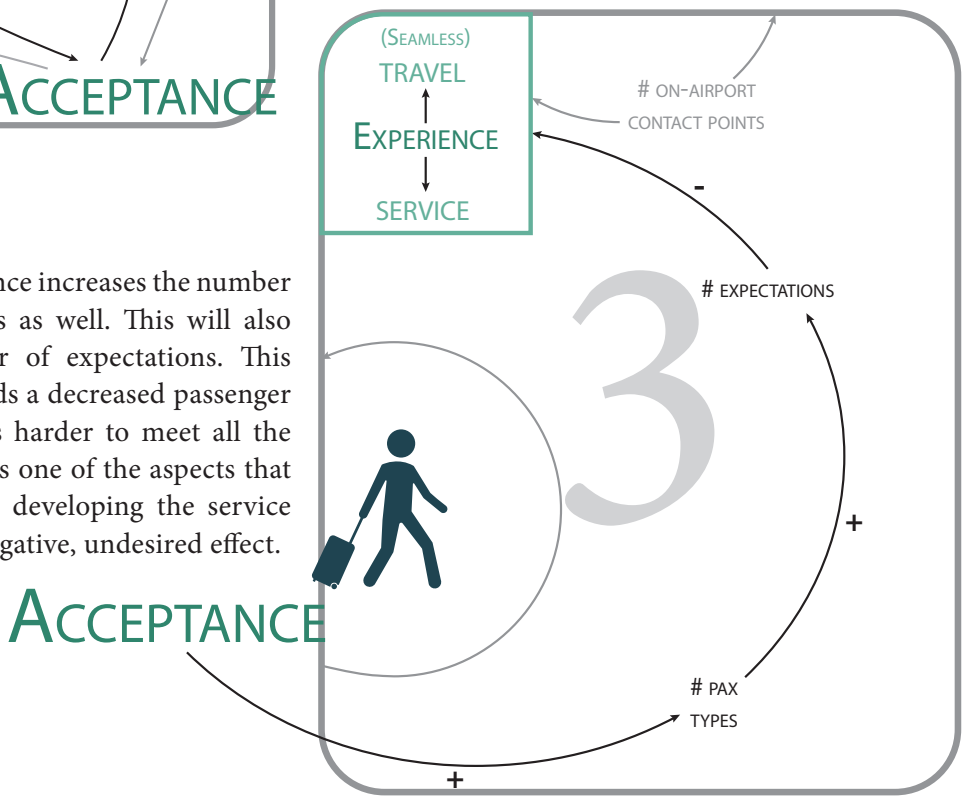
2.
When the network acceptance increases, it is likely that more parties want to enter the network and therewith the number of nodes in the network increases. When the number of nodes in the network increases the amount of stakeholder (SH) requirements increases as well. Admitting to every (new) requirement could potentially be a thread for the service. Therefore, it is important to have clear service conditions defined from the beginning. This does not mean that the conditions cannot change over time.

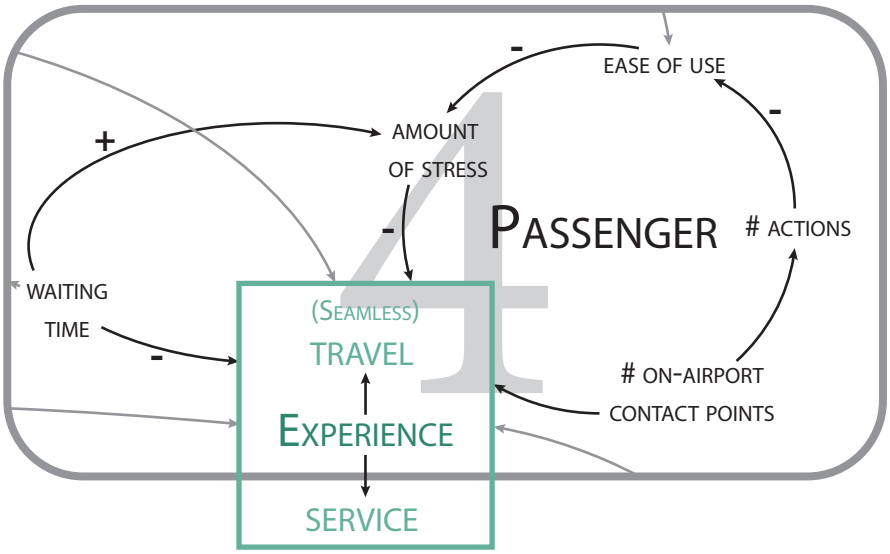


The number of nodes is also related to the profit per stakeholder. This relation could include multiple scenario's. For example, when the service includes fixed prices for passengers and the number of bags that travel through the network is constant but the number of nodes in the network is increasing than the profit per stakeholder decreases. The profit per stakeholder is again linked to the (network) acceptance, since naturally the market becomes more attractive when the profit increases.

When the passenger acceptance and therewith the willingness to pay for the service increases there will be an increased number of bags travelling through the network within a given amount of time. This will cause network growth which will cause an increase of profit per stakeholder.

3.
When the passenger acceptance increases the number of passenger types increases as well. This will also cause an increased number of expectations. This could potentially lead towards a decreased passenger experience since it becomes harder to meet all the different expectations. This is one of the aspects that should be considered when developing the service since this can be seen as a negative, undesired effect.





4.

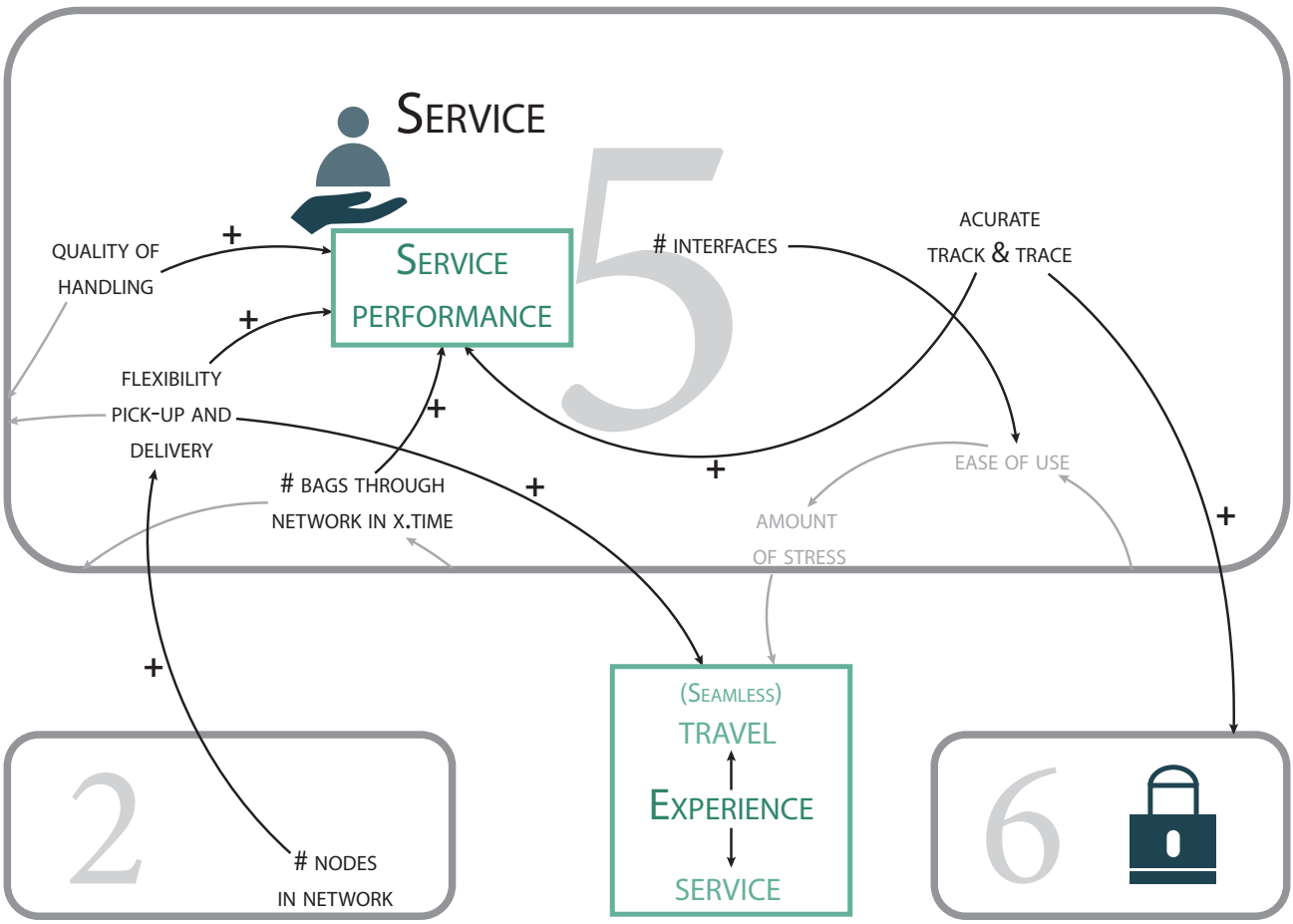
The component passenger experience does include both travel experience and service experience. As presented earlier in this research waiting time is one of the inputs for the passenger experience; when the waiting time during the passenger's journey increases the travel experience decreases.

Furthermore, when the waiting time increases the amount of stress increases as well, also causing a decreased travel experience. When the ease of use of the service is increasing the amount of stress will decrease.

It could be discussed if the decreased travel experience due to waiting time is merely caused by stress. The direct link between waiting time and passenger experience could in that case be removed. Since this is not clear yet, both interactions are included. Becuase of this, the variable waiting time has a higher influence on the complete model, since it includes more relations, as explained before.

The passenger journey presented in FIGURE 13 ON PAGE 37 showed some (hold) baggage related steps. When introducing a d2d baggage service some of these steps will change or disappear, resulting in less on-airport contact points for passengers. On-airport contact points are opportunities for parties to contribute to a positive passenger experience. However, to many contact points could have a negative contribution. Further research should indicate whether there is an optimal amount of contact points to give the best experience possible. This also might differ per passenger type, since some passengers prefer moments of interaction at the airport and others just want to continue as independent as possible.

The interaction between the number of on-airport contact points and the number of passenger actions is not clear yet. However, it may be evident that there is a link. When the number of airport contact points decreases, it could mean that passenger must take more actions themselves, however it could also mean that there are less actions to take. Nevertheless, when the number of action decreases the ease of use increases.



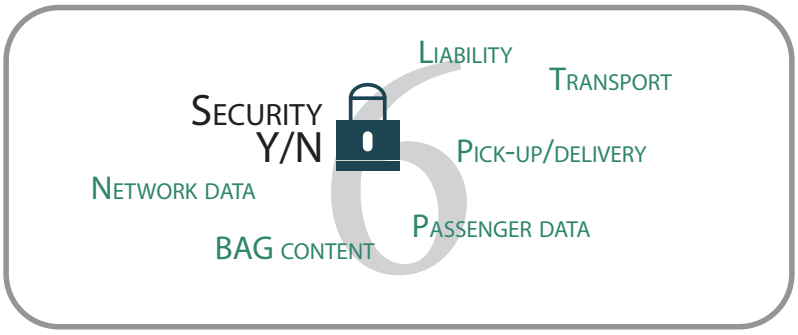
5.

Another aspect related to the ease of use is the number of service interfaces. which can be found in the fifth block. No plus or minus is presented along the arrow since further research should indicate what the excact relations is.

The most interesting variable of the service component is defined as the service performance. The service performance is again depended on the (1) quality of handling, (2) the flexibility of pick-up and delivery, (3) the number of bags travelling through the network in a given amount of time and (4) an accurate track and trace of bags. When one of these variables is increasing the performance of the service is increasing as well.

Where the service performance is influencing the passenger experience, as indicated by the green lines presented in FIGURE 56, the flexibility of pick-up and delivery is also directly influencing the passenger experience. When this variable is increasing, the experience increases as well. The flexibility of pick-up and delivery increases when the number of nodes, i.e. the amount of parties within the network increases.

The fourth aspect of the service performance has to do with accuracy, represented by the variable 'accurate track & trace'. When the accuracy of the track and trace is increasing, the security is increasing as well.



6.

The component security includes several aspects. If one of the aspects is not secure the whole service is not secure. Therefore, the relation of the security with the rest of the model is indicated with Yes/No. Most of the aspects below speak for itself, when needed some explanation is given:

- Secure transport; including transfer between parties
- Secure pick-up and delivery; related to liability
- Passenger data; both within the platform (registration) and within the network. For example details about pick-up and delivery.
- Liability
- Bag content; this aspect is twofold:
  (1) it is safe for parties within the network to transport the bag. This means no illegal content (import/export) or for example bombs
  (2) can no one access the content of the bag. So no pilfering or adding (illegal) goods to the bag.
- Network data; mainly within the platform

Back end

7.

In the seventh block, two variables from the service component are making a link with the back end of the service. First of all, the quality of handling, second the flexibility of pick-up and delivery. When the quality of handling is increasing the mishandled bag rate will decrease.

At this point, the variable "amount of time bags are available for handling" is only influenced by the flexibility of pick-up and delivery. Caused by the , in this model, disconnection of the passenger journey from the service. However, it may be evident that the pick-up and delivery is also dependent on passenger needs as well as regulations. For example:

- passengers require their bags to be picked-up not earlier than a few hours before their flight
- regulations still require that passenger and bag must travel in the same aircraft

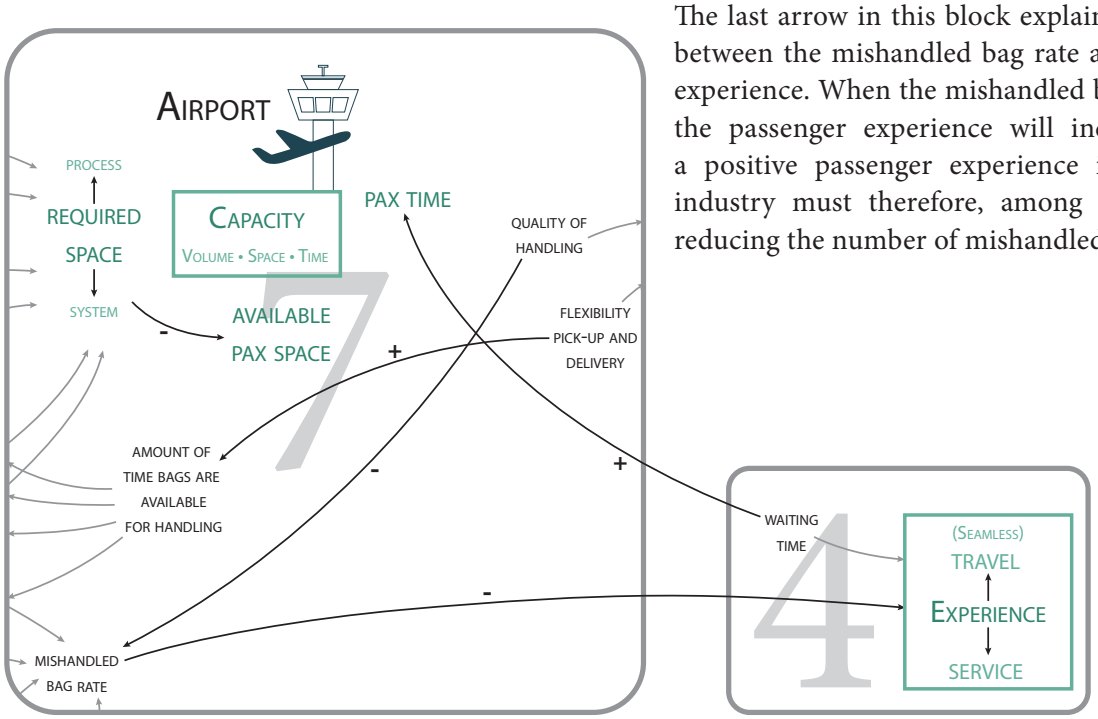
Together these two aspects contribute to a limited time to handle the bag.

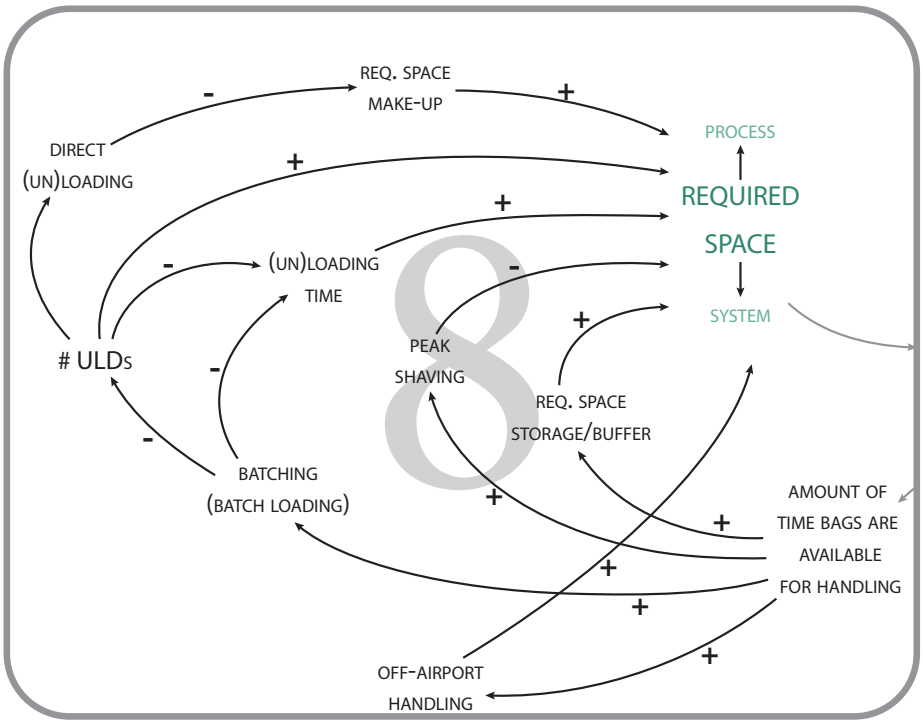
Another scenario could be included here; for example, passenger and bags do not have to travel in the same aircraft anymore, and therefore bags are travelling as cargo or even via another airport. This has major influence on the flexibility of the service and the time bags are available for handling.

As defined at the beginning of this research; airport capacity is about the passenger throughput related to number of passengers, available space and the time passengers spent at the airport.
The passenger time in this model is related to the waiting time at airports. When the (new) passenger journey includes less waiting time at airports, the time passengers are required at an airport decreases. This could be beneficial regarding the airpot capacity.

The other two aspects of capacity presented in this model are related to space. When the required space for baggage handling systems and the baggage handling process decreases the available space for passengers increases. The factors that influence the required space for process and systems are explained in the next block.

The last arrow in this block explains the connection between the mishandled bag rate and the passenger experience. When the mishandled bag rate decreases the passenger experience will increase. Naturally, a positive passenger experience is desirabed, the industry must therefore, among others, focus on reducing the number of mishandled bags





From now on the variables and interaction will be explained in a slightly different way. The reason for this is that some of the variables are enablers, more than a cause. Also, the comparison with the current situation becomes more important and several scenarios are included. This will become clear when explaining the first variable of the eighth block.

8.

The potential impact when the amount of time bags are available for handling increases is defined in four aspects: off-airport handling, batching, peak shaving and required space for storage/buffer.

For the last one mentioned, the following applies: when 'the amount of time bags are available for handling' increases, the required space for storage/buffer increases as well, therefore the required system process space at airports increases which leaves less space for passengers.

For the other three aspects, the 'amount of time bags are available for handling' is an enabler to possibly decrease the required airport space for system and process. When bags are available for a longer amount of time:

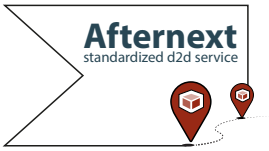
a) bags can be handled at a different moment, desirable when the systems are not operating at their peaks, i.e. peak shaving (see FIGURE 22).

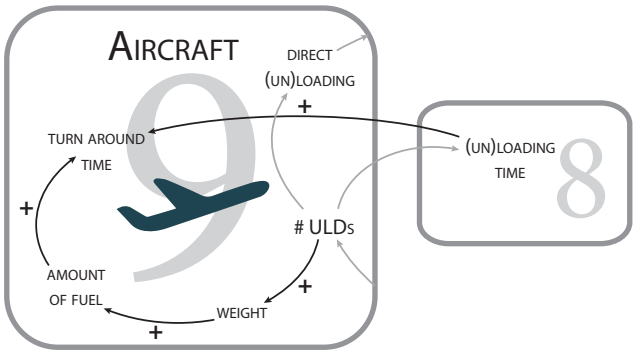
b) they can be handled (e.g. scanned, sorted) off-airport and possibly sent as a batch to the aircraft

c) they are available for batching. When bags are batched and locked together it will decreases the (un)loading time of the aircraft. Therewith the required space for the baggage handling (for instance and the apron) decreases.

Batch loaded bags, provided that the bags are locked together, could replace ULDs. Less ULDs will also decrease the required space at airports (for instance the storage space of empty ULDs). Currently, an increase of ULDs will cause a decrease in loading time. Further research should indicate what the role of ULDs could be in the afternext service with standardized bag.

A possible link when removing ULDs from the process could be direct (un)loading of the aircraft, for example by means of an AGV. When the direct aircraft (un)loading increases the required make-up space decreases and therewith the required system/process space. However, it would also require space for new processes.





9.

A removal of ULDs has now been mentioned a few times. This next block indicates why it is interesting related to aircrafts. When the number of ULDs decreases, also the weight of the aircraft decreases. When the aircraft total weight decreases the amount of fuel decreases as well. As explained before, refuelling the aircraft is influencing the turnaround time. Therefore, when the amount of fuel decreases, the turnaround time cold possibly decrease as well. Another factor influencing the turnaround time is the aircraft loading and unloading. This could also include passenger (un)loading, however this is not directly related to (hold) baggage. However, when the afternext service has an impact on carry-on luggage the passenger (un)loading could be considered as well. Since boarding takes extra time when passengers take extra hand luggage.

10.

The last block includes most of the interaction related to the systems. The system/process efficiency is defined by four factors: waste of energy, waste of materials, waste of time and waste of money. The first things that should be noticed is that there are no connections drawn to waste of energy. At this point, there seems to be no direct link between a standardized bag and waste of energy. However, energy efficiency of the systems is an important focus within the industry.

Starting and the mishandled bag rate, earlier mentioned when discussing the seventh block, there are four causes that could influence the mishandled bag rate: delayed flights, system transportation speed, the amount of downtime and manual handling.

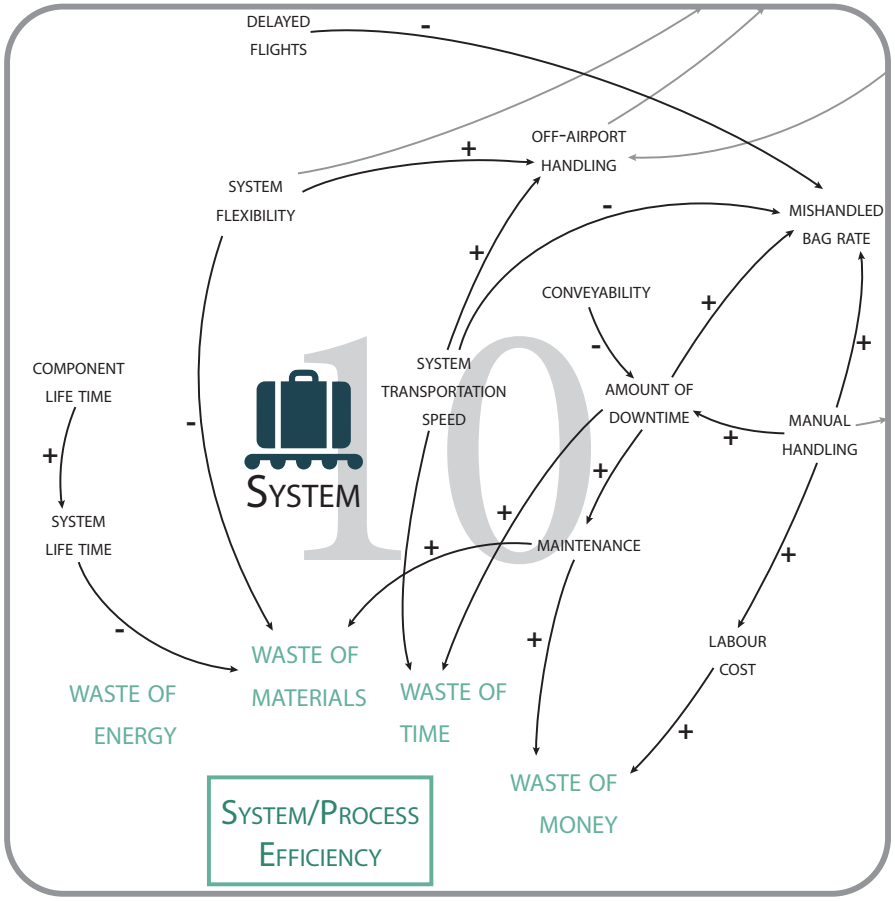
As defined earlier, the mishandled bag rate includes delayed, damaged, pilfered, lost or stolen bags. The earlier explained quality of handling (block 7) can relate to each of these types of mishandling, however, that does not count for the four variables discussed in this block.

A large number of mishandled bags are related to delayed flights with bags that need transfer. This factor is not easily changed when introducing a standardized bag, since the delay of flights is depend on many factors including weather, air traffic and mechanical problems.

Three other factors are represented that influence the mishandled bag rate:

a) manual handling; as indicated before most errors happen during manual handling. A bag might be classified by an operator in a wrong category or get lost when put aside during one of the process steps. Also pilfering is related to manual handling. Therefore, when the manual handling decreases the mishandled bag rate will decrease.

b) amount of downtime; when for instance a bag with straps gets stuck in the system (hence the interaction between the variable conveyability and downtime) it could cause downtime and damage to both the system and the bag. Since damaged bags are also included in the mishandled bag rate the



interaction can be explained as follows: a decreased amount of downtime will cause a decrease in mishandled bag rate. This example refers to operational downtime. Another type of downtime is the technical downtime. Technical downtime could also cause bags getting delayed and therefore influences the mishandled bag rate as well.

c) system transportation speed; when the system transportation speed increases there is, for example, a higher change that bags from delayed flights could still make it to the next one (in case of a transfer), therewith decreasing the mishandled bag rate.

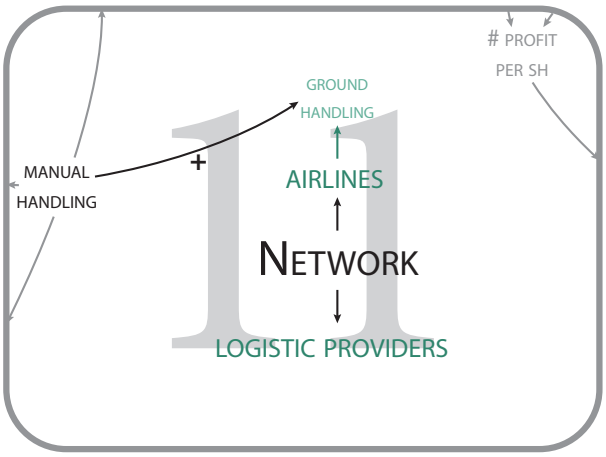
Downtime of technical ground has the highest impact on the maintenance of the system, resulting in less waste of money as well as materials.

Regarding manual handling, when this decreases the labour cost will decrease as well, resulting in less waste of money.

At this point, the waste of materials is related to three factors. The aforementioned maintenance, the system flexibility and life time of both system components. When the component life time increases, the systems life time increase and therewith the waste of material decreases. This aspect is also linked to sustainability, which is of course an important driver for system efficiency.

When the system flexibility increases, for instance when conveyers or transport systems can be placed at lager angles when the load becomes more predictable, the required space for the systems decreases, i.e. the systems could become more compact.

More flexibly system and higher system transportation speed could be enablers for off-airport handling. Which again reduces the required space for the systems at airports. For example, the TUBTRAX system presented in "Automation" on page 24 can reach speeds of 14m/s. One of the restrictions on the speeds are the bags that are placed in the TUBS. It could be that the speed could even increases when a standardized bag would be the TUB traveling through the systems (so no separate/loose element). However, this would have a major impact on the wear and tear of the bags. Therefore, it is more likely that the standardized bag needs a carrier within the system. But a perfect fit between carrier and bag could already make a difference and speeds could possibly be higher.



11.
The last interaction worth mentioning is the relation between manual handling and ground handling. Namely, when manual handling is decreasing it will also cause a decreased need for ground handling in its present form.

Figure 58 on page 96 shows the full scale model of the Interaction Loop.

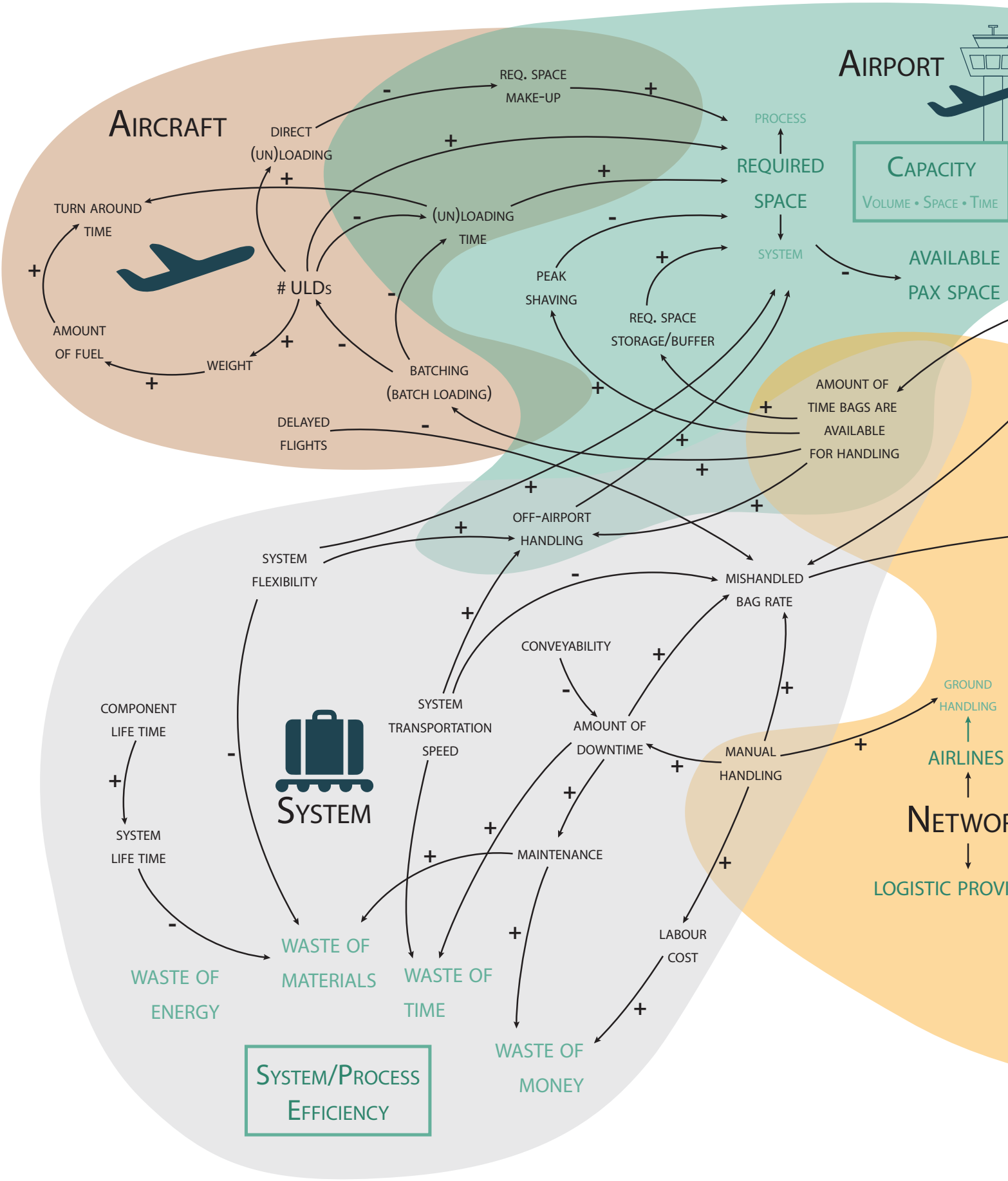
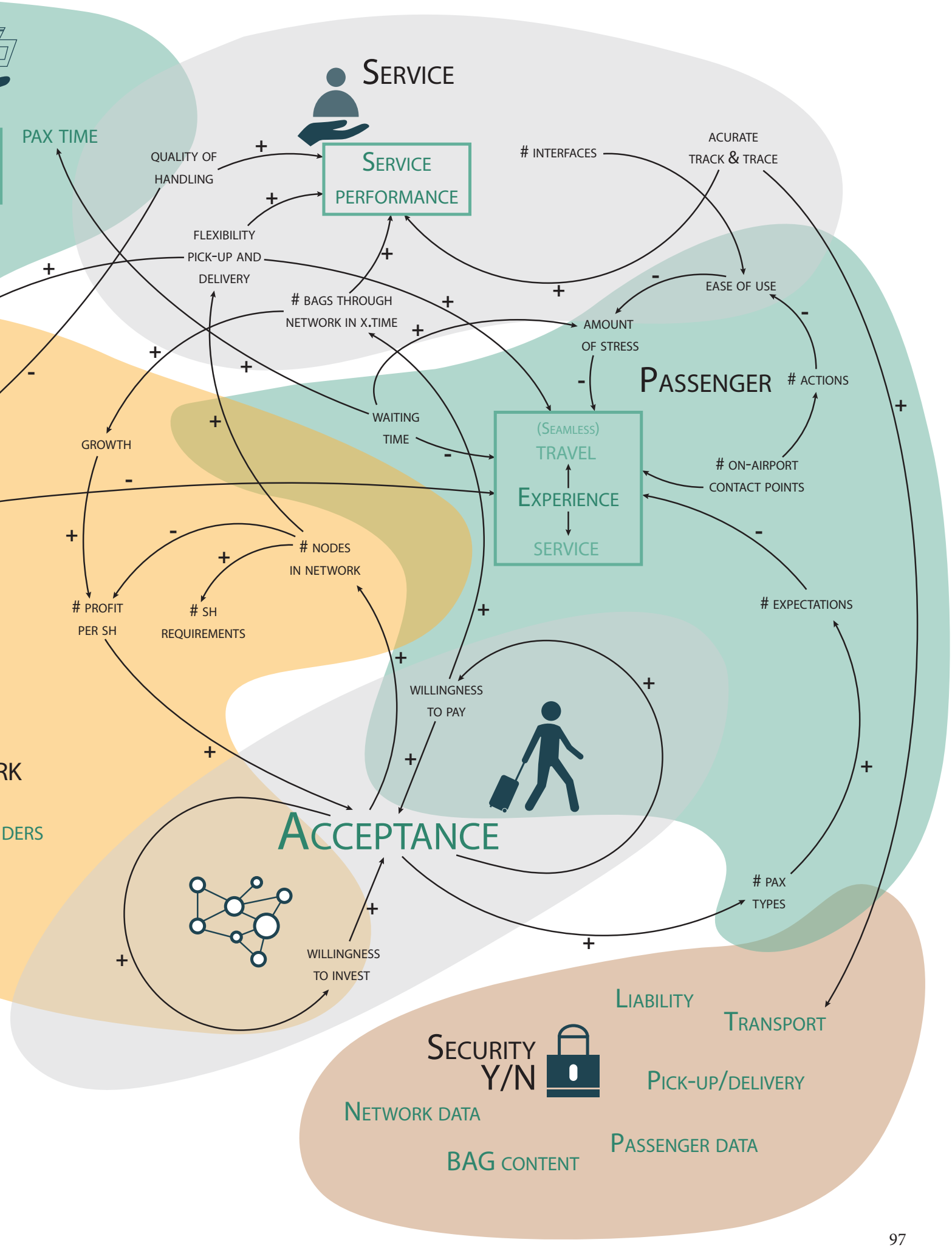


Figure 58: Interaction Loop


SERVICE
PAX TIME
QUALITY OF HANDLING
SERVICE PERFORMANCE
FLEXIBILITY
PICK-UP AND DELIVERY
INTERFACES
ACURATE TRACK & TRACE
EASE OF USE
BAGS THROUGH NETWORK IN X.TIME
AMOUNT OF STRESS
PASSENGER
ACTIONS
WAITING TIME
GROWTH
(SEAMLESS) TRAVEL EXPERIENCE SERVICE
ON-AIRPORT CONTACT POINTS
NODES IN NETWORK
PROFIT PER SH
SH REQUIREMENTS
EXPECTATIONS
WILLINGNESS TO PAY
ACCEPTANCE
PAX TYPES
WILLINGNESS TO INVEST
LIABILITY
TRANSPORT
SECURITY Y/N
PICK-UP/DELIVERY
NETWORK DATA
PASSENGER DATA
BAG CONTENT

Chapter 5

Introduction

After presenting the afternext in the previous chapter, according to the Interaction Loop, the step towards the current phase of development can be made.

In the next it must become clear how the service evolves and what roles stakeholders have to implement the afternext. Since the Interaction Loop is a conceptual model based on future perspective, it should be developed further in the next. Several application of how the Interaction Loop can be used in the next are presented, such as a discussion tool or furher development into a probability network.

APPLICATION

During the iterations and discussion about the interaction loop it became clear that the model needs a clear goal to be able to use it.
First of all, the interaction loop as presented in this research can be seen as a first concept. Since many other variables could be discovered and (new) relations could be added. However, there are already a few possible applications imaginable.

The Interaction Loop is a first inventory, resulting in a conceptual model of the afternext. At this point the Interaction Loop can be used as a discussion tool, for instance when gathering several experts from different fields or departments, each with their own view and expertise. This will result in interesting discussions as was already happening at Vanderlande when validating the interactions within the model. A system engineer will probably put a lot more variables between 'amount of downtime' and 'maintenance' (BLOCK 10, PART OF SYSTEM COMPONENT) than is currently presented. And someone who is focussed on the passenger will put the passenger in the centre of the Interaction Loop.
When the Interaction Loop would be further developed, it would be possible to write a statistical model based on it. For example, by means of a Bayesian Network (Bayesia, 2017). A Bayesian Network is a probabilistic network where interdependencies between variables are represented. There will be other network theories which are applicable to this Interaction Loop, since this is not included within this project it should be further researched.

Based on how these kinds of models work, it can be stated that the variables that have most interactions within the network, those are the nodes in the model having the most impact. As the Interaction Loop is designed now, this would include acceptance, passenger experience, amount of time bags are available for handling and mishandled bag rate. Therefore, it can be concluded that based on this model, these variables are most important.

In a Bayesian Network, there are several types of interactions which can be modelled:

- Percentage (e.g. mishandled bag rate)
- Yes/No relations (e.g. security)
- Scale (e.g. satisfaction)

However, when such a model would be developed, there should be data present to be able to calculate the desired probabilities. However, since the model is representing the afternext, i.e. a future service, there is no data available yet. Therefore, when some parties think that one or more areas within the model are worth exploring or modelling, data should be generated within the next.

For example, since the weight of ULDs is known, as well the relations between aircraft weight and the amount of fuel (BLOCK 9, AIRCRAFT COMPONENT), this part of the model can already be modelled. Also, the amount of fuel related to the (re)fuelling time is known data within the aviation industry, which is influencing the aircrafts turn around time. However, the impact of a standardized bag on the (un)loading time which is impacting the turn around time as well is unknown since there are no standardized bags yet. This is again also dependent on the number of standardized bags (i.e. the service acceptance, growth, etc.) and the number of ULDs that could be replaced by the interlocked standardized bags. On the other hand, when assuming that the loading of (interlocked) standardized bags is similar to the loading of ULDs, data is present. But again, when the standardized bag would enable direct loading of the aircraft, this variable would change again.

As might become clear from this example, there are many variables, many uncertainties but most of all many opportunities for this Interaction Loop. And in the end, it makes clear that for every party within the industry, their actions are indirectly influencing the passenger's travel experience and in case of the afternext their service experience as well.

Steps to be taken in Next

During the next phase of development certain elements of the afternext service need to be defined before the afternext can be implemented. An indication of this elements is represented in a set of questions or design issues per component. The standardized bag is not addressed since it will be separately discussed in "Chapter 6: Standardized Bag".

Service

• What is the desired number of bags processed through the network (in what time)?
• What is the quality of the handling i.e. damages on bags?
• What pick-up and delivery time-span customers want or can expect and how can these be met?
• How to ensure pro-active problem management?
• Since the weakest link in the systems will determine the PAX expectation: what will be the weakest link and how to improve this link (or even prevent it)?
• How to ensure an accurate track & trace across the network? (For both network and passengers)
• How/where can passengers apply for the service?
• What are passengers willing to pay for the service delivered? Possibly passengers are willing to pay more when the service level is higher.

Security

• Does the bag need to be sealed?
• Who is responsible for the bag (network related)?
• How to deal with privacy issues, both passenger data and bag content?

Airport

The envisioned afternext will have impact on the required terminal space for luggage, and airports should carefully plan the available space.
• Will cargo travel with passenger flight and luggage with cargo flights?
• How should the airport deal with luggage as cargo? Does it lead to a new category concerning import and export duties? “Baggage-cargo”
• Airport is now partly owner of the luggage data stream, what about afternext?
• Where will the luggage enter the system? Airside? Where is it cleared?

Network

• What are the main nodes in the network?
• What is the desired number of nodes in the network? Here it is important to keep in mind that the efficiency of the network will determine its profit. The number of nodes and the relations between the nodes will influence this efficiency.
• How will the passengers fee be distributed in the network?

Passenger

• There are several passenger types, how to adress different types of passengers for this service? Frequent flyers could be early adopters of this service, since they are used to exposure of other technological innovation within the industry.

• Passengers expectations are an important input for the development of the service. As can be derived from the trends (see "Trends" on page 60) passengers:

- expect to be connected and informed;
- expect to receive a high level of service but still the lowest prices
- desire a seamless (absence of disruption) travel experience (which is personal to every passenger);
- demand a personalized, tailored service
- demand transparent communication which could mean that passengers receive the same information as airlines on their bag status.

Also, the moment information is received is important. The information should be relevant and accurate at the right time and location.

• The service should have a minimum amount of actions for passengers, however, it should still show a secure service and process. Here an optimum should be found between ease of use and security.

• Application that are part of the service platform should be fast, ease of use, adaptive to different devices and location based.

• What emotions are desired and how to stimulate these?

Aircraft

• How could a standardized suitcase influence the design/lay-out of an aircraft?

Acceptance

• What will cause acceptance?

• How to make passengers willing to hand over their bags?

• What do we have to do to make people trust the service?

• How to find a balance between ease of use and the feeling of a secure service (since it should not be too easy to use the service)?

System

• Does a standardized bag requires a new, separate system or will the bags be transported on current systems?

• How is backward compatibility organized? Meaning, if not all airports aquire specific systems for standardized bags, how to ensure they can still process the bags?

• Which current process steps can be eliminted in case of the afternext service? Are there any?

• Does the standardized bag need a dedicated carrier?

• The standardized bag will travel through both the parcel as well as the baggage systems. How to ensure efficient transport of standardized bags over both systems?

General Questions

Besides the questions and design issues per components, there are also general questions that should be anwerd or designed.

- Who is going to be the afternext service provider? Could Vanderlande for example do such things?
- What is needed to be this service provider?
  - Understand industry, able to communicate with passengers, logistic network (worldwide)
  - IT expertise
  - Customer service focus
  - Trusted party within industry, reliable
  - Standardized bag: outsource or develop internally
- As foreseen within the model, when the acceptance increases, more different types of passengers will be part of the service resulting in more expectations and expactions will become harder to meet. What expectations may different type of passengers have and what solutions can be found to anticipate on this.
- When assuming that passengers are more likely to accept a d2d service with standardized bag when they are already used to d2d baggage service, what can be done to make the d2d service accepted (via the airport)? What is needed for this?
- What should the airport facilitate to make this service happen? (Is the airport needed and whatfor?)
- What should the airline facilitate to make this service happen? (Is the airline needed?)

Unknown relations

Furthermore, there are also unknown relations presented in the model.

- On-airport contact points - passenger experience
- On-airport contact points - number of actions (for passengers)
- Number of interfaces - ease of use of service
- Number of ULDS - direct (un)loading
- Waste of energy

For these relations it is clear that there is a relations present, it may also be clear in what direct (i.e. what variable is the cause and what variable represent the effect). However, it is not clear whether these relations should be reprented by a plus or a minus. Finding what these interactions include will be part of the next.

Chapter 6

A standardized bag

Introduction

The goal of this research included the requirements for the standardized bag. The standardized (Std.) bag was excluded from the Interaction Loop before to increase the readablity of the model. In this chapter a few things will become clear:

- requirements for the standardized bag as appearing in the interaction loop
- at what points is the the standardized bag an enabler and for what variables
- basic design steps of what the standardized bag could look like based on the requirements

REQUIREMENTS

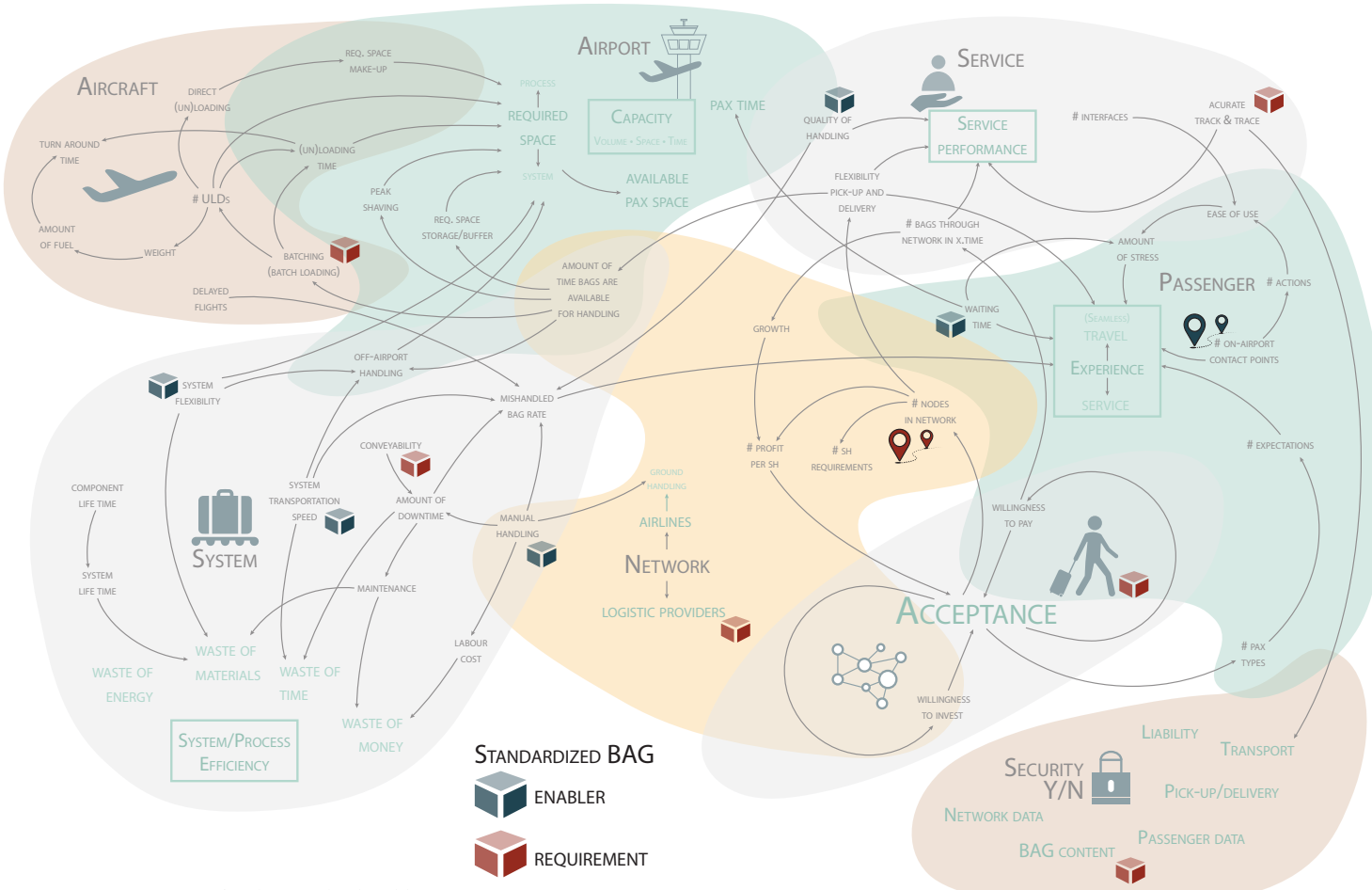


Figure 59: Requirements for the standardized bag

As mentioned before, during the iterations of the model it became clear that the standardized bag did not fit as an area within the model. And therefore, until this point it has not been shown. Now the question is for what variables the standardized bag could be an input or enabler. This is mainly important for the variables which do not have an input(arrow) yet. Also, some variables require certain characteristics for the standardized bag. FIGURE 59 shows the same interaction model, now including icons of a standardized bag. The two coloured bags either represent the Std. bag as an enabler or input to a certain variable or the icon representes requirements for the Std. based on the variable. The requirements include but are not limited to the ones mentioned. An overview of the Interaction Loop including both standardized bag and relations with polarity can be found in APPENDIX F.

The requirements from the process on the standardized bag:
• Interlockable; then it becomes an enabler for batch loading without ULDs
• One material type (to increase the predictability which allows for automation)
• Restricted in at least one dimension
• Effective storage of empty standardized bag

The requirements from the stakeholders within the process (including which stakeholder):
• Portable (logistic providers)
• Hygienic (passenger)
• Lock; the bag has to be secure (logistic providers, passengers)
• Chip; to ensure an accurate track & trace (passengers, logistic providers)
• Personalization of journey and/or bag (passenger)

Requirements for d2d service:
• Scalable (derived from the vision presented earlier in this research)

The consequences of a d2d service for stakeholders:
• Airports need a drop-off point for standardized bag by logistic providers, possible airside, possible bags are already batched, possibly cargo, etc.
• The service provider might become in controle of passenger data which is currently exchanged between airport and airline. The party who is in charge, is the party in control of the passenger data and baggage data
• Investment needed for parties when entering service network

The consequences of standardization for the stakeholders
• Current ground handling tasks will change or even disappear
• Possibly new systems can be designed which fit the Std. bag. Airports need to invest in new systems if the new process does not include backward compatibility.

The standardized bag as an enabler
The Std. bag is an enabler for increased process quality of handling through process automation and less damages and mishandled bags.

The Std. bag is also an enabler for higher system tranportantion speed, increased system flexibility and less manual handling.

The d2d service as an enabler
As presented in FIGURE 59 as well, the d2d service is an enabler for less waiting time at airports. Which influence both the passenger experience as well as the airport capacity in a positive way.

Design

Figure 60, on the right page, shows a visual representation of the requirments presented in the previous section. It shows how the most ' logic' bag, based on the Interaction Loop is created.

The design of the bag will start with a (squared)box, the most basic type of standardization. As can be seen on top, there are 3 sizes included, for exampe to meet passengers in their wish to have a perzonalized journey. With 3 sizes passenge are able to choose. These size could also be based on the amount of weight that is allowed. When including different sizes in the service, at least 1 dimension should be restricted.

To be able to produce such a Std. bag, roudings are needed. Also, the bags are design to contain personal belongings so it must be able to open it. The section line could still be in any direction.

As mentioned before, the Std. bag should consist of one material type (compared with current bags). This does not mean that the bag itself could not include multiple materials.
To enbale batch loading, the bags should be interlocked. Beside, it also needs a lock to secure the content for both the passenger and the network.

When the bags are shared throughout the network, hygiene is an important aspect. This could for instance be solved by providing a liner to the passenger which can be placed inside the bag.

For an accurate track-and-trace the Std. bag also requires a chip. It could also be an option to insert a display where information about the transport is displayed. However, the information could also be in the chip which can be read by logistic providers.

The last requirement presented in this overview is the portability of the bag. Whether by a handle or an external carrier, the bag should be transported by the logistic providers and even by the passenger at home.

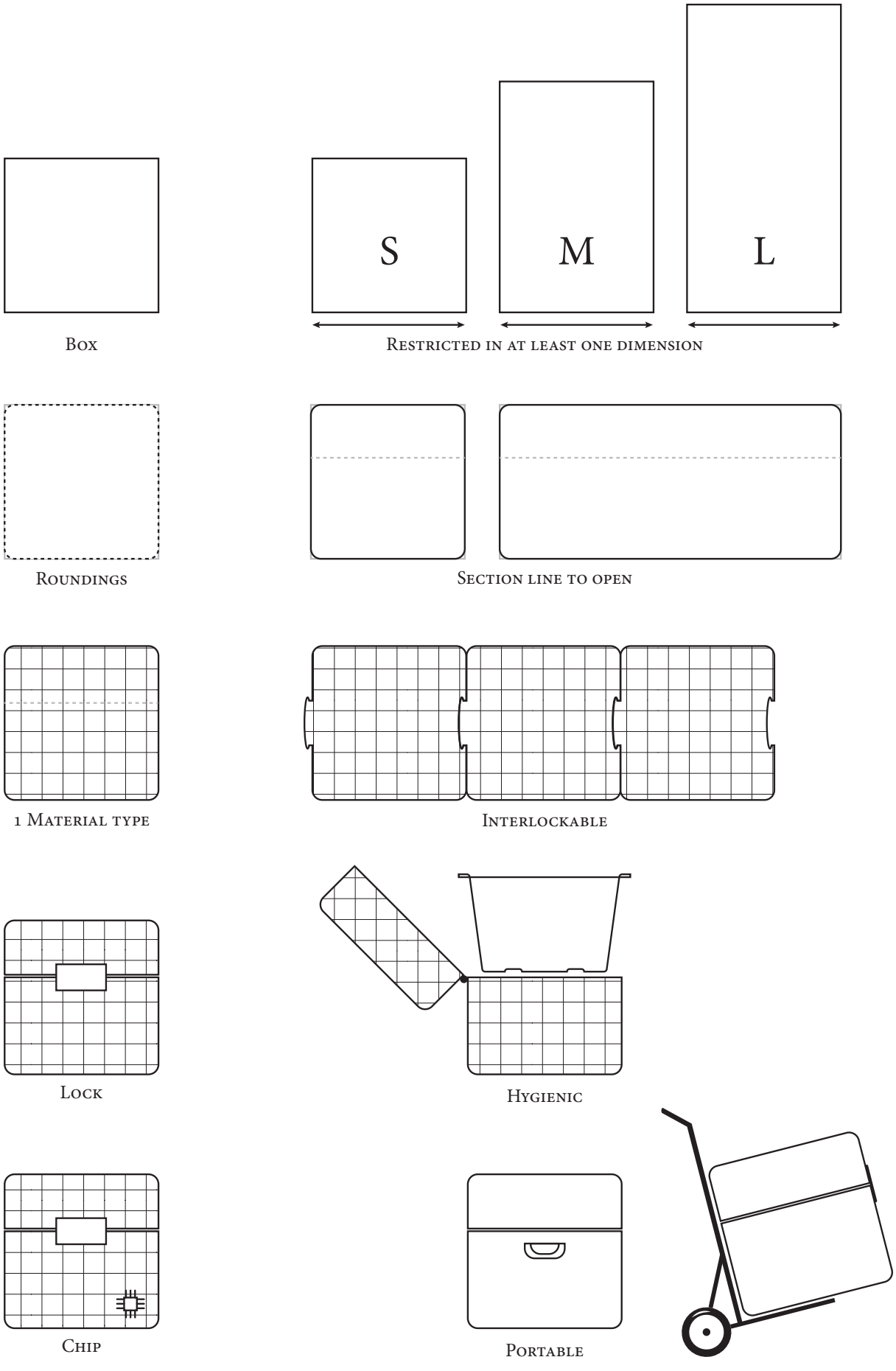


Figure 60: The standardized bag

Chapter 7

Conclusions

Introduction

The Interaction Loop as presented in this report can be seen as findings of the overall research. In this chapter a summary of these findings and the conclusions drawn from this research can be found.

Thereafter, the recommendations can be found. These recommendations are two fold; on one hand it presents the recommendation for this research, on the other hand recommendations for further development of the Interaction Loop.

Conclusions

This master thesis was initiated with the idea of door-to-door (d2d) baggage services as a possible solution to solve airport capacity issues. The goal of Vanderlande to optimize baggage handling systems through process automation created the initial assumption for this research: the implementation of a standardized bag.

Uncertainty concerning the impact of a door-to-door baggage service with standardized bag on the aviation industry has become apparent during the initial analysis. This lack of knowledge makes the realization of the d2d service is not feasible. After concluding this, the focus of this research has shifted to the understanding of the interaction between the consequences of this standardized bag and its subsequent requirements.

The aviation industry consist of a large variety of parties with different roles and relationships, therewith forming a complex network. Within the network, the identification of the relations between consequences and requirements of a standardized bag in the context of a d2d baggage service is realized and presented in an Interaction Loop. In the Interaction Loop the results of this research are mapped according to the context presented in the first chapter. Although the Interaction Loop has increased insight in the complex issue, there are still many variables and interaction to be found.

The Interaction Loop reveals the relations within a d2d service and indicates how different components affect the passenger journey in the end. The Interaction Loop can be applied as a tool for different parties within the industry, to indicate what their (future)

role within d2d services can be. Based on the current model, focus can be created concerning the further development of different areas (components) within the Interaction Loop. The Interaction Loop could thus serve as an input for a probability model in which the interdependencies of variables are calculated. Before this can be realized, the afternext service requires further development and data should be generated for this probabilistic model. The variables that have most impact within the current model are the following: acceptance, passenger experience, the amount of time bags are available for handling and the rate of mishandled bags.

By using current, next and afternext situations to describe the development towards a d2d baggage service, this feasibility study was structured. When creating a vision for the afternext, a certain level of assumptions are made since the industry is still moving in various directions. Therefore, the afternext is still largely conceptual and dependent on many possible scenarios. It is therefore impossible to draw direct conclusions or give practical or implementable recommendations for the next phase of developing d2d services. However, recommendations concerning which further steps can be made and how they can be beneficial to the aviation industry. Altough the Interaction Loop is based on the idea of a platform where goods and products are shared, it does not necessarily include a standardized bag. Therefore, the Interaction Loop can also be used during the next phase of development.

The assumption whether a standardized bag would optimize baggage handling processes, as stated in the research question, could then be answered by looking at where the standardized bag appears in the model as an enabler of a more optimal baggage handling system. From this research, this is apparent at the following elements:

- Increased system flexibility
- Less manual handling
- Higher system transportation speed
- Increased quality of handling

The standardized bag also enables reduced waiting time for passengers at the airports which therefore enhances the passenger experience. Besides, the d2d baggage service is an enabler for a reduced number of on-airport contact points. Since the passenger was not included in this research, the influence on the passenger experience should be further researched.

Regardless whether the Interaction Loop is a model for the next or afternext, certain requirements for a standardized bag can be found. The strength of the model here is that the motivation for certain requirements became very clear. Hence, the value of each requirement can be defined. The observed requirements are listed in CHAPTER 6.

Furthermore, current d2d baggage services indicate that the industry is already moving into the next phase of development. This has consequences for the development of the afternext, since the afternext needs to be implemented in the next. When the next is already present, the aviation industry should act, steering the next towards the desired afternext. However, there are many possible scenarios of the afternext, of which only a few have been elaborated on in this research. The strength of the current research can therefore be found in the examples given, which are possible scenarios for the afternext service.

Recommendations

Based on the previous presented conclusions, there are several recommendations which will be explained in this section. The recommendations are two-fold, on one hand it presents recommendations for further exploration of the research-topic. On the other hand, it presents the recommendations for further development of the Interaction Loop.

Interviews

This study included interviews with 8 parties from the industry. For both further development and validation of the Interaction Loop more interviews should be conducted. This could be more parties within the same field as well as more departments within one party. Unfortunately, there was no change to interview someone from a customs department. However, this is recommended for further development.

Passenger

During this study, all information related to passengers was taken from previous PASSME research. This provided enough insights to include the passenger in the study. However, this previous research did not include information on topic of a door-to-door baggage service with standardized bag. Therefor further passenger research on this specific topic should be done.

Also, the standardized bag should be further evaluated and should include both further passenger research as well as industry research. This will result in extra requirements for the standardized bag.

Approach

At the start of this study, a current – next – afternext approach was developed to structure the research. However, this also brought some limitations since the line between the phases not fixed, and the industry is subject to ongoing changes. Where the next is already changing, this will influence the afternext as well. Also, when the next is becoming the current, what will be the new next and new afternext? Using this kind of development phases includes redefining the phases every now and then. Further study might indicate this new definition when moving from the current into the next.

Service design tool

The afternext service is represented by an Interaction Loop which was designed for this study. Such loop

is not used in common (service) design toolkits. However, it might be interesting to develop it further in a service design tool to display relations within complex industries. In that case, the Interaction Loop should not only be further validated within the context of this research but also within other topics. This could indicate whether the Interaction Loop could be further developed into a tool.
Although the project became a service design project, no service design theory has been studied during this research. This aspect needs further attention in future study. It could also include whether the next should be pushed based on a suggested afternext or vice versa.

Probability network

As indicated in this thesis, the Interaction Loop can be further developed into a probability network. As an example, a Bayesian Network was suggested, however there will be other comparable network theory available which could be applied to the Interaction Loop. Further research should be executed to find the most suited model after which the Interaction Loop can be developed according to that.

As presented, the next step is to evaluate the core components, to indicate what the most relevant areas are and to start gathering data for these variables to be able to quantify them. Only than the full potential of this Interaction Loop can be achieved.

Missing relations

The current Interaction Loop is still missing many relations. For example, relations between the network and other components as well as parties within the network. Not only relations are missing, other variables could be added as well, which also causes new relations. Further study of the aviation, baggage and parcel industry, for example by executing additional interviews, will indicate where these new variables and relations can be added.

Scenarios

The vision created for the afternext was the base for the development of the Interaction Loop. However, as indicated throughout the thesis, there are multiple scenarios possible. Generating multiple visions, possibly with various parties from the industry, will give opportunities to develop the afternext in a different direction.

Function analysis

The function analysis for the baggage handling systems and airport processes, is executed on a high level, without many details, to present the information that was needed for the continuation of the research. However, it would be interesting for the optimization of the systems to further examine some processes in depth, translate them into corresponding needs and find where these can be met with a standardized bag.

Stakeholder analysis

The different types of stakeholder interaction should be further developed and validated. There might be other parties which should be included as well. Also, it is recommended to create a new stakeholder map for the afternext service and see how interactions have changed. Parties need to be aware that their business might change due to standardization. As presented the ground handling will change. Further research could indicate what new roles these parties could occupy.

As presented, the next step is to evaluate the core components, to indicate what the most relevant areas are and to start gathering data for these variables to be able to quantify them. Only than the full potential of this Interaction Loop can be achieved.

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Appendices

The list below gives an overview of the appendices which can be found in the digital version of this thesis.

Appendix A: **Interview Guide**

Appendix B: **Summary of Interviews**

Appendix C: **Function Analysis**

Appendix D: **IATA Baggage categories**

Appendix E: **Passenger Journey Marie**

Appendix F: **Interaction Loop**

A

This is an example of one of the interview-guides used during this project. The interview guides where changed based on the company and previous interviews.

Interview Guide

Interviewer:	Lisanne Boersema
Interviewee:	Dennis van der Noll
Company:	TNT Express
Function (LinkedIn):	Senior commercial supply chain specialist logistics and mail; *Logistic Supply Chain management and process optimization*
Date:	09-05-2017
Time:	12.30 – 13.30
Location:	Taurusavenue 111, Hoofddorp

Introduction:

BELANGRIJK: Mag het gesprek opgenomen worden?

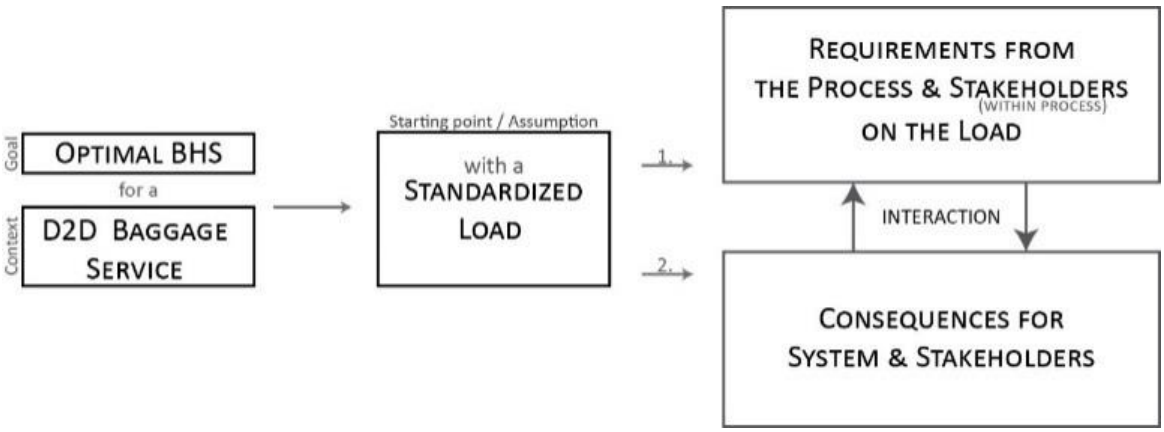
General:

- My background: IDE, medical, (patient)journey mapping, complex puzzles; stakeholders
- Project phase: explorative, context
- Link TNT – PASSME
- Invitation for interview sent per email:
  Het doel van mijn afstuderen is in kaart brengen hoe een d2d bagage service vanuit de bagage handling systemen eruit kan gaan zien. En daarbij wat de eisen zijn vanuit de industrie, maar ook wat de gevolgen zijn van een d2d service op de industrie en haar gebruikers. Door de verschillende processen van bagage afhandeling op elkaar af te stemmen kan het hele proces geoptimaliseerd worden.

  *Ik zie TNT als interessante stakeholder binnen een d2d bagage service en daarmee ook als belangrijke stakeholder binnen mijn project. Tijdens mijn project hoop ik **twee scenario's** in kaart te brengen, namelijk een d2d service via het vliegveld maar ook buiten het vliegveld om.*
  *Binnen beide scenario's is een logistieke dienst nodig, zij het in een andere rol. Graag zou ik eens met je rond de tafel gaan zitten om je **visie** te horen op een d2d bagage service en welke randvoorwaarden er vanuit de logistieke kant aanwezig zouden moeten zijn om deze service van de grond te krijgen.*

Research Question:

When moving towards an optimal baggage handling system for a door-to-door baggage service with a standardized load, what are the requirements from the process and the stakeholders within the process on the load and what are the consequences of standardization for the system and the stakeholders?



Why this meeting? >> Create value together

- Manage and shape relationship (of stakeholders within d2d)
  To see stakeholders as: “bound together by the jointness of their interests” (Freeman)
  Joint rather than opposed (process of value creation: no stakeholder stands alone)
- Creating as much value as possible for every stakeholders

Goal of this meeting:

- First introduction - *kennismaken*
- Exchange of information, and possibly: do we want a follow-up
- Understanding of general activities of TNT;
  Goal: to combine this information with a d2d service.

Show:

- Customer and baggage journey (A0-drawing), direct translation of d2d service (incl. suitcase delivery) based on the current customer journey

TNT – current business

- What is TNT core business?
  - The TNT Network (as presented on the website TNT, what does it mean?)
  - B2B vs B2C?

- Is TNT currently handling baggage?

TNT & d2d – future service

Current baggage journey (compared with a d2d baggage process)
- Basic steps in current TNT-journey (packages / baggage)
  Which blocks are interesting for TNT and *why*?
- Where can the ovelap with the passenger jourey be found (show initial stakeholder map)

What is your vision on a door-to-door service?
What value van TNT add in a door-to-door service?
How would a d2d service change the process for TNT?

Do you find any stakeholder missing in the overview?
- main stakeholders
- TNT Express stakeholders

Vanderlande Industries & TNT Express
What is the link between Vanderlande and TNT Express?

TNT & d2d – future service, standardized

What are the implications of standardization on a d2d service model for TNT?
What could be the role of TNT express in a d2d service model? (Opportunities)
What is TNT's interest in a d2d service?
>> why would you join?
What are requirements from TNT?
[What are the service components?]
Should your current process change to support a d2d service? >> How?

What do you think would happen to the industry if the service becomes a success?

Interesting service model components:

- Lease
- Subscription
- When booking?
- Cooperation with airline?
- Current douane process?
- Time span
- Ensure safety
- Scanning
- Pricing (& Toeslagen?)
- Sustainability
- Pick-up and delivery

> Dankzij ons snelle, uitgebreide wegennetwerk in Europa zijn we in staat om een uitgebreid serviceaanbod te leveren. Hiermee kunt u voldoen aan de wensen van uw klanten en uw bereik vergroten. Wij verbinden Europa met meer dan 55.000 ritten over de weg en 700 vluchten per week....

Close

- How to continue?
  Are you interested in further contact during this project (when applicable)?
  What kind of updates?
- …

B

Summary of interviews; only the most relevant aspects of the interviews are presented. Since the interviews have been excecuted in Dutch, the summaries are in Dutch as well.

TNT
D. van der Noll; D van Zuidam
Date: 09-05-2017

Huidige business TNT (FedEx)

- TNT FedEx heeft een netwerkomgeving met zowel vrachtauto's als vliegtuigen. Deze vertrekken op gezette tijden. Oplossingen voor klantvraag worden zowel binnen als buiten het netwerk gezocht.
- Buiten het netwerk zijn aantal producten ontwikkeld, bijvoorbeeld Airline Recovery Service: vertraagde bagage kwam via airline of afhandelaar binnen. TNT zorgt voor sorteren en leveren. Variërende service per airline, afhankelijk van de eisen. (Bijvoorbeeld, levering per directe koerier of levering binnen x aantal uur.)
- Samenwerking met TravelLight: volledig bypass van luchthaven.
- Hub-en-spoke netwerk
- Supply chain bestaat uit 3 stromen, fysieke goederen, data stroom en financiële stroom.
- Doel van netwerk is altijd 'terug naar logistiek centrum'

Link met d2d

- Nu zakelijke markt met B2B netwerk, shift naar consumentenmarkt is moeilijk want geen door-to-door netwerk maar wel d2d behoefte
- 5 groepen afhandelaren op Schiphol
- Koeriers beschikbaar make kan alleen als je volumes hebt. Breakpoint (aantal zendingen nodig voor bagage): 300 zendingen per dag)
- Groei van volumes moet groeien door een TUI en een Neckermann, die moeten het opnemen in het bookingsprocess. (Airline is uitvoerende partij voor reisorganisaties)
- Onze huidige sorteermachine vereist een vierkant streepjescode, dus suitcase met display moet dat ook hebben. In de toekomst geen eenzelfde barcode voor verschillende procesdelen, want verschillende logistieke diensten. (INTERESSANTE GEDACHTE!)
- Het wordt steeds belangrijker dat wij en iedereen steeds heel goed op de hoogte zijn van wat er met een zending gebeurd.
- Handtekening bij ontvangst nodig, overdracht van verantwoordelijkheid. Oppassen voor 'claim' cultuur uit VS. Customer inzicht geven in wat er aan de hand is.
- Bagage zien we ook als vracht.
- Cargo heeft heel andere invoerrechten, tijdelijke invoer en uitvoer rechten zijn dan nodig voor bagage in postale netwerk
- Het liefst hebben we alles geborgd in eigen netwerk omgeving, dus 1 partij van A tot B, toekomst d2d inclusief departure.

NS Stations
M. Lamberts
Date: 15-05-2017

Belangen NS Stations:

- Capaciteit: reizigers groei explodeert, perrons te smal, wachtrijen bij trappen. Reizigersaanbod op Schiphol Airport momenteel met +/- 4% per jaar).
- Besparing in noodzaak om te investeren (e.g. uitbereiding station)
- Primaire doel NS Reizigers: mensen vervoeren (niet cargo, vergl. beschikbaarheid materieel)
- De kern van NS Stations: bouwen/ verbouwen en beheren van stations + omgevingen.
- NS Stations, geen exclusieve relatie met vervoerder NS Reizigers, want ook andere vervoerders
- Koffer neemt per stuk 1,5-2x zoveel ruimte in als persoon zonder koffer, persoon met bagage loopt langzamer
- Verantwoordelijkheid ProRail: capaciteitstoedeling op het spoornetwerk

Aansluiting NS Station met d2d service:

- Station drop-off >> binnen scope NS Stations, winkeltjes, Retail

In samenwerking met bijvoorbeeld TNT, PostNL
Aannemen, inchecken, transport naar luchthaven:

kan vanuit station faciliteren. Aangeven waar meeste reizigers komen, dus verhoudingsgewijs meeste koffers
Drop-off op vliegveld (Schiphol Plaze) is onwaarschijnlijk. Want de grond erg duur is terwijl de toegevoegde waarde vermoedelijk niet hoog.

En verder:
- Schiphol ligt in hoofdrailnetwerk; treinreizigers op Schiphol zijn niet allemaal luchtreizigers. Sterker nog, het grootste gedeelte treinreizigers op Schiphol Airport is geen luchtreiziger)
- Capaciteitstekort (ook als koffers weg zijn)
- Functie station: afwikkelen reizigersstroom, sub-functie: aangenaam, wachten, ontvangst verschaffen van reisinformatie, etc.
- Schiphol (luchthaven) gedimensioneerd op 30 miljoen reizigers per jaar, nu: 65 miljoen.
In 2014 24 miljoen reizigers via treinstation Schiphol Airport, maar is ook veel meer dan waar het station oorspronkelijk op is gebouwd
- Mensen pakken eerste mogelijkheid om handeling uit te voeren (trap nemen, uit checken)

PostNL
M. Franzen
Date: 15-05-2017

(Veel overlap met verhaal TNT, niet herhaald)
- Huidige d2d (van TravelLight) zijn de doorlooptijden te langzaam. Vanwege het over de weg gaan.
- RFID tag is oude technologie, maar moeilijk om de logistiek mee aan de slag te gaan. Want je hebt bijvoorbeeld poortjes nodig, en in de logistiek wil men daar niet in investeren
- Belangrijk om te ontdekken welke tussen design van d2d (met gestandaardiseerde koffer) er zijn die wel geaccepteerd gaan worden door de industrie
- Bagage is product voor airlines waar ze aan verdienen. Daar moet de industrie eerst aan gaan wennen, dat ze daar misschien niet meer aan verdienen.
- Acceptatie en succes van een product is heel belangrijke focus
- Voor ons is nu het eindpunt gewoon vliegveld. Door-to-door, ik snap het wel, maar we moeten niet daar alleen maar op focussen. Maar kijken naar wat de klantvraag is hier in Nederland. We snappen wat de roze wolk van d2d is maar wat zijn de stapjes daar naartoe.

Viggo
J. Melissen
Date: 18-05-2017

- Grondafhandeling heb je splitsing tussen passagier afhandeling en vliegtuig afhandling:
  - Passagier komt met zijn koffer, moet je afgeven, inchecken of handbagage. Word je uiteindelijk door het terminal gebouw geleid en dan zorgen we dat de passagier naar het juiste vliegtuig toe loopt. Aantal kilo's, passagiers, koffers en alle administratie daarbij.
  - Vliegtuig: Alle koffers moeten erin en eruit, vuil water moet eruit. Schoon water erin. Toiletten moeten geflushed worden. Hij heeft stroom nodig. Catering, cleaning, etc. pushback: een vliegtuig heeft geen achteruit, dus moet ie weg geduwd worden.
Al het materieel wat erbij zit, een trap e.d. komt allemaal van de grondafhandelaar. Maar bijvoorbeeld ook de-ing. Dus alle handelingen rondom vliegtuig, behalve kerosine. (vanwege ketenaansprakelijkheid, andere tak van sport)
- Cargo wordt vaak lang opgeslagen voordat het doorgestuurd wordt (via land of lucht)
- Als bij security je boarding pas gescand wordt kom je in het DCS (Departure Control System)
- Ryanair checked passagier automatisch in, en je krijgt een reminder per mail.
- Ik zie niet waarom d2d via airport moet gaan. Over de weg is veel makkelijker. Dan heeft afhandelaar geen toegevoegde waarde. Voor

Vanderlande verplaatst de business.

- D2D en automatisering door standaard koffer 'gevaar' voor grondafhandeling want (huidige) business verdwijnt.
- Intercontinentaal krijg je te maken met regelgeving en die is erg lastig.
- Als airline zegt 'dit is een koffer' dan heb je geen douane documenten.
- Op gemiddelde vlucht van Ryanair zitten maar 26 koffers. Iedereen neemt alleen handbagage mee.
- Als 50% van de mensen van deze service gebruik gaat maken en TUI kan ipv 55 naar 45 minuten turnaround dan kan je in een week 10x extra slag maken. Afschrijving per uur van een boeing is schandalig hoog. Vliegtuig moet vliegen, als hij aan de grond staat levert het geen geld op. Dus als je bagage kan verminderen en daardoor vliegtuig extra de lucht in kan, dan heb je een business case.

Transavia
M. Limmen
09-06-2017

- Bagage is zowel commercieel als operationeel product.
- Passagiers beleving die vasthangt aan dit product (Std. Koffer) is voor airline heel interessant. Heeft impact op beleving van onze service. Inleveren van bagage levert nu enorm veel stress op. Maar ook het wachten aan de band en de onzekerheid of bagage aankomt.
- We willen toe naar 100% internet check-in, vanuit die hoek is deze service denk ik interessant.
- Check-in is verouderde term. Wat voor passagier belangrijk is: Gate, stoel. Wat voor airline belangrijk is aan informatie, stoel en bagage. Stoel wordt steeds eerder gereserveerd (is ook verdienmodel). Kan je allemaal lost van elkaar zien/ koppelen.
- Check-in balies zijn van airport. Gebruiken wij als airline
- Belangrijkste derde partij die enorm veel impact heeft op customer journey (maar dat misschien niet direct realiseert) is handler. Handling doet heel veel, check-in (belangrijk proces) laden, etc.

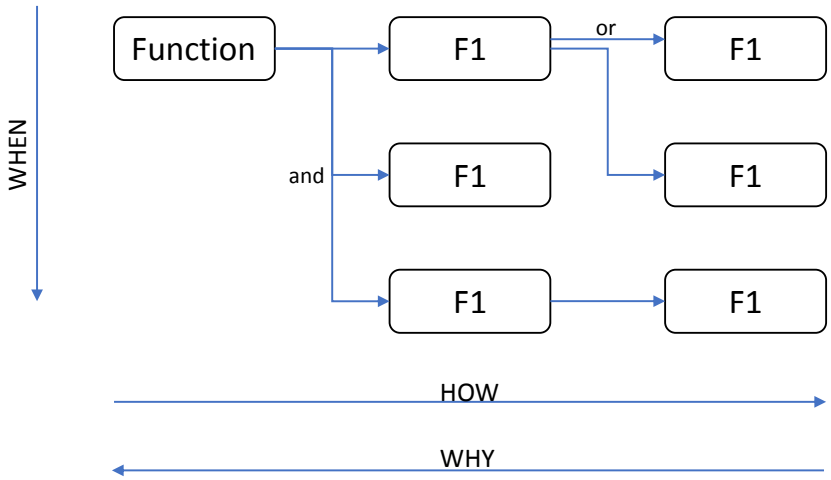
Samsonite (Skype)
S. Rakhshandehroo
W. Baert
28-04-2017

- Samsonite is een internationaal bedrijf en hoewel veel van de innovaties vanuit EU HQ gebeurt voor de EU markt, streven naar global solutions. Hoe groter het bereik van oplossing, des te beter het is voor het bedrijf (d2d met gestandaardiseerde koffer).
- We kijken steeds naar hoe wij onze kanalen optimaal kunnen inzetten wat past binnen een omni-channel systeem. Ook d2d oplossing zal alleen volledig zijn voor ons wanneer het binnen dit plaatje past en zich niet beperkt tot een bepaald kanaal.

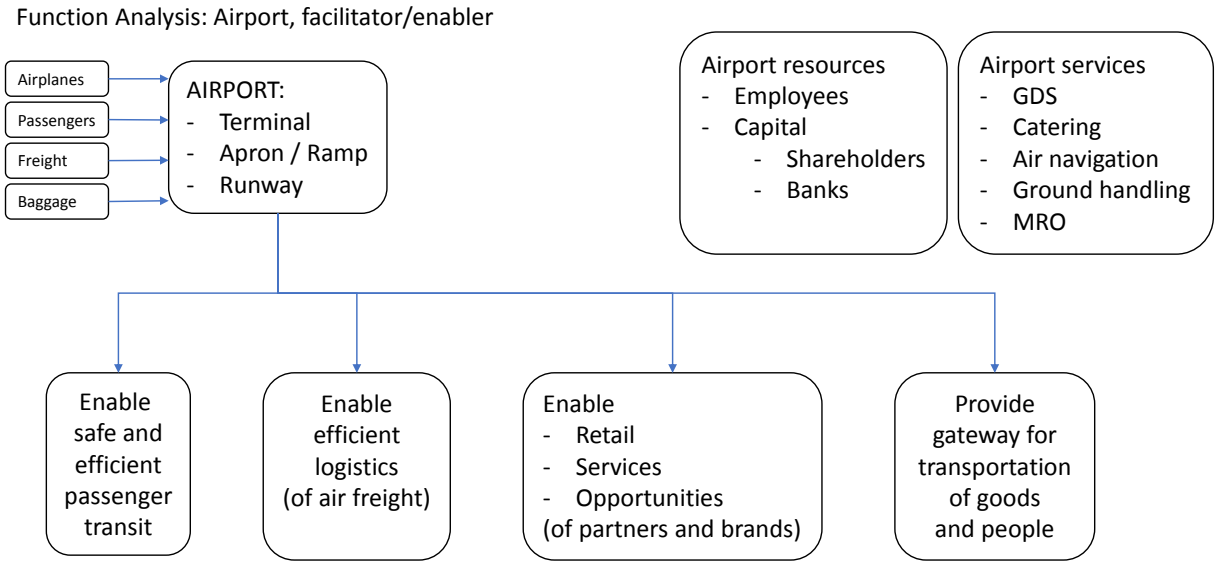
C

In this appendix the schedules from the function analysis (FA) are presented. The first overview shows how the FA is structured.

Function Analysis

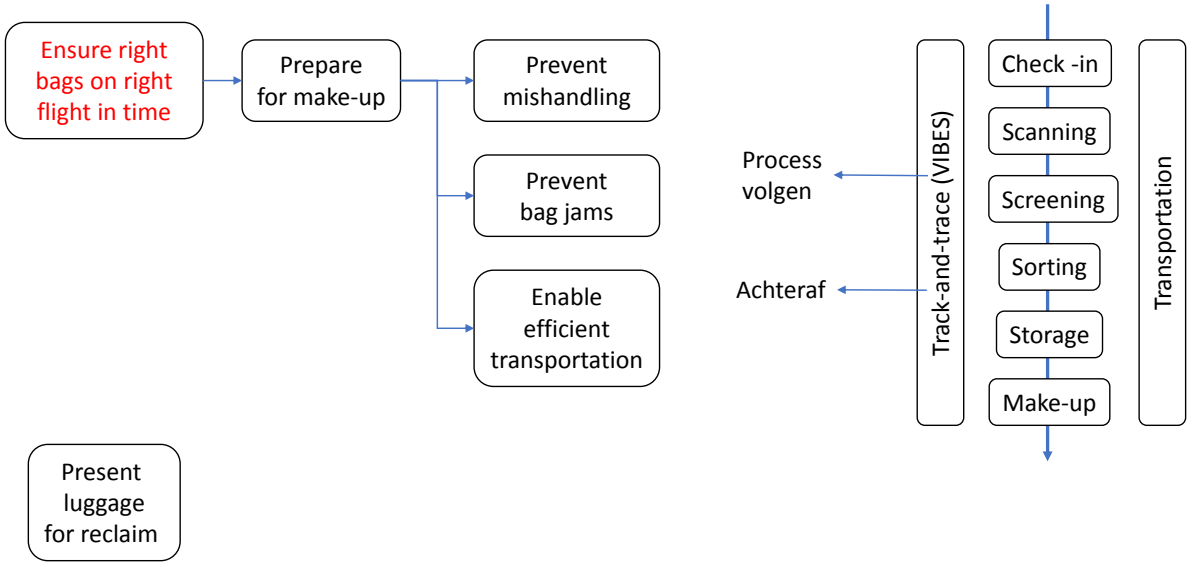


Function Analysis: Airport, facilitator/enabler

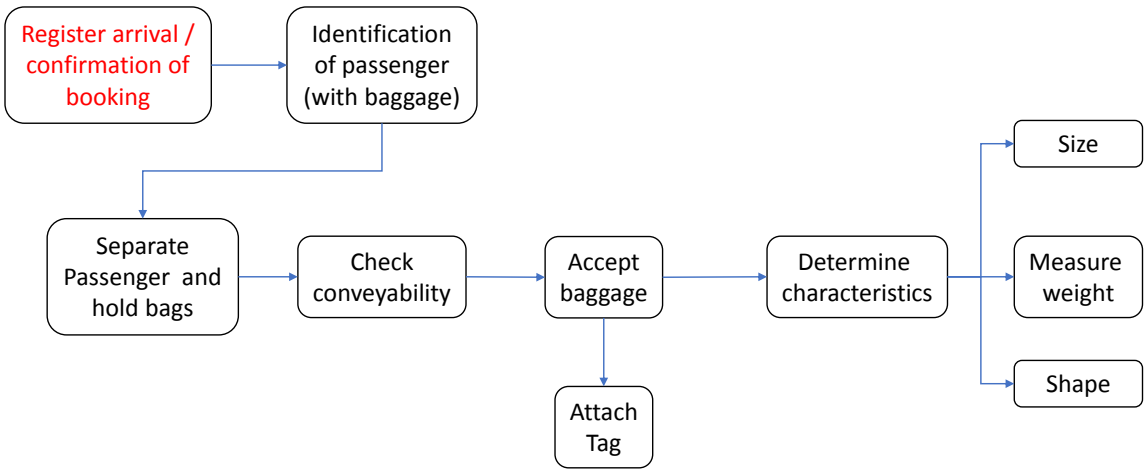


C

FA: Baggage handling Process



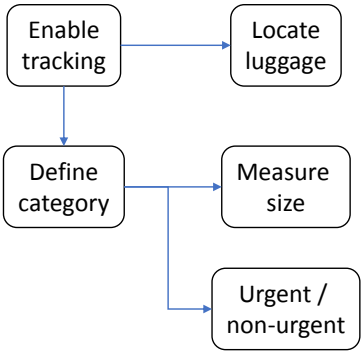
FA: Check-in Process; confirm arrival, exchange of specific informatie (gate, seat number, xx.kg)



C

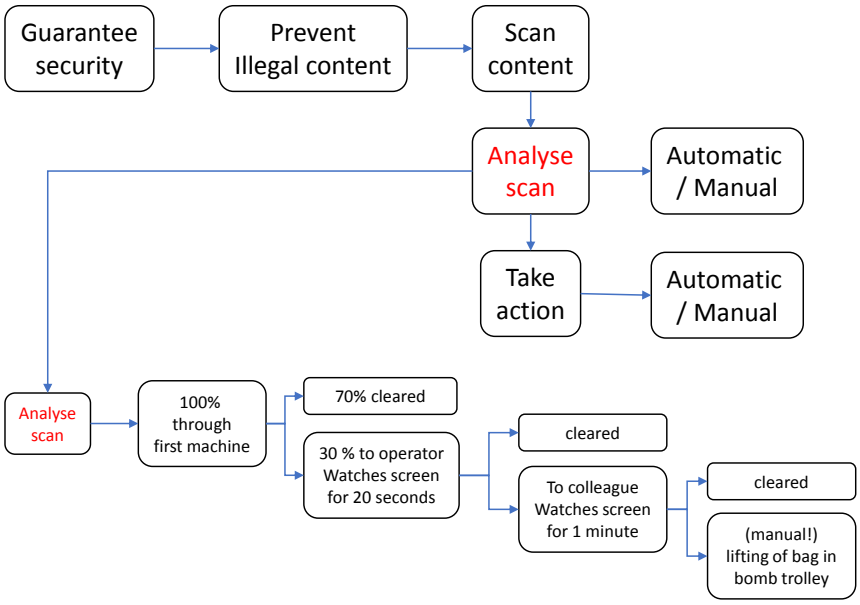
FA: Scanning Process; identify

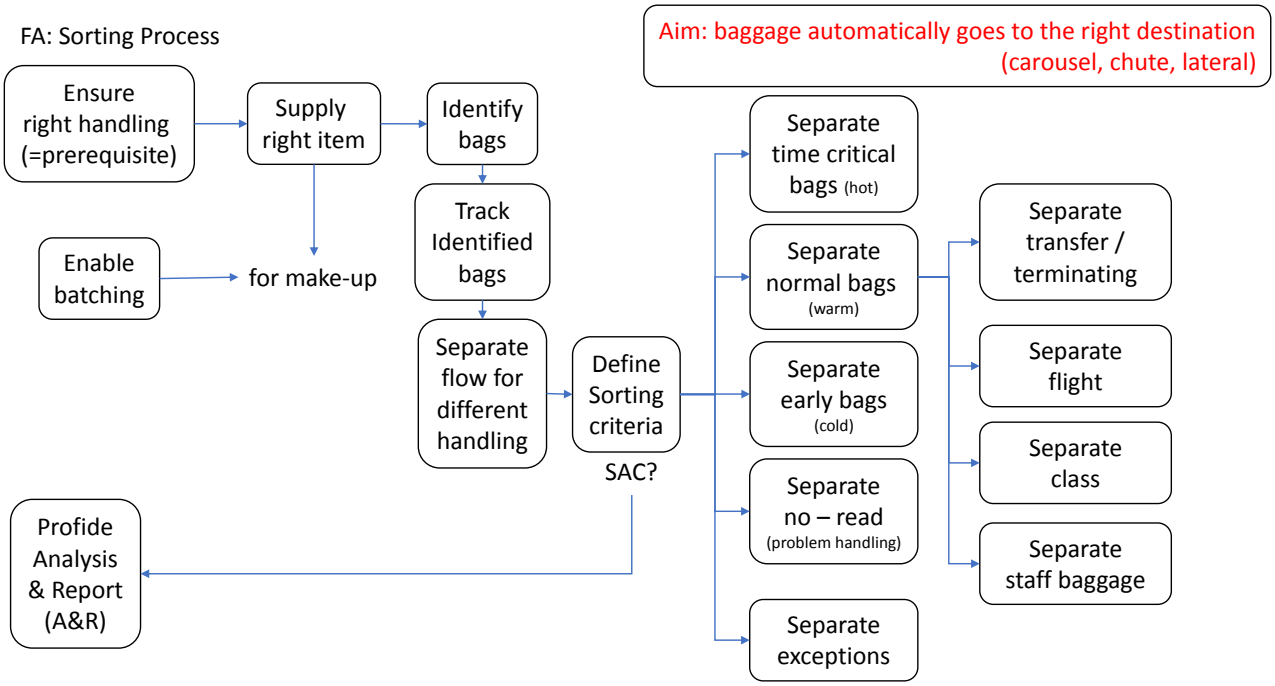
Goal: Accept luggage in stystem

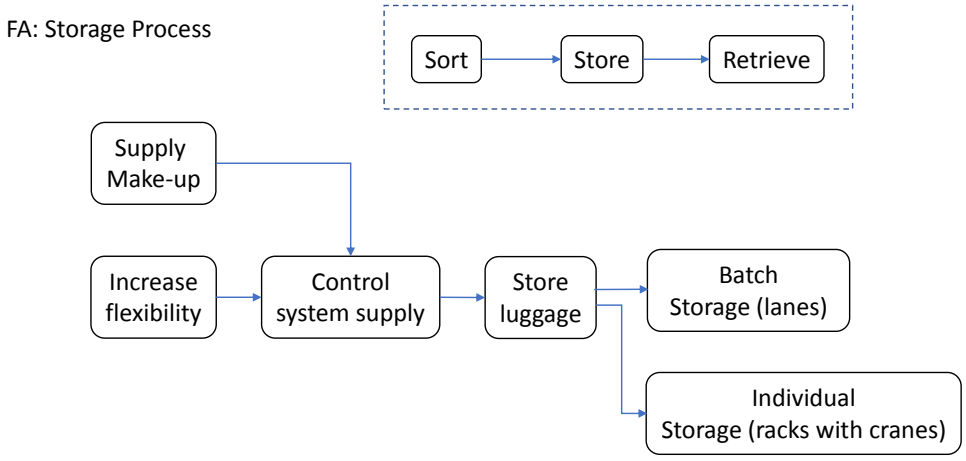


FA: Screening Process

If screening would be 100% secure than the bag and passenger do not have to travel in the same aircraft.

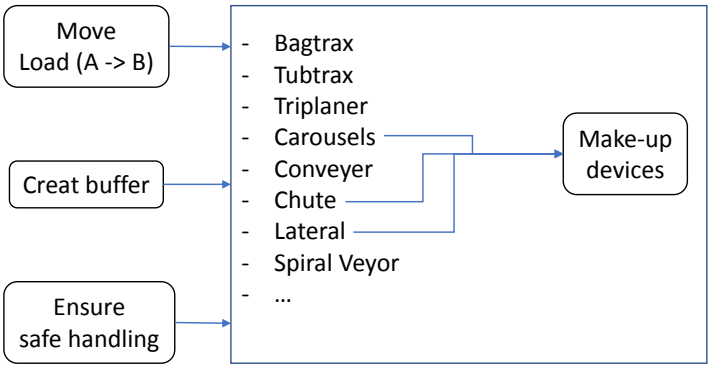



FA: Sorting Process
Aim: baggage automatically goes to the right destination (carousel, chute, lateral)
Ensure right handling (=prerequisite)
Supply right item
Identify bags
Track Identified bags
Enable batching
for make-up
Separate flow for different handling
Define Sorting criteria
SAC?
Profide Analysis & Report (A&R)
Separate time critical bags (hot)
Separate normal bags (warm)
Separate early bags (cold)
Separate no – read (problem handling)
Separate exceptions
Separate transfer / terminating
Separate flight
Separate class
Separate staff baggage


FA: Storage Process
Sort
Store
Retrieve
Supply Make-up
Increase flexibility
Control system supply
Store luggage
Batch Storage (lanes)
Individual Storage (racks with cranes)

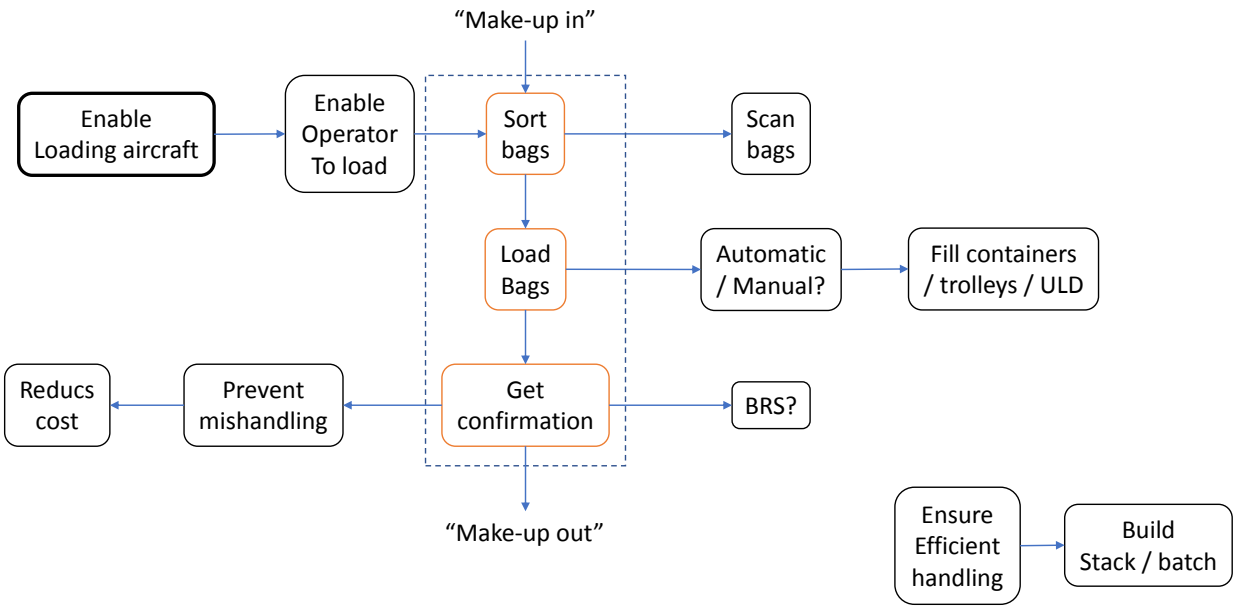
C

FA: Transportation Process



FA: Make-Up Process; create buffter

Goal: Ensure right bags on right flight in time



D-I

The IATA identification chart for baggage is presented and followed by Vanderlande's overview which items fit which categorie of baggage.

Referring to the Airline Baggage Identification Chart from IATA, resolution 743b for baggage definition of what VI considers as baggage.
The identification chart (see figures shown below) is used to decide whether this item can or cannot be handled and on which condition (according to the above categories and the necessary restrictions).

General requirement:
All bags must be within the dimensions and weight specifications for the type of baggage to be transported. The list of transportable baggage can be identified as follows:

Table 1

Type of baggage	IATA ID number	Remarks
Standard baggage	01, 03, 05, 06, 07, 10, 23, 52, 56, 61	
Standard baggage	02, 22, 22D, 22R	Handle pushed in completely.
Potential problem baggage	12, 27, 28, 53	Baggage needs to be closed to prevent items from falling out.
Potential problem baggage	08, 25, 64, 96	No round packs, to prevent rolling of baggage. Otherwise; OOG or non conveyable. In general considered as OOG baggage.
Potential problem baggage	09, 50, 51	Sacks may not be round shaped, to prevent rolling of baggage. Material (plastic) might present a risk of bag being torn, especially in combination with sorter equipment. If not round shaped; consider as standard baggage, preferably consider as OOG.
Potential problem baggage	20	Folded together and hook not sticking out.
Potential problem baggage	29	No sticking-out frame allowed. Long loose straps bound together.
Potential problem baggage	58, 59, 68, 69, 71, 89, 92, 93	Conveyable if properly closed, or properly packed. Otherwise; consider as OOG or non conveyable.
OOG	62, 72	In some systems this needs to be handled as potential problem baggage, according to dimensions specified for standard baggage.
OOG	63, 65, 66, 67, 98	If properly packed. Otherwise non conveyable.
OOG	73, 74, 75, 90, 94, 95	Folded together, loaded on belt with wheel not on belt. Otherwise non conveyable.
OOG	81, 82, 83, 85, 97	Baggage has a high damage risk. If properly packed; handle as standard or OOG baggage. If not properly packed; handle as non conveyable. What is allowed generally depends on airport rules.
Non conveyable	54, 60	Depending on the OOG conveyor configuration it is possible to transport in length direction.
Non conveyable	57	With live animals; items are non conveyable. Without animals; handle as standard baggage.
Not applicable	26, 55	Specified as cabin baggage only. Can also be checked in as standard baggage if within specification

See http://intranet/baggagehandling/PRODUCTS/Pages/IATA.aspx for IATA reference documents

E

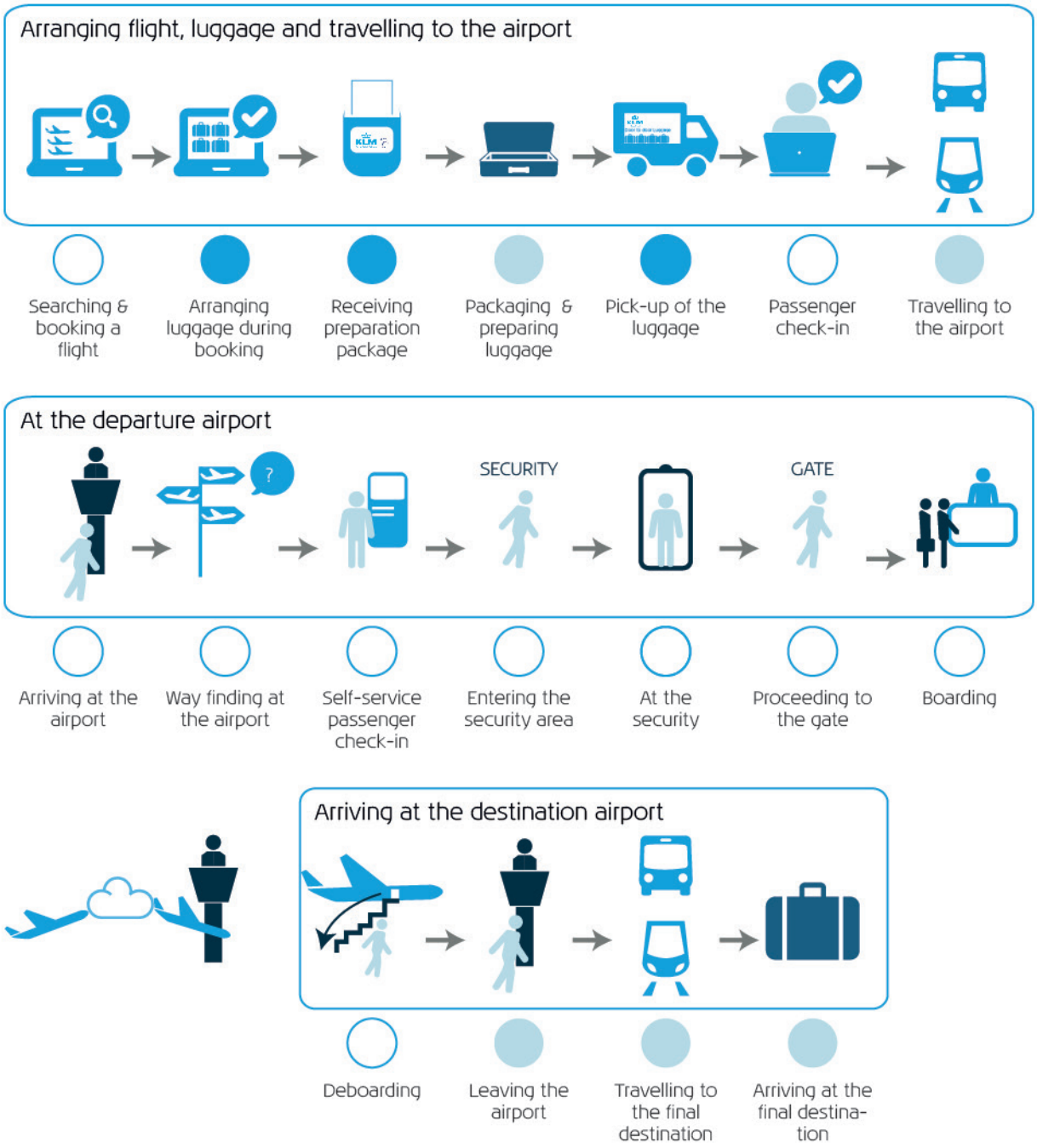
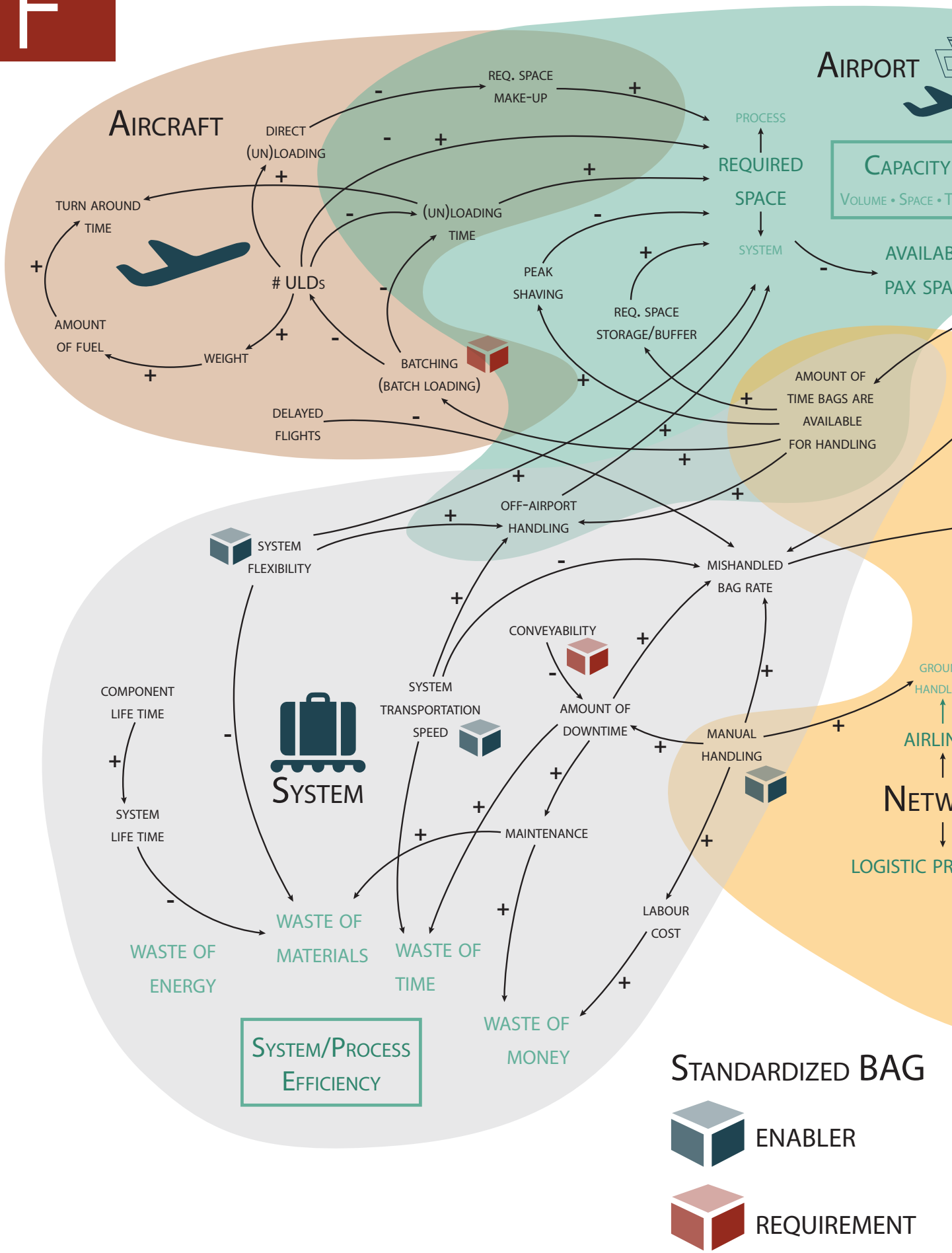
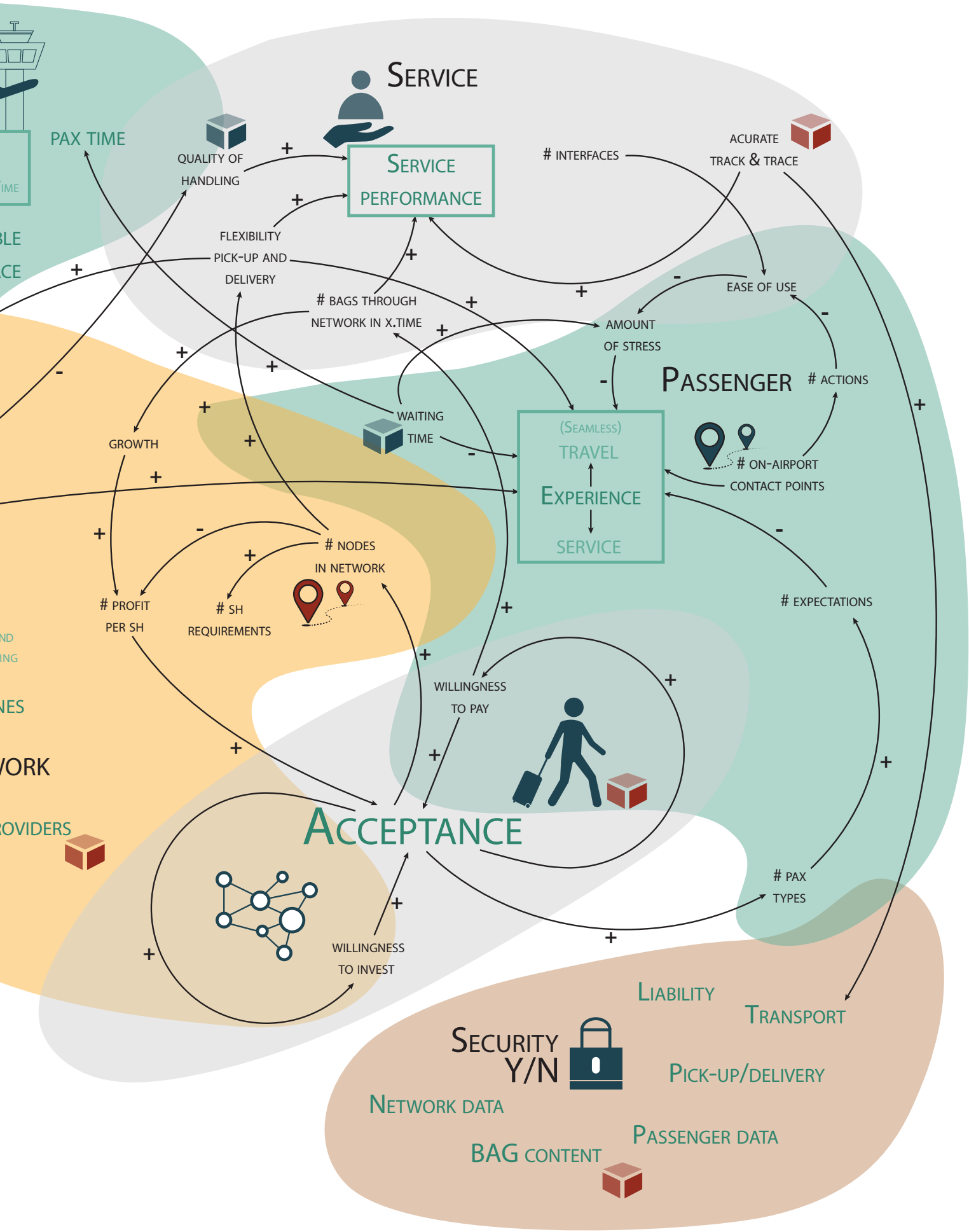


Figure 45: *The new passenger journey*

F


AIRCRAFT
AIRPORT
DIRECT (UN)LOADING
REQ. SPACE MAKE-UP
PROCESS
REQUIRED SPACE
CAPACITY
VOLUME • SPACE • T
TURN AROUND TIME
(UN)LOADING TIME
ULDS
AMOUNT OF FUEL
WEIGHT
BATCHING (BATCH LOADING)
PEAK SHAVING
REQ. SPACE STORAGE/BUFFER
SYSTEM
AVAILAB
PAX SPA
DELAYED FLIGHTS
AMOUNT OF TIME BAGS ARE AVAILABLE FOR HANDLING
OFF-AIRPORT HANDLING
SYSTEM FLEXIBILITY
MISHANDLED BAG RATE
CONVEYABILITY
COMPONENT LIFE TIME
SYSTEM TRANSPORTATION SPEED
AMOUNT OF DOWNTIME
MANUAL HANDLING
SYSTEM
SYSTEM LIFE TIME
MAINTENANCE
LABOUR COST
WASTE OF ENERGY
WASTE OF MATERIALS
WASTE OF TIME
WASTE OF MONEY
SYSTEM/PROCESS EFFICIENCY
STANDARDIZED BAG
ENABLER
REQUIREMENT


SERVICE
PAX TIME
QUALITY OF HANDLING
SERVICE PERFORMANCE
INTERFACES
ACURATE TRACK & TRACE
FLEXIBILITY
PICK-UP AND DELIVERY
BAGS THROUGH NETWORK IN X.TIME
EASE OF USE
AMOUNT OF STRESS
PASSENGER
ACTIONS
WAITING TIME
(SEAMLESS) TRAVEL EXPERIENCE SERVICE
GROWTH
ON-AIRPORT CONTACT POINTS
NODES IN NETWORK
PROFIT PER SH
SH REQUIREMENTS
EXPECTATIONS
WILLINGNESS TO PAY
ACCEPTANCE
PAX TYPES
WILLINGNESS TO INVEST
LIABILITY
TRANSPORT
SECURITY Y/N
PICK-UP/DELIVERY
NETWORK DATA
PASSENGER DATA
BAG CONTENT