

DIGITAL DISRUPTION SOLUTION

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This Capstone Project was prepared and approved under the direction of the
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Abstract

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Since March, 2017, the cost of denied boarding began to draw the attention of all Brazilian airlines because of the Resolution 400 of the Brazilian National Civil Aviation Agency. This Resolution covers several items but here we will focus on the penalty that the airlines need to pay for each passenger who had his boarding denied involuntarily in domestic flights.

An operating restriction of an airline may result in the denial of boarding of a specified number of passengers. When this process of selecting the passengers and their accommodation on another flight happens very close to the time of departure, the probability of delays is high. We believe that is possible to reduce the contingency costs based on identifying volunteer passengers in advance. Since the operational restriction, whether caused by excess weight or seat limitations, is not always predicted in advance, we are considering having the passenger profile of all flights in advance to understand their needs and looking to identify the more flexible ones.

Our goal is to create a plug-in that any airline could use in their self-service check in channels, and making direct communication with the passenger. It also could become a way to offer proactive accommodation options as well as commercial compensations due to itinerary or ticket schedule change.

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Chapter I

Introduction

Nowadays the operation of Brazilian airlines has a significant concentration of flights in airports of short runways, such as the case of Congonhas (CGH) and Santos Dumont (SDU). According to the statistical control report of the Department of Airspace Control (DECEA, 2017), they are respectively the second and the fifth busiest airports in the country. This fact results in recurring overload situations that may result in denied boarding. In addition, the perishability of airline tickets allied with the low financial margins of the airline industry requires increasingly aggressive overselling practices. The results of these actions are complex situations that the ground staff of the airports have to face and solve in order to offer a good experience for the customers.

The cost of denied boarding began to draw the attention of all Brazilian carriers since the ANAC's Resolution 400 came into force in March of 2017. Due to this new resolution, all carriers must pay a fine of R\$ 1065.00, for each passenger who had his boarding denied involuntarily on domestic flights. According to Section II, Art.23, § 1º from the Resolution 400, if there are passengers who have accepted the preterition in exchange for compensation, whether financial or through loyalty points and/or upgrades, the company is not obliged to pay them the imposed penalty due to operational restrictions. The range time between the closing of the check-in window and the start of the boarding process is the interval that the airport team has to identify which passengers will have their boarding denied. For domestic flights in Brazil this range varies between 30 and 40 minutes. The proximity to the takeoff schedule makes the process critical for punctuality. Another aggravating factor that is important to mention is the passenger contact

information that the airlines have. Currently some Brazilian carriers question passengers if they would like to receive information about their flights during the check-in process, but the lack of clarity about the purpose of providing the information causes the quantity and quality of information provided to be low. Finally, when the airline has a voluntary customer to change its original ticket, the passenger must receive a receipt that guarantees that there was a disruption on his/her flight and he/she has to accept that he/she received the notification as established in the Art.23, § 1º in the same Resolution 400. This is what gives the airline the guarantee that the passenger is a volunteer and exempts the airline from paying the penalty fee.

Project Definition

With the increase in self-service check-in stages to domestic flights, and since the beginning of the new Brazilian National Civil Aviation Agency (ANAC) resolution that encouraged the use of hand luggage due to the payment of checked baggage, the minutes before boarding passengers have been critical regarding punctuality. The negotiation between airline and customers when a denied boarding situation occurs increase the complexity of the operation, especially as the airport agent needs to negotiate with the group of passengers in an attempt to select possible groups with flexibility.

The prior identification of passengers who have flexibility to accommodation in cases of operational restrictions, such as overbooking and overload, bring operational efficiency, as the airport agents don't spend time identifying which passenger they must

first address . Compensation options must be provided by airlines, but as long as they claim to make the change voluntarily, no penalty will be imposed on the airline.

Today the only point of contact we can guarantee between the airline and the passenger before boarding is the check-in process. So, this step was chosen to be the moment where we will classify the passenger as flexible or not. Our suggestion for a technological solution is based on the use of this moment for the classification if the passenger is voluntary or not for each trip, since they can be flexible in one flight, but may not be flexible for the other connecting flight.

Project Goals and Scope

The purpose of this project is not to discuss best overselling practice or how to avoid overload. Its main goal is to improve the operational process during disrupting situations, avoiding delays and minimizing the number of involuntary denied boarding, consequently reducing the total amount spent with fines paid by airline companies. The proposal is also to discuss a solution to identify potential passengers who are flexible with their flights and willingly accept to be accommodated on a different flight. Since the scope is to select the most flexible passenger profiles among the other passengers on the flight, it is not within the scope of this project to discuss disruption processes for canceled flights.

Although every airline has a current process today, there is no guarantee that the company will find someone, already at the airport, that will accept to change his flight. Contrary to what we have today, the idea is to have a proactive action and not reactive resulting in saving time, money and wear with passengers.

Upon collecting this information, the airline will know who to contact first to offer a new flight, when the company faces an operational restriction problem, reducing the total amount spent with fines due to denied boarding and avoiding big delays. It's important to emphasize that ANAC says that the companies must search for volunteers to be reallocated in other flights through negotiated compensation between the voluntary passenger and the carrier.

For the payment of compensation, the airline may require the passenger to sign an acceptance term, ensuring that there will be no charges or subsequent costs related to the same case. Re-arranging voluntary passengers on another flight by accepting compensation shall not constitute an involuntary denied boarding, and the carrier doesn't need to pay the fine of R\$ 1065.00. In this way, our project will help the carriers to find flexible volunteers who will ask for cheaper compensation.

We expect to determine an initial concept model project to achieve three main goals:

- a. Create a digital solution where the passengers could state whether they are flexible and may be willing to change flights, due some compensations;
- b. Reduce the disruption cost to the airline, considering that the carriers will offer others compensations for changing a flight without paying the fine of R\$ 1065.00;
- c. Reduce the impact of disruption during the short time between the check-in closure and the end of the boarding process, improving the impact of punctuality.

A disruption experience can be traumatic to the customer. It is important to improve the airport recovery actions to minimize the impact to the customer. It is also important to clarify that this project will not measure customer satisfaction; the goal is to identify the

passenger profile and to offer better information to the ground staff for decision making and improving the airport management.

Definitions of Terms

Air carrier means an air transport undertaking with a valid operating license.

Cancellation the non-operation of a flight which was previously programmed.

Customer meaning of passenger to an airline company perspective.

Denied Boarding a refusal to carry passengers on a flight, although they have presented themselves for boarding.

Disruption an interruption in the usual way in the airport process. It could be cancelation or delay flight.

Final Destination the destination on the ticket presented at the check-in counter or, in the case of directly connecting flights, the destination of the last flight; alternative connecting flights available shall not be taken into account if the original planned arrival time is respected.

Loyalty Tier	Customer groups program based on the amount of the loyalty airline program utilization. Each group (Tier) receives, in this way, different privileges.
No-show	those who has the ticket but did not show up for boarding.
Overbooking	the fact of the company overselling seats per flight but there are more passenger per seats at the airport that want to board in the flight.
Overload	excess of weight on the aircraft.
Overselling	when the airline sell more seats than it is available in the flight in which it is expected that some people will cancel.
Passenger	customer that by a ticket to travel in a flight in the airline.
Pretermission of boarding	boarding not realized due to security problems, aircraft change, overbooking or other reasons. Occurs when the passengers has his boarding denied, even though they have fulfilled all the requirements for boarding.

Reservation	the fact that the passenger has a ticket, or other proof, which indicates that the reservation has been accepted and registered by the air carrier or tour operator.
Satisfaction	a measure of how happy customers feel or we achieve this expectation about airline service. It could be measured by NPS (Net Promoter Score), PROCON (“Programa de Proteção e Defesa do Consumidor” - Consumer Protection and Defense program) or others social media posts.
Stand-by	passenger that is an airline employee or has any benefit from the company and didn't pay for the full ticket. They will only be on the flight if there is available seat, after closing the check-in process.
Ticket	means a valid document giving entitlement to transport, or something equivalent in paperless form, including electronic form, issued or authorized by the air carrier or its authorized agent.
Volunteer	a person who has presented himself for boarding under some conditions in exchange for benefits.

List of Acronyms

ABEAR Brazilian Association of Air Carriers.

ANAC	Brazilian National Civil Aviation Agency
APP	is an abbreviated form of the word application. An application is a software program that is designed to perform a specific function directly for the user or, in some cases, for another application program.
AU	The maximum number of seats available for sale in a booking class.
CCPM	Critical Chain Project Management.
DBC	Denied Boarding Compensation
DECEA	Department of Airspace Control.
DOT	US Department of Transportation.
EUR	European zone official currency.
IATA	International Air Transport Association.
OTA	Online travel agency.
ROI	Return on Investment.
StB	Simplifying the Business (IATA's program)
TOC	Theory of Constraints.
USA	United States of America.

Chapter II

Review of the Relevant Literature

This chapter presents the Literature. It starts by presenting the United States and European legislation regarding overbooking and denied boarding, as well as the best practices adopted by the major carriers of USA to reduce the impact, in cost and in airports operations, generated by denied boarding. In addition, a comparison with Brazil presenting the evolution in the behavior of the Brazilian passengers will follow. The Theory of constraints (TOC) is also presented in this chapter.

USA Scenario

Since 1960s, the USA has a regulation that forces air carriers to pay compensations for those passengers who were bumped from flights because carriers sold more confirmed seats than it was available. But the standard for denied boarding compensation (DBC) that were established in 1978 remains the same until 2008, when the US Department of Transportation (DOT) ruled that passengers that encounter delay of more than 1 hour due to the involuntary denied boarding are entitled to compensation, and in 2010, the US DOT issued a Proposed Ruling on Enhancing Airline Passenger Protections that seeks to increase the denied boarding compensation airlines should pay when involuntarily denied boarding occur (Federal Register, 2010). The figure 2.1 shows the new compensations that were established by the DOT.

USA Denied Boarding Compensations	
Domestic transportation	
0 to 1 h arrival delay	No compensation
1 to 2 h arrival delay	200% of one-way fare (but no more than \$650)
Over 2 h arrival delay	400% of one-way fare (but no more than \$1300)
International transportation	
0 to 1 h arrival delay	No compensation
1 to 4 h arrival delay	200% of one-way fare (but no more than \$650)
Over 4 h arrival delay	400% of one-way fare (but no more than \$1300)

Figure 2.1. Compensation policy for denied boarding in USA.

As Garrow, Kressner and Mumbower (2011) showed in their study, this new regulation didn't reduce the number of involuntary denied boarding in the USA. In addition, the increasing load factor also contributed to the problem, since companies have fewer options to accommodate the passengers, in a convenient way.

After this regulation, the carriers are looking for new solutions to tackle the involuntary denied boarding problem, the first one and more common is to seek volunteers to give up their seats. However, Garrow, Kressner and Mumbower (2011) already listed others actions that the US carriers adopted to avoid denied boarding. These included the following:

- 1- Day of departure flight management: carriers use to leave the AU at high levels until the day of departure, and this could generate more denied boarding when one carrier experiences any contingency and needs to reallocate passengers, once the no-show rate of those passengers are close to zero.
- 2- Demand-driven dispatch: as some flights experience higher Load Factor than expected and others lower than expected, companies can swap aircraft closer to the departure to match supply and demand and avoid denied boarding.

Another strategy that is presented by Wang and Fung (2014) entailed using airline alliances to reduce the cost of reallocating passengers.

With all these actions, the US Carriers started to reduce the percentage of denied boarding, reaching its lowest level in 15 years in 2017. The figure below shows the impact of those actions to reduce the total number of denied boarding in the United States:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Boarded	467.205	485.797	522.308	516.553	552.445	567.740	576.474	548.041	595.253	591.825	600.774	599.405	535.551	602.019	660.618	680.890
Denied Boarding Total	837	769	747	597	674	685	684	719	746	626	598	494	467	531	471	365
Voluntary	803	727	702	552	619	621	621	651	681	578	539	440	418	486	430	342
Involuntary	34	42	45	45	55	64	63	68	65	48	59	54	49	44	41	23
Percent Denied Boarding	0,18%	0,16%	0,14%	0,12%	0,12%	0,12%	0,12%	0,13%	0,13%	0,11%	0,10%	0,08%	0,09%	0,09%	0,07%	0,05%

Table 2.1. Passengers Boarded and Denied Boarding by the Largest U.S. Air Carriers (Thousands of passengers)

The denied boarding evolution showed in the table 2.1 is based on the U.S. Department of Transportation reports.

European Scenario

Considering the European scenario, the regulation 261/2004 of the European Parliament and of the Council establish common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights. This regulation defends that passengers should be fully informed of their rights in the event of denied boarding and of cancellation or long delay of flights, so that they can effectively exercise their rights. The rules for denied boarding after this resolution are:

1. When an operating air carrier reasonably expects to deny boarding on a flight, it shall first call for volunteers to surrender their reservations in exchange for benefits under conditions to be agreed between the passenger concerned and the operating air carrier.

2. If an insufficient number of volunteers come forward to allow the remaining passengers with reservations to board the flight, the operating air carrier may then deny boarding to passengers against their will.

3. If boarding is denied to passengers against their will, the operating air carrier shall immediately compensate them.

According to this resolution, passengers shall receive compensations amounting to:

1. EUR 250 for all flights of 1500 kilometers or less.
2. EUR 400 for all intra-Community flights of more than 1500 kilometers, and for all other flights between 1500 and 3500 kilometers.

3. EUR 600 for all flights not falling under (1) or (2).

But the operating air carrier can reduce the compensation mentioned above by 50%, when passengers are offered re-routing to their final destination on an alternative flight which does not exceed the schedule arrival time of the flight originally booked by:

1. Two hours, in respect of all flights of 1500 kilometers or less; or
2. Three hours, in respect of all intra-Community flights of more than 1500 kilometers and for all other flights between 1500 and 3500 kilometers; or
3. Four hours, in respect of all flights not falling under (1) or (2).

Brazilian Scenario

Some of these solutions are useful for the Brazilian carriers, such as to search for volunteers and to reduce the AU level the day before the flight, but as two of the busiest airports of the country have small runways with restrictions on the size of the aircraft, the carriers can't use the demand-driven dispatch solution. The strategy to reallocate passengers into partners flight as well, aren't applicable in the Brazilian scenario, as we don't have carriers from the same alliance operating domestic flights in the country, so the companies need to relocate passengers on competitors flights, and this generate more costs.

Despite the USA has a specific regulation for denied boarding since the 1960s, Brazil has only reestablished more clear rules of denied boarding at the end of 2016. The same resolution of the National Civil Aviation Agency (ANAC) establishes that the passenger have 24 hours after the purchase to give up their travel and be refunded by the airlines and that the airlines must show in their website and in any marketing campaign or promotional action the total amount of the ticket, already with the taxes. With this new resolution the companies were also able to offer ancillary revenue options, such as reserved seats and the purchased of checked baggage. Airlines saw the possibility to increase ancillary revenues, such as to charge for the first checked bag. This new resolution brought a chance to improve their operating financial margins, however the new rules for denied boarding brought extras costs, such as the compensation, that needed to be immediately managed, especially during a disruption.

A disruption situation occurs when some passengers will not be able to reach the final destination at the time they were scheduled. This can occur for a number of reasons, such as weather conditions, aircraft maintenance, overload and overbooking. Overbooking,

however, cannot be treated as a common contingency, as passengers often feel betrayed and deceived by the companies.

As the Load Factor of Brazilian carriers increased over the past 18 years, nowadays companies have fewer options to reallocate passengers.

Brazilian Load Factor Evolution

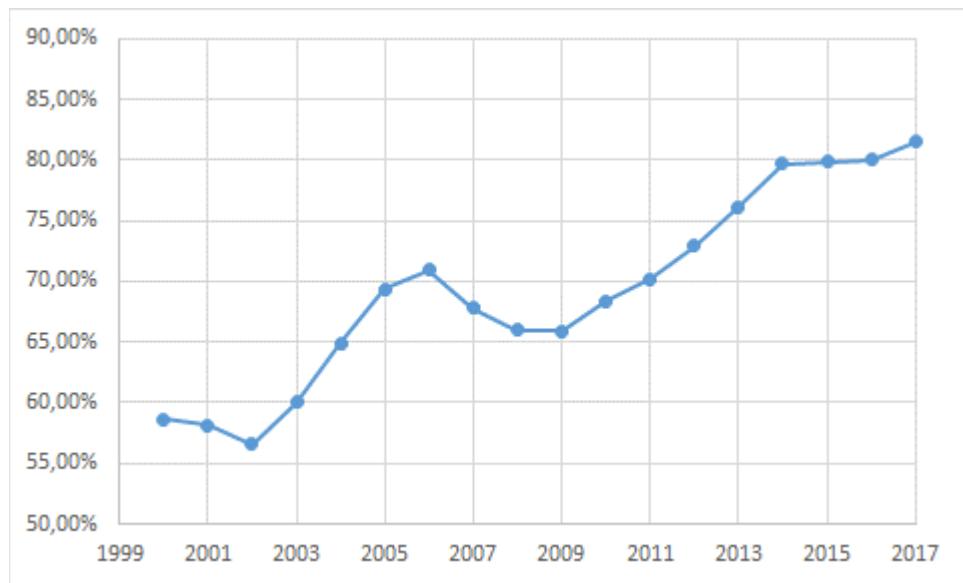


Figure 2.2. Load Factor Evolution by Brazilian carriers

The Load Factor evolution, showed in the figure 2.3, is based on data reported by ANAC, 2018, and shows that the Load Factor rate is increasing in the country. Denied boarding is a problem not only to the passengers but also to airlines in the entire world. There are several factors that cause the airline to deny boarding and those factors differ across carriers. Carriers generally have strong internal incentives to reduce denied boarding, due to it impacts directly their operational costs and passenger's satisfaction. It is important to set that this project will cover only flight depreciation, it means that it

considers the airline action to define which customer will board the flight. We will not consider cancelled flight disruption in this project.

It is clear that even with all the efforts, the disruption situation could occur and is a reality in the airline business. The point of this project is to minimize the operational costs and improve recovery actions to the passenger.

To tackle those points, we will present two different perspectives:

1. Operational Costs

In accordance with Section II, Article 24. item I from Resolution 400, in case of an involuntary denied boarding, the airline shall, immediately, make payment of financial compensation to the passenger, and may be by bank transfer, voucher or cash, in the amount of 250 (two hundred and fifty) SDR, (approximately R\$ 1065.00) in the case of domestic flight.

On the other hand in the Art.23, § 1º in the same Resolution 400, the rearrangement of the volunteer passengers on another flight by the acceptance of compensation will not set preterition so, in this case, if the passenger was a volunteer and accepts the negotiation, the airline is not obliged to pay the penalty of R\$1065.00.

Establishing an accurate mechanism for estimating the cost of a disruption for each voluntary or involuntary passenger is useful for many aspects of modeling airline behavior and for better understanding the likely impact of regulations on this.

Unfortunately in Brazil, there is no official number available to identify the Passengers Boarded and Denied Boarding like we presented in Figure 2.2 by the Largest U.S. Air Carriers, so we will collect this data directly from the air carriers.

2. Improvement of the Management Airport Operation

Currently, the airport process in case of disruption is a chaos. The process happens when the passengers are already in the boarding area and at this moment the airline airport agent reports that there is an operational problem on the flight and ask for volunteers to follow on a different flight. At this point there are no criteria for electing denied boarding passengers.

This usually causes a collective commotion and turmoil in the boarding area, and could cause more delays in the flight. If no passenger volunteers, the airline airport agent randomly selects passengers, and this configure an involuntary denied boarding situation.

Today, the only available option of passenger profile differentiation to the airline company is the classification of its loyalty program, as well as the information about the need for some special assistance during the flight, such as wheelchairs, seniors and unaccompanied children. The only way to differentiate them in the few minutes before takeoff is through a face-to-face approach, when the airline asks the passenger group if there is anyone willing to change the original flight schedule, or make another route to their final destination.

In addition to the lack of differentiation between passengers, direct communication between passengers and the airline is also restricted. One of the important flows where the telephone contact is requested is at the time of purchase of the tickets, however not all purchases are made through the direct channels of the airlines. Intermediate channels such as travel agencies are used to purchase tickets and the airline does not have the guarantee that the contact and telephone information will be forwarded to the departure control system used by the airport front line.

According to a survey conducted by the company MindMinners and ordered by Paypal in the beginning of 2017, in Brazil almost 35% of leisure passengers buy tickets from an OTA or a Travel Agency, and culturally these companies do not send the customers information, which is a critical process to this project. Without their own flow of contact information for passengers, airlines become very dependent on third parties. The consequence is the lack of real-time means of communication.

What Passengers Expect from Technology

In May, 2017, the International Air Transport Association (IATA) conducted a Passenger Survey and its findings were published in a Global Passenger Survey. This survey received a feedback from almost 10,700 passengers around the world. The results revealed that passengers expect technology to give them more personal control over their travel experience. In this survey, the passengers expect to be well-informed and the preferred options for receiving notifications are by e-mail (26% of the passengers) and Smartphone app (28% of passengers). They are still able to use the SMS as a way to receive information but this number is decreasing. So in this project, it is clear what the passenger prefer.

The Customer travel journey is composed by 13 steps, but after buying the ticket, the remaining point of contact with customers is during their check-in. In this part of the process, the customers need to include their national ID or passport number and is, prior to the boarding process, the singular point of contact that can be guaranteed that will exist between the airline and the passenger. At this point, the company collects all the required information to make the trip safe and tailored to the needs of its passengers. If the company

calls for some additional information after this step, the only way is to contact the passenger is in person or through the means of contact provided by them.



Figure 2.3. Customers Travel Journey

After having the customer contact, it is imperative to distinguish what the passenger wants in a disruptive situation to minimize the inconvenience and resulting frustration. As soon as the airline has this information, it becomes possible to notify the passenger in their previously chosen channel.

In the same IATA survey, the passengers considered 3 important services to improve what they called “the travel disruption experience”

- Real-time information shared with passengers.
- Flight re-booking.
- Hotel accommodation.

However, the factors affecting time use are different between business and non-business travelers, and they could be different even by journey, since a passenger may not have flexibility on his outward flight, but he has on the return, making possible to implement a solution that takes in account the different needs of the passengers in each part of the journey.

An alternative to managing a situation of collective dissatisfaction is to identify the different profiles within a group of passengers affected by a disruption. The article by

Zhang, Wang, Wang, & Wang (2010) discussed the different passenger profiles and classified them into two types, those who are under time pressure, and time enough customers. In addition, the authors presented how the solutions given by airlines can have different impacts on passenger's satisfaction and dealing with customer expectations, as the customers under time pressure preferred losses prevention and time enough customers were more concerned about achieving gains.

Theory of Constraints

The Theory of Constraints (TOC), proposed by the physicist Eliyahu Moshe Goldratt in *The Goal* (Goldratt & Cox, 2016) is a business philosophy that is based on the existence of constraints or bottlenecks.

According to Goldratt, constraint is anything that limits a system from achieving higher performance verses its goal and every real system must have at least one constraint limiting their outputs. The core idea of TOC is also a thinking process that enables people to invent simple solutions to seemingly complex problems.

In other words, TOC helps companies to focus on improvement efforts where they will have the greatest immediate impact on the bottom line and provides a reliable process that insists on follow through. A bottleneck is nothing more than a resource within the production system whose capacity is less than the demand allocated for that resource. In other words, a bottleneck is a part of process that is unable to meet the demand that is needed of it therefore, reducing the productivity index.

Although TOC has been born in the industrial sector, its philosophy can be applied in different types of organizations, such as in the health area according to Sabbadini et al.

(2006). Applying the principles of TOC, an analysis of the flow of treatment and the restriction in the procedure of surgery has been identified (Sabbadini et al., 2006). It was found that the number of patients hospitalized for surgical intervention was superior to the capacity of the physicians to attend. The result of the application of TOC was an increase of 16% in capacity system attendance.

Considering the aviation world, a study which applies TOC was found in an aircraft production company. According to Lemos (2008), the idea was to improve the production capacity of applying the concepts of CCPM (critical current) derived from the theory of constraints.

It is noteworthy also that the choice of theory was made given the highly complex environment, thus proving the effectiveness of the application of the theory.

Considering the airline industry, denied boarding occurs when there are cases of overbooking or when we have some climate restriction (runway very hot or a storm) which obliges the airline to reduce the number of passengers per flight.

This concept of constraints requires a systemic view of the organization, which is, seeing the production process as a continuous flow, instead of segmenting it into several independent units. This ensures that the entire system is aligned with a single goal and allows bottlenecks to be worked out to achieve it more easily.

According to TOC, all business systems are under restriction due to at least one bottleneck, which may influence reaching the goals set by the organization. It is the manager's role, therefore, to control as far as possible the bottlenecks or weak links of the company thus ensuring better performance and effectiveness.

Goldratt (1990) argued that the way to solve the bottlenecks is changing the process. The first step in effecting a change is to have focus, and to know exactly what to change. To this end, TOC is based on the principle that the effectiveness of a production entity is always limited by at least one constraint. For Goldratt (1990), a bottleneck within a productive system is nothing more than a resource whose capacity is less than the demand allocated to it. So identifying what change comes down to identifying bottlenecks.

Among the bottlenecks to be identified, Goldratt (1990) described three main ones:

1. Equipment / Machinery: The way certain equipment is used can limit the capacity of a process: unfortunately, considering that short runways and the weather are the main issue, there is not a problem related to a capacity of the process
2. Human Resources: Lack of capable people and / or outmoded mental models can generate behaviors that limit a process. This point is being treated once the airport responsible is receiving better information which allows them to make better decisions while minimizing impacts.
3. Policies / Standards: Policies and standards used both formally and informally can disrupt more than helping a company achieve its goals. In the case of this project, the whole idea is to adequate a new ANAC resolution – an official policy.

After finding the bottlenecks, Goldratt (1990) described how to make changes to them in order to adjust the process. This point is described in a simple script composed of five steps.

Five Focusing Steps - The Process

1. Identify the constraints (bottlenecks) of the system studied: for this project, the constraints are the number of seats that should be denied due to some issue on the operation (a very hot day combined with a short runway, for example)
2. Explore the constraints encountered (make them work in favor of production capacity): the way that we choose to work with the constraints is minimizing their impacts.
3. Subordinate the system to the changes elaborated in the previous step; once we have the information, the airport attendant is able to identify who to look for first and avoid a financial penalty as soon as they find volunteers.
4. Increase the capacity of constraints: In general terms, you have identified the constraint and this is the step where you will mitigate or eliminate it by changing the process so that this constraint is no longer a constraint.
5. Prevent inertia from generating new constraints (ensure that the lack of action and changes in existing processes do not create new bottlenecks): the major problem is the lack of information once the necessity of a denied boarding was identified. With a list of possible volunteers, it is easier and cheaper to approach directly people that already pointed their flexibility. So, we do not create new bottlenecks as it usually occurs when the airport attendant has to randomly search for volunteers

Step 5 in particular constantly reminds us of the need to revise and review changes made to bottlenecks, to ensure that they are still being implemented and also to ensure that no change was because of the creation of a bottleneck elsewhere in the process.

TOC constantly seeks new constraints on the process as a whole (always remembering the systemic view), ensures that the constraints dictate the entire production rhythm, and finally raises the capacity of all constraints, thereby increase its capacity.

However, the biggest problem in making these changes is not identifying the bottlenecks or increasing their capabilities, but rather motivating the change process.

Even if problems are found and suggestions are proposed, there is the possibility of resistance to change. The challenge is to convince those involved that the proposed changes will lead to an improvement. Organizations often find two major obstacles in terms of change: lack of direction on how to clearly implement change and unvoiced concerns and resistances even after the agreement to make the change. That internal doubt gives the impression that actions will have no effect, or are unnecessary.

The figure 2.5 below shows the scenarios that the companies could find once a change is proposed: it is necessary to explore the advantages and disadvantages of the change. The more important is to share the conclusions with all employees or at least the leaders, in order to disseminate the information.

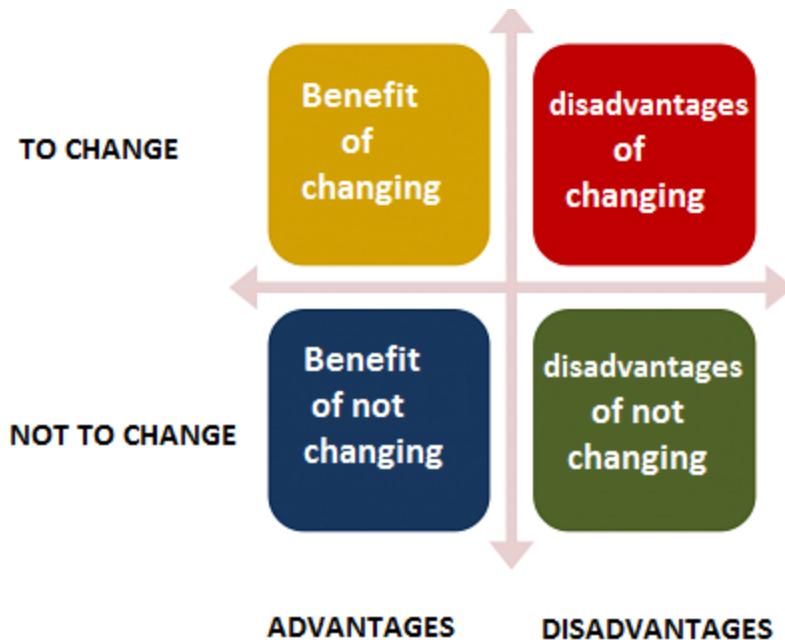


Figure 2.4 – How the organization can convince people to change?

Once the constraint is identified, the organization has to show the whole scenarios and impacts in order to prove the benefits of change. Sometimes to change parts of important processes is the only way to reach the point that the company's needs.

According to Goldratt (1990), to overcome these barriers it is necessary to first understand why they exist. He preaches that we must understand the needs of our customers (which in this case are the employees and managers of the company in which the change is intended to be implemented).

Once you get to know the motivations of those involved, you should begin to present the change in aspects that interest your clients and motivate them to act and test the suggestions presented. Every proposed change involves the exit from a current state and the transition to a future state, with new perspectives and positions on the process carried out in the organization. Each position (the old and the current) involves advantages and

disadvantages. Highlighting the advantages is the way Goldratt suggests to get the support needed for any implementation of change.

Summary

The review of the literature demonstrated that ANAC's Resolution 400 establishes a new regulation for denied boarding in Brazil, Brazilian aviation scenario and a load factor evolution. The literature also shows that United States and European's legislations regarding denied boarding are similar as Brazilians in several points. In addition, the literature presented some best practices to avoid involuntary denied boarding. The Theory of the Constraints was chosen as theoretical base and the customer travel journey were also explored in the literature.

Chapter III

Methodology

The theory chosen to support the present project is the Theory of Constraints (TOC), that is a business philosophy that is based on the existence of constraints or bottlenecks.

Experimental Design

The project was designed to consider denied boarding in domestic flights in Brazil, not considering cancelled flights. The initial goal was not to spend money with penalty fees to involuntary passengers, achieving it based on the Section II, Art.23, § 1º from the ANAC Resolution 400. In this section of Resolution there is a note that if a passenger accepts the preterition in exchange for compensation, there is no imposed penalty to the airline company.

The data used for this project was gathered with internet research, and the authors' professional experience.

Since there is no official information available about the denied boarding costs in Brazil, the projection was based in the available data from USA and Europe. By these means, it is expected to learn the most common airports practices, regarding how to adjust the airport processes in case of involuntary boarding.

This project is deeply grounded on the theory of constraints. This theory was designed to help organizations achieve their goals continuously so, in this project we will bring possibilities to the airlines companies to start a process of change and to continually improve. This is a perfect tool to use in strategic and management projects.

In this methodology, any organization has at least one restriction that impacts performance. We identify a policy bottlenecks that is the penalty fee that needs to be paid in case of involuntary denied boarding caused by a disruption in a flight and the lack of time to search for volunteers.

Following the methodology after finding the bottlenecks, we use the Five Focusing Steps to make changes in order to adjust the process and achieve the goals.

1. Identify the constraints (bottlenecks) of the system studied:

The main constraint of this process is the number of seats, that result in denied boarding, and this restriction generates others constraints:

- a. Time: once the carriers know that they will need to deny boarding close to the departure time.
- b. Process: lack of a standard procedure, make the companies waste time searching for volunteers.
- c. Technology: with the new ways that the passengers have to make the check in, the number of passengers passing through the check-in desk is reducing.

2. Explore the constraints encountered (make them work in favor of production capacity);

This restriction impacts the Operational Costs, Airport Operation Management process and Customer experience. The solution that we are proposing will help air carriers to overcome those restrictions.

3. Subordinate the system to the changes elaborated in the previous step;

With this new plug in, the airlines can modify their system and adapt their airport process to improve the recovery when a disruption occurs, so that the airport agents can

work on this new process, without wasting time searching for volunteers, once they will already know who to contact.

4. Increase the capacity of constraints;

To improve this new recovering process, it is important to the airlines to create campaigns to stimulate the passengers to download and use the companies' APP. The more the passengers use this channel, the easier it is to the carriers to contact the clients in a timely manner to change the flight, in other words, the companies have more guarantees that they will find volunteers.

5. Prevent inertia from generating new constraints (ensure that the lack of action and changes in existing processes do not create new bottlenecks);

This item we will not be detailing in this project, this needs to be done after implementation. We expect to motivate airlines to change the mindset that it is possible to have passenger's information and learn more about that. The expectation is that the airlines that accept this solution are rather motivating the process change.

Summary

The methodology demonstrates how to apply the Theory of Constraints to improve airport process during disruptions and reduce the amount spent with denied boarding compensation.

Chapter IV

Outcomes

Since March of 2017 when ANAC published the Resolution 400, the airlines have been studying how to improve their processes to minimize impacts or to improve the quality of services provided to the passengers.

This project focused on section II of the Resolution that covers prepermission process in domestic flights. The critical point in this specific section is that all carriers must pay a fine for each passenger who had his/her boarding denied involuntarily in domestic flights. In the Art.23, § 1º in the same section, there is a possibility to save this cost if there are any passengers who have accepted the prepermission in exchange for compensation.

As previously mentioned, a denied boarding could happen for any reason like operating restriction of an airline, airport or even overbooking problems.

By researching corporate websites like IATA, ANAC, ABEAR and Abracorp, it was verified that they do not have historical information about denied boarding in Brazil. The probable cause is that this is a new resolution in Brazil, with only a little more than a year of effect. Another possible reason for the difficulty of collecting data is the fact that currently all denied boarding processes, whether voluntary or involuntary, are performed manually by Brazilian airlines.

Given the absence of technology available to assist airlines in the management of a denied boarding process, this project proposal is to create a plug-in that can be used in any self-check-in channel, as it was considered as the first point of contact with the passenger and the airline.

In a study conducted by SITA in 2016 in Brazil's eight international airports, which together represent approximately 63% of the country's passenger traffic, the results showed that Brazilians were positive with the use of self-service technology, and more than half of them (51%) used these channels during check-in. Latest IT Trends from Sita (2017) has shown a worldwide breakthrough in APPs for airports and airlines, with the goal of providing real-time and personalized information for passengers. When the clients are questioned as to what kind of information and services they would like to have through APP the first of all is flight information, as can be seen in figure 4.1.

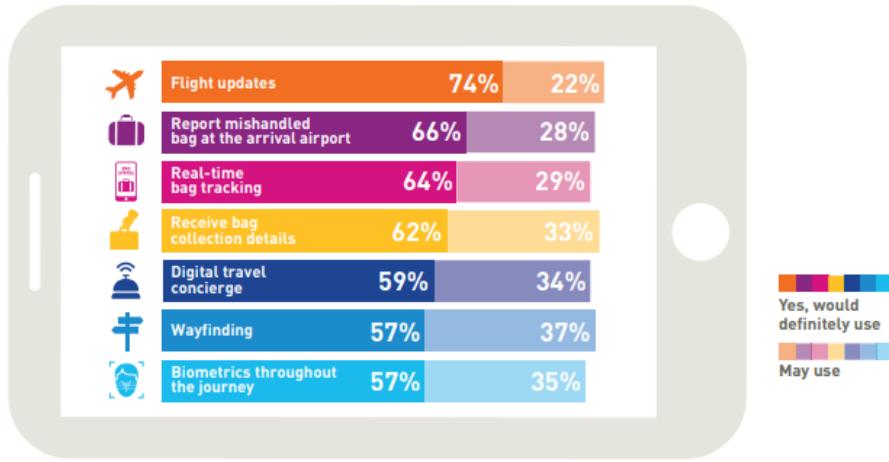


Figure 4.1 – Which Mobile Services Would Passengers Use? Percentage of passengers in 2017.

These survey results show a possible new form of communication between the airline and passengers for matters related to their flights. Another important point to highlight is the fact that it is believed that more and more the use of smart and personal devices will continue to gain space. Looking at the global passengers, most of them carry a smartphone when they fly, these devices are becoming the unifying technology to provide a connected end-to-end experience (Sita, 2016).

The Project Approach is to use the **Plug-in**, which will give the airline conditions to previously identify the voluntary passengers to check which items would be accepted by them, in case airline have to negotiate a compensation, for the passengers that did not take their original flight. The goal is to provide to the airline the number of volunteers they could have by flight and give them the possibility to optimize the process and making the individual and customized negotiation. This improves the trading power of the airline that actually performs this operation in groups. Having this information in advance helps the airlines achieve a quantitative improvement, with the operational costs reduction in the negotiation and save the fine for involuntary passengers. The qualitative goal of the airline is **Process Improvement**, being able to generate a reduction in the aircraft ground time during disruption situations.

Plug-in

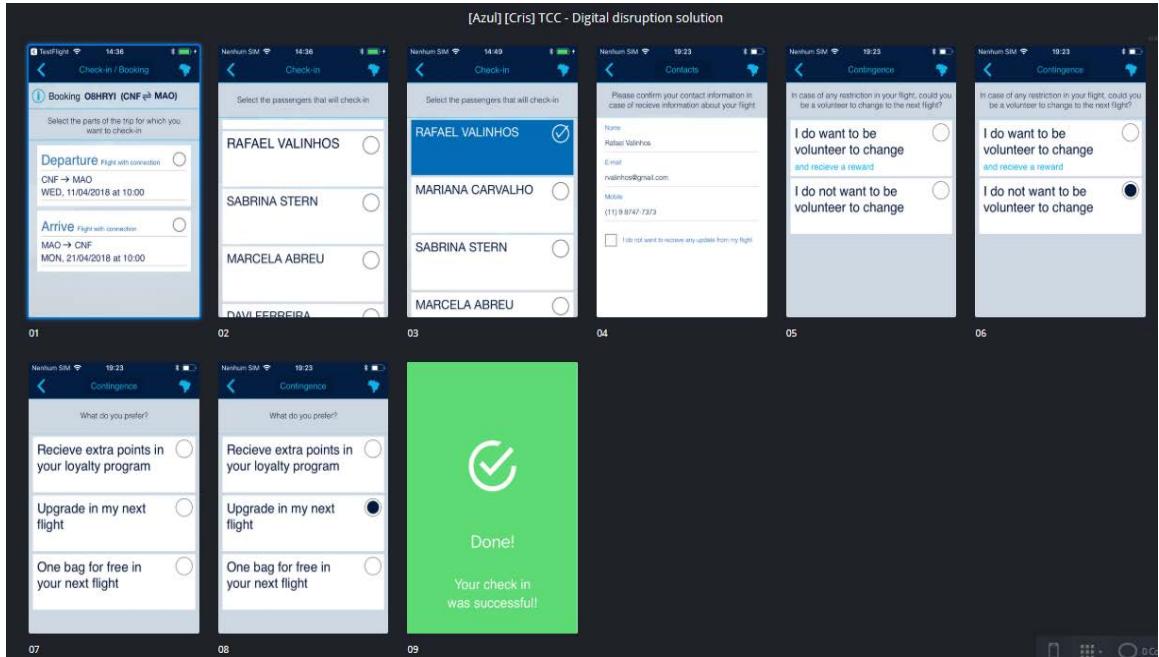


Figure 4.2. Website Prototype
<https://invis.io/76OBBUHYMD9>
 Password: DigiDisrupt

The Plug-in scope is gathered by two necessities:

- Passengers expect technology to give more personal control over their travel based on the IATA Passenger Survey conduct in May 2017.
- Airlines need to know how many volunteers are and what customers would like to receive as compensation

Based on these requirements, the plug-in proposes a simple stream after the check in process with questions that will join these two demands, while maintaining the continuity of the customer experience and providing to the airline the passenger profile in advance. The questions were defined through the researchers experience with the airline business.

This Plug in can be used by any airline and implemented in any self-service channel:

- Mobile – embedded in airline app application in the middle of the header and footer.
- Web – it is a webpage after the check in flow.

It provides a seamless experience to continue in the airline check-in.

The steps established in this plug-in are listed below:

First Step

1. Confirm Data Information

In this step, the passenger updates his/her data information. This ensures that the airline has the data updated and is more successful in contacting the passenger in case of contingency.

The passenger could do not want to include his/her data. That takes him/her out of the stream and the plug-in assumes he/she is not a volunteer.

Second Step

2. Identify the passenger volunteer

The passenger will answer a question: “In case of any restriction in your flight could you be a volunteer to change to the next flight?”

This question gives to the airline the information of how many passengers are flexible or not to be considered in a denied board problem.

Third Step

3. Identify Passenger compensation needs:

If one day you have some problems how could we help you?

- Points in your loyalty program.
 - Upgrade in a next flight.
 - One extra bag for free
-

These three possible answers are based on the compensation ways that the airlines use in a negotiation in domestic flights in Brazil.

All of the answers noted in the three steps are recorded in an airline data base and the information could be used as soon as needed.

It is important to notice that this application just provides a repository with information requested to the passenger and does not modify, cancel or send any additional information about the flight.

PLUG-IN TECHNICAL INFORMATION

Last Update	SIZE	Installation
October, 26 th 2018	3,0M	0,00
Release	Requirement	Content
1.0.1	Android 6.0 or superior Windows 7 or superior	Classification Free
Permission	Report	Provided by
📍 Location <ul style="list-style-type: none"> • Approximate Location (network-based) • Precise Location (GPS and network-based) ➡ Connection Wi-Fi <ul style="list-style-type: none"> • View Wi-Fi connections 	N/A	CharliesAngels Group
Others		
<ul style="list-style-type: none"> • Receive data from Internet • View network connections • Full network access • Read Google service configuration 		
Developer	Investment	
Access site	Design: U\$ 3,000.00 Application: U\$ 6,530.00	

Figure 4.4. Plug-in Technical Information

Process Improvement

After the passenger checks that he/she could be a volunteer, this information goes to the airline data store and could be used at any time until the flight departure. This simple process brings to the airline the information that they need to better identify possible volunteers in case of disruption.

If the airline faces some problems, it could use the information in the new process in the flowchart below:

Process Improvement

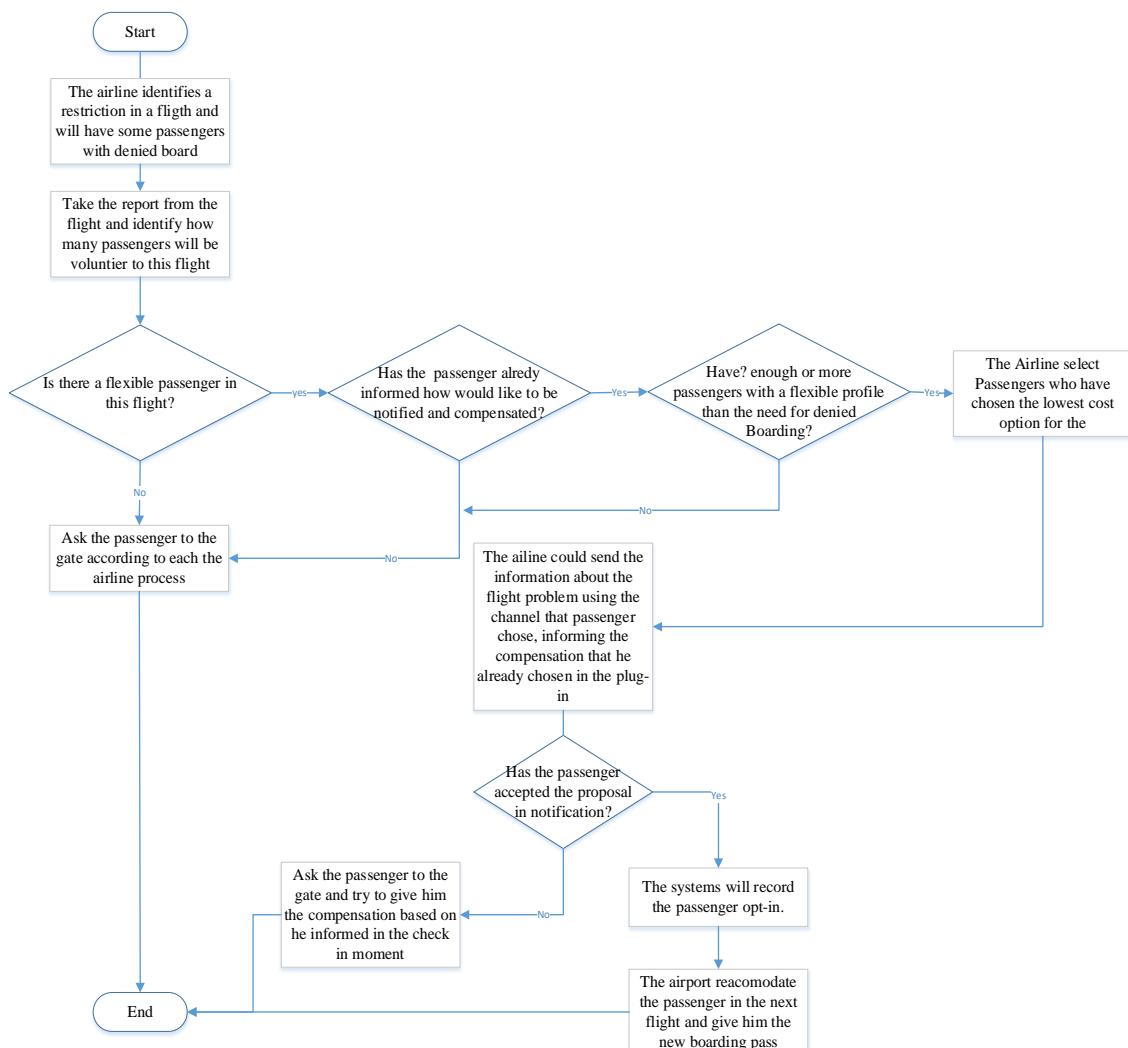


Figure 4.4 –New Disruption Recovery Process.

Our analysis matches with IATA's Simplifying the Business (StB) program. StB looks over the passenger experience from an end-to-end perspective across all processes, with a special focus on transformation. There are Programs under the StB umbrella that include Real-Time Interaction that aims to provide customers with trusted, accurate real-time information from all travel service providers throughout their journey.

The main gains with this process are:

- Knowing the profile of the customer, the airline can be more assertive in approaching customers and improving the management of the operation. Consequently reducing flight delay time with the operating procedures of resettling.
- To be able to minimize frustration knowing the customer's preferences
- To avoid payment of no-volunteer denied boarding penalty fee and reduce the compensation paid for volunteers.

Summary

In these Outcomes, the researchers provided a prototype of a plug-in that could be used by any airline in their website or in their app. This plug-in consists of additional 3 steps in the self-check in booking flow.

- 1- Confirm Data Information
- 2- Identify the passenger volunteer
- 3- Identify Passenger compensation needs

This plug in provides to the airlines the passenger information that can be used when the airline faces some flight restriction problem. With this plug-in we achieve two goals in the airline business:

- Personalized flight to the passenger.
- Update passenger contact information to airline.

In addition, this information helps to optimize the process in the airport and we propose an optimized flow in the outcomes.

Chapter V

Conclusions and Recommendations

This project motivation was ANAC's resolution 400, more precisely based on the Section II, Art. 23, § 1.. This section establishes that all carriers must pay a fine of R\$1065.00, for each passenger who had his boarding denied involuntarily on domestic flights.

The main goal of this project is to minimize the number of involuntary denied boarding, reducing the total compensations amount spent by the airline companies and improve the airport process. The proposed way that to tackle this problem is to create a plug-in to identify possible volunteers in advance, avoiding problems at the check-in counter and reducing the legal costs.

Conclusions

One of the main problems faced in this project was the lack of existing information on this subject, due to its recent legislation and the lack of interest of the airlines in disclose this information.

This project was then continued based on the survey produced by IATA in March 2017 which brings the information that passengers look for a personalized trip, adding information about how customers would like to be contacted and what they prefer as compensation.

Based on the presented analysis, it was identified that more than 60% of passengers transported are sensitive to using this plug-in to make the check in.

This theory need to be tested because it was not implemented. A prototype was produced and it is available for development and testing. In addition to the financial impacts, the operational challenges to determine which passengers will be denied to board is also something that the front line of an airport needs to deal with, using the new process improvement proposed in the *Figure VII. 8 –New Disruption Recovery Process*.

In summary, this project identified the following:

- A way to identify the type of passengers prone to volunteer
- Initiated an Internal process changes for the airline as soon as they have the passenger information.
- IT development guides and channels to communicate with passengers

The suggestion of Roll out plan is to put the plug-in embedded in the airline mobile app, web check in and implement the Process Improvement showed in the outcomes. It works based on the implementation results analyses. Expecting to motivate airlines to change their mindset, showing that is possible to have passenger's information and learning more about that, with the airlines accepting this solution, changing and improving their processes.

Recommendations

The relevant result of this project was not only the construction of the simple plug-in, but also to bring information about the passengers profile to the airline companies. We propose new studies in the sequence of this project in order to enhance the use of the application. It's also important to conduct a consumer survey to see how the passengers will react to the plug-in questions.

The effective implementation of the plug-in, in order to have statistics to validate the improvement of the process and characterize the cost reduction. For this, companies should also be more flexible and disseminate data to promote future studies in order to improve customer service to the Brazilian airline market.

The information produced by this app, though being simple, can be used for load factor optimization and increase of the average rate per flight. A practical example for the application of this project can be identified in the example below:

An airline has more than two frequencies of flights to the same destination. One flight is with a high load factor and high fares, other one later, with low load factor and low fare. If there are passengers on the first flight that inform through the plug-in that they are flexible to move for the other flight, the airline can transfer passengers to the flight with low load factor and give a compensation that they choose. In this case, the airline increases the availability in the first flight so more seats will be available in a flight with higher fares. In summary, the airline has the possibility to manage the load factor in their flights without causing problems with passengers.

Key Lesson Learned

On account of the lack of information, it becomes more difficult to make a deeper analysis regarding the denied boarding. The good way is to have centralized information in an institution such as ABEAR. Doing this collectively, airlines would have more strength to solve various problems, which are often not up to their domain as: slope restrictions and airport infrastructure.

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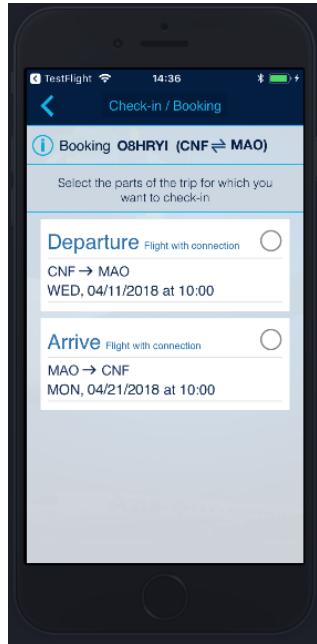
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Appendix A

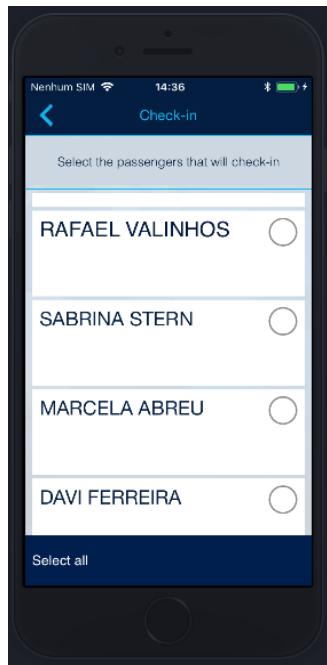
Figures

Plug-in screen shots flow

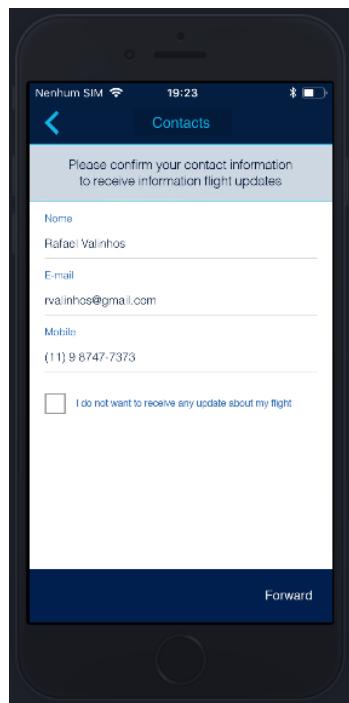
B1 Select flight to make check-in



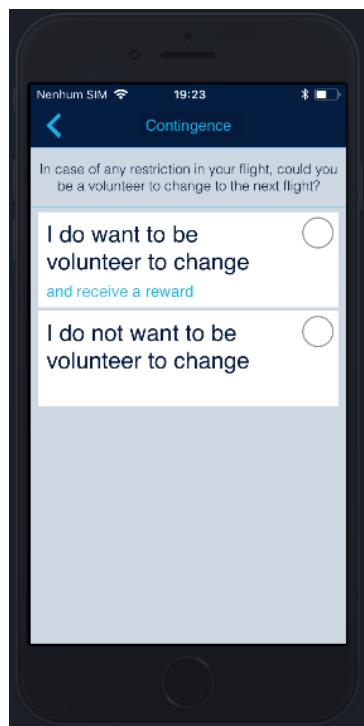
B2 Select Passenger



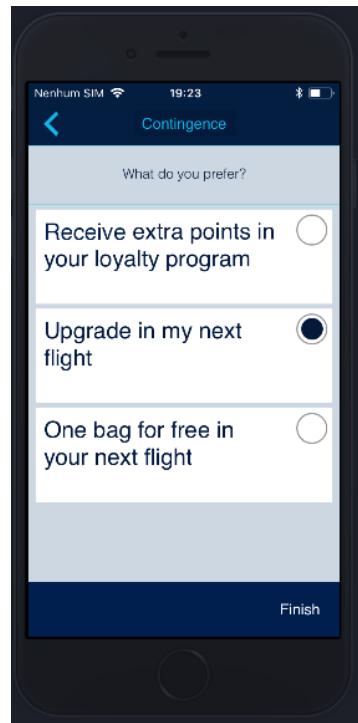
B3 Ask the passenger information



B4 Ask the passenger to be a volunteer



B5 Ask the passenger what they prefer as a reward



B6 Check in Done

