DIGITAL DISRUPTION SOLUTION FOR AIRLINES IN BRAZIL

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ABSTRACT

Since March 2017, the cost of denied boarding began to draw all Brazilian airlines' attention because of the Resolution 400 of the Brazilian National Civil Aviation Agency. This Resolution covers several items, but we will focus on the penalty that the airlines need to pay for each passenger who had his boarding denied involuntarily in domestic flights. Our goal is to create a plugin that any airline could use in their self-service check-in channels and direct communication with the passenger. It could also become a way to offer proactive accommodation options and monetary compensations due to itinerary or ticket schedule change.

INTRODUCTION

Nowadays, Brazilian airlines' operation has a significant concentration of flights in airports of short runways, such as 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. Also, airline tickets' perishability allied with the airline industry's low financial margins requires increasingly aggressive overselling practices. These actions are complicated situations that the airports' ground staff has to face and solve to offer a good customer experience.

The cost of denied boarding began to draw all Brazilian carriers' attention since the ANAC's Resolution 400 come into force in March of 2017. Due to this new Resolution, all airlines 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.

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. When a denied boarding situation occurs, the airline and customers' negotiation increases its complexity, especially as the airport agent needs to negotiate with the passengers to select possible groups with flexibility. The prior identification of passengers who can accommodate operational restrictions, such as overbooking and overload, brings operational efficiency. The airport agents don't spend time identifying which passengers 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 whether this moment for the passenger's classification is voluntary or not for each trip. They can be flexible in one flight but may not be flexible for the other connecting flight.

This research's primary purpose is to investigate 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.

REVIEW OF THE RELEVANT LITERATURE

USA Scenario

Since the 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 were available. But the standard for denied boarding compensation (DBC) established in 1978 remains the same until 2008 when the U.S. Department of Transportation (DOT) ruled that passengers who encounter a delay of more than 1 hour due to the involuntarily denied boarding are entitled to compensation

(Schoonover, 2011). 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 occurs (Federal Register, 2010).

Figure 2.1 shows the new compensations that the DOT established.

Figure 2.1. Compensation Policy for Denied Boarding in the USA.

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 two 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 four h arrival delay	400% of one-way fare (but no more than $1300)

Garrow, Kressner, and Mumbower (2011) showed in their study; this new regulation didn't reduce the number of involuntarily denied boarding in the USA. Also, the increasing load factor contributed to the problem since companies have fewer options to accommodate the passengers conveniently. After this regulation, the carriers look for new solutions to tackle the involuntarily denied boarding problem; the first and more common is to seek volunteers to give up their seats. Garrow, Kressner, and Mumbower (2011) listed other actions that the U.S. carriers adopted to avoid denied boarding. These included the following: 1)Day of departure flight management: carriers use to leave the A.U. at high levels until the day of departure. 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 is close to zero; 2) Demand-driven dispatch: as some flights experience higher Load Factors 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 presented by Chung and Feng (2016) entailed using airline alliances to reduce the cost of reallocating passengers.

With all these actions, the U.S. 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:

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

	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%

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

According to representatives from an airline industry association, GAO (2019) published a study to explain how denied boardings can be avoided on specific routes using larger aircraft if available. According to GAO (2019), airlines may accommodate passengers in a special aircraft section by upgrading or downgrading passengers. Airlines have taken a range of actions,

primarily intended to reduce such incidents by offering added incentives for passengers to volunteer to be denied boarding. Some additional ways that airlines have implemented to avoid denied boarding include reducing the rate or eliminating overbookings, improving the ability to predict no-shows or rebook passengers, improving communication with passengers, increasing and diversifying compensation for passengers, and offering passengers the opportunity to suggest acceptable voluntary denied boarding compensation.

European Scenario

Considering the European scenario, regulation 261/2004 of the European Parliament and the Council establish standard rules on compensation and assistance to passengers in the event of denied boarding and 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 cancellation or long delay of flights to 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 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 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 scheduled arrival time of the flight booked initially 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).

Defossez (2021) conducted a study to propose revisions of regulation 261/2004. He explains an updated airline passenger's rights from a passenger's perspective. The proposal includes some well overdue changes needed to account for a passenger's satisfaction, such as the inclusion of missed connecting flights.

Brazilian Scenario

Some of these solutions are useful for the Brazilian carriers, such as searching for volunteers and reducing the A.U. level the day before the flight. Still, as two of the country's busiest airports have small runways with restrictions on the aircraft's size, the carriers can't use the demand-driven dispatch solution. The strategy to reallocate passengers into partners flight isn't applicable in the Brazilian scenario, as we don't have carriers from the same alliance operating domestic flights in the country. Hence, companies need to relocate passengers on competitors' flights, and this generates more costs.

Even though 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 has 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 any marketing campaign or promotional action the total amount of the ticket, already with the taxes. With this new Resolution, the companies could also offer ancillary revenue options, such as reserved seats and checked baggage purchase. Airlines saw the possibility of increasing ancillary revenues, such as charging for the first checked bag (Josephs, 2018). This new Resolution brought a chance to improve its 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 reach the final destination when scheduled. This can happen for several reasons, such as weather conditions, aircraft maintenance, overload, and overbooking. However, overbooking cannot be treated as a common contingency, as passengers often feel betrayed and deceived by the companies (Wangenheim & Bayo, 2007; Büsing, Kadatz & Cleophas, 2019; Matikiti, Roberts-Lombard, & Mpinganjira, 2019). Haynes & Egan (2020) examined the ethics of overbooking from a guest's perspective exploring compensation options to guarantee satisfaction and customer loyalty (Hwang, & Wen, 2009).. If frontline employees can offer appropriate compensation to guests and give a warning of an outbooking scenario they perceive, then an ethical balance between hospitableness and commercially driven overbooking practices can be achieved.

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

Figure 2.2. Load Factor Evolution by Brazilian

Carriers
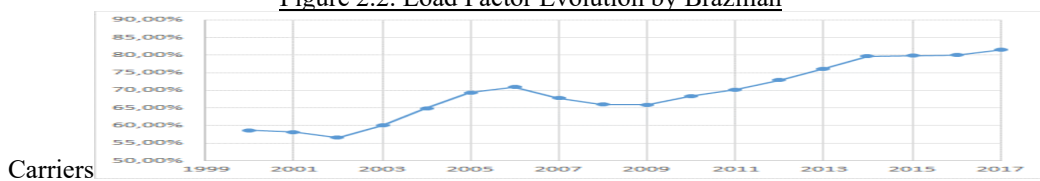
The Load Factor evolution shown in figure 2.3 is based on ANAC, 2018, and shows that the Load Factor rate increases. Denied boarding is a problem not only to the passengers but also to airlines in the entire world. Several factors cause the airline to deny boarding, and those

factors differ across carriers. Carriers generally have strong internal incentives to reduce denied boarding because it directly impacts their operational costs and passenger satisfaction. It is essential 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 canceled 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

Following Section II, Article 24. the 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 maybe 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 accepted the negotiation, the airline is not obliged to pay the penalty of R\$1065.00.

Establishing an accurate mechanism for estimating the cost of 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, there is no official number available in Brazil to identify the Passengers Boarded and Denied boarding. In Figure 2.2, we presented the Largest U.S. Air Carriers to directly collect this data from the air carriers.

2. Improvement of the Management Airport Operation

Currently, the airport process in case of disruption is chaos. The process happens when the passengers are already in the boarding area. At this moment, the airline airport agent reports that there is an operational problem on the flight and asks 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 flight delays. If no passenger volunteers, the airline airport agent randomly selects passengers, which confuses an involuntarily denied boarding situation.

Today, the airline company's only available passenger profile differentiation option is its loyalty program classification and the need for 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 anyone is willing to change the original flight schedule or take 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 essential flows where the telephone contact is requested is to purchase the tickets. However, not all purchases are made through the direct channels of the airlines. Intermediate channels such as travel agencies are used
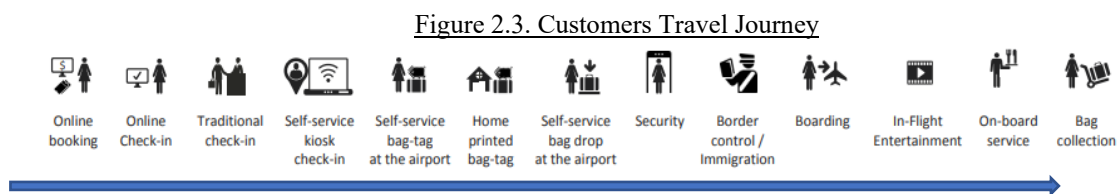
to buy tickets. The airline does not guarantee that the contact and telephone information will be forwarded to the airport front line's departure control system.

According to a survey conducted by the company MindMinners and ordered by Paypal at 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 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 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 the Smartphone app (28% of passengers). They are still able to use SMS as a way to receive information, but this number is decreasing. So, in this project, it is clear what the passenger prefers.

Thirteen steps compose the Customer travel journey, but the remaining contact with customers is during their check-in after buying the ticket. In this part of the process, the customers need to include their national I.D. or passport number. Before the boarding process, they are the singular point of contact that can be guaranteed between the airline and the passenger. At this point, the company collects all the required information to make the trip safe and tailored to its passengers' needs. If the company calls for some additional information after this step, the only way is to contact the passenger in person or through their contact.

Figure 2.3. Customers Travel Journey

| Online booking | Online Check-in | Traditional check-in | Self-service kiosk check-in | Self-service bag-tag at the airport | Home printed bag-tag | Self-service bag drop at the airport | Security | Border control / Immigration | Boarding | In-Flight Entertainment | On-board service | Bag collection |

After having 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 three essential services to improve what they called "the travel disruption experience."
- Real-time information is shared with passengers.
- Flight rebooking.
- Hotel accommodation.

However, the factors affecting time use are different between business and non-business travelers. They could be altered even by the journey since a passenger may not have flexibility on his outward flight. Still, he has on the return, making it possible to implement a solution that considers the passengers' different needs in each part of the journey. An alternative to managing a situation of collective dissatisfaction is identifying the different profiles within a group of passengers affected by the disruption. Zhang, Wang, Wang, & Wang (2010) discussed the different passenger profiles and classified them into two types: under time pressure and time enough customers. The authors also presented how airlines' solutions can have different impacts on passenger satisfaction and customer expectations. The customers under time pressure preferred loss prevention and time enough customers were more concerned about achieving gains. Oki & Dewi. (2018) examined expected revenue in the dynamic programming model to maximize revenue expectations of airlines' overbooking policies as a whole. They explain revenue management with overbooking in airlines and how customer behavior plays a significant role in cancellations and no shows. According to their findings, the expected revenue function is projected to maximize the expected revenue from accepting or rejecting the booking requests between passengers and air cargo by the same airline.

Zhang (2011) conducted a study using data gathered from the Chinese Airline industry to expand the conventional attribute-satisfaction analysis by combining customer's psychological factors and suggested a novel implementation process. His research establishes the efficacy of categorizing the customers into time fixed versus time flexible situations while highlighting asymmetric impacts in both time situations.

This study's findings propose a more contended and added accuracy to prioritize service recovery attributes contemplating psychological impacts.

METHODOLOGY

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

This research is deeply grounded in the theory of constraints (TOC) (Goldratt, 1990; Polito et al., 2006, Goldratt & Cox, 2016). This theory was designed to help organizations achieve their goals continuously. Through TOC, any organization has at least one restriction that impacts performance. We identified a policy bottleneck that is the penalty fee that needs to be paid in case of involuntarily 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 used the Five Focusing Steps to adjust the process and achieve the goals.

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

The primary constraint of this process is the number of seats that result in denied boarding, and this restriction generates other limitations:

      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 makes 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 reduces.

 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 Plugin, the airlines can modify their system and adapt their airport process to improve the recovery when a disruption occurs. The airport agents can work on this new process without wasting time searching for volunteers once they know who to contact.

 4. Increase the capacity of constraints.

   To improve this new recovering process, the airlines need 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 for the carriers to contact the clients to change the flight promptly; 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 will not be detailed 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 passengers' information and learn more about that. The expectation is that the airlines that accept this solution are rather motivating the process change.

OUTCOMES

   Since March of 2017, when ANAC published Resolution 400, the airlines have been studying how to improve their processes to minimize impacts or to enhance the quality of services provided to the passengers. Our research focused on section II of the Resolution that covers the pretermission process in domestic flights. This specific section's critical point 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 of saving this cost if any passengers have accepted the pretermission 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, we verified that airlines 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 managing a denied boarding process, we created a plugin that can be used in any self-check-in channel. It was considered 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 optimistic about the use of self-service technology, and more than half of them (51%) used these channels during check-in. Latest I.T. Trends from Sita (2017) have shown a worldwide breakthrough in APPs for airports and airlines, intending to provide real-time and personalized information for passengers. When the clients are questioned about what kind of information and services they would like to have through APP, the first is flight information, as shown in figure 4.1.

Figure 4.1 – Which Mobile Services Would Passengers Use? Percentage of Passengers in 2017.
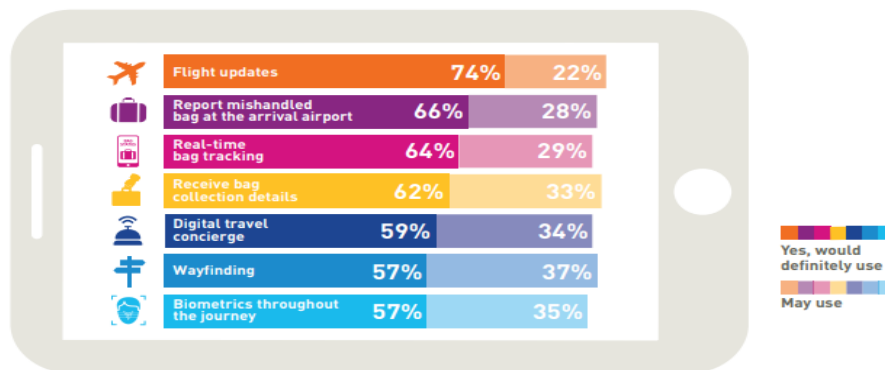
These survey results show a possible new form of communication between the airline and passengers for matters related to their flights. Another critical point to highlight is that it is believed that more and more smart and personal devices will continue to gain space. Looking at the global passengers, 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 (Lemes, 2008) uses the Plug-in, which will give the airline conditions to previously identify the voluntary passengers to check which items would be accepted by them. Airlines have to negotiate compensation for the passengers who did not take their original flight. The goal is to provide the airline with the number of volunteers they could have by flight, optimize the process and make the individual and customized negotiation. This improves the trading power of the airline that performs this operation in groups. Having this information in advance helps the airlines achieve a quantitative improvement, reducing the operational costs in the negotiation and saving the fine for involuntary passengers. The airline's qualitative goal is Process Improvement, generating a reduction in the aircraft ground time during disruption situations.

Figure 4.2. Website Prototype
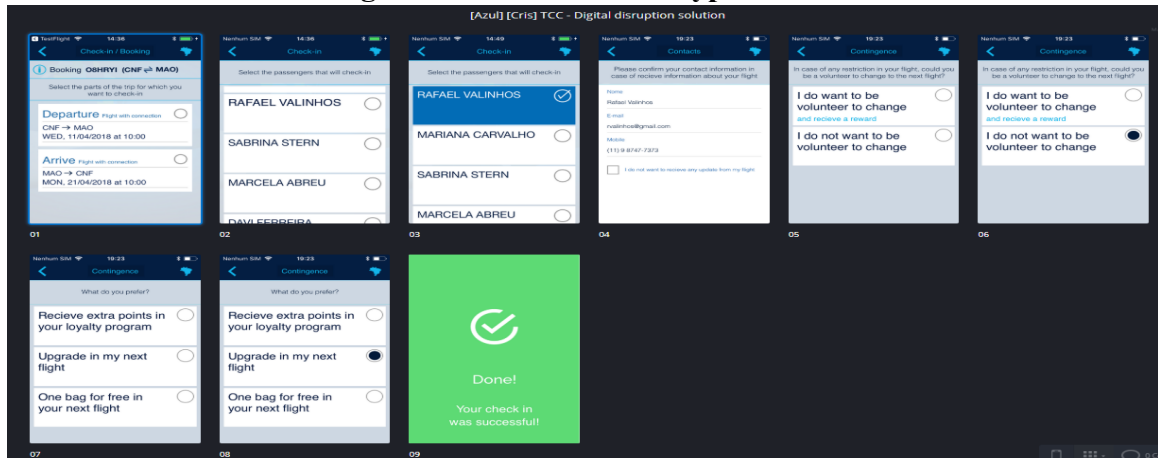
The Plugin scope is gathered by two necessities:

- 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 Plugin proposes a single stream after the check-in process with questions that will join these two demands while maintaining the customer experience's continuity and providing the airline the passenger profile in advance. The items were defined through the researcher's involvement with the airline business.

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

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

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

The steps established in this Plugin 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 makes him/her out of the stream, and the Plugin 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 the airline the information on how many passengers is flexible or not 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 the next flight.

   - One extra bag for free

These three possible answers are based on the airlines' compensation methods in a negotiation in Brazil's domestics flights.

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

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

Figure 4.4. Plug-in Technical Information

Last Update	SIZE	Installation
Oct. 26, 2018	3,0M	0,00
Release	**Requirement**	**Content Classification**
1.0.1	Android 6.0 or superior Windows 7 or superior	Free

Permission
 Location
   • Approximate Location (network-based)
   • Precise location (GPS and network-based
 	
 Connection Wi-Fi
   • View Wi-Fi connections
	Report
	N/A
		Provided by
		Charlies angels Group

Others
   • Receive data from the Internet.
   • View network connections
   • Full network access
   • Read Google service configuration.		

Developer Access site	**Investment** Design: U$ 3,000.00 Application: U$ 6,530.00	

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 identify possible volunteers in case of disruption better. If the airline faces some problems, it could use the information in the new process in the flowchart below:

Figure 4.4 –New Disruption Recovery Process
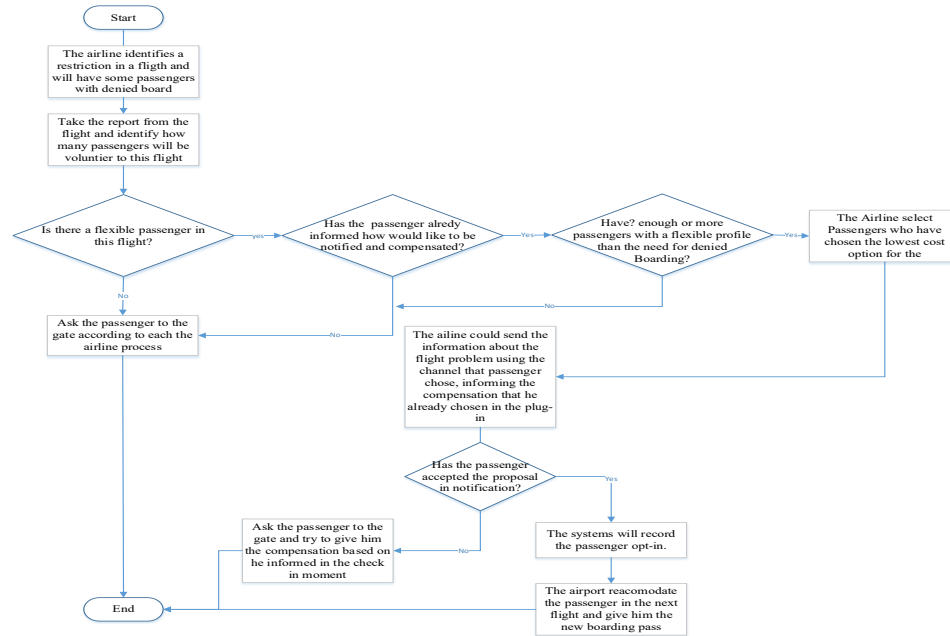
Our analysis matches with IATA's Simplifying the Business (StB) program. StB looks over the passenger experience from an end-to-end perspective across all processes, with a particular focus on transformation. Under the StB umbrella, some programs include Real-Time Interaction that aims to provide customers with trusted, accurate real-time information from all travel service providers throughout their journey. The main gains with this process are: Knowing the customer's profile, the airline can be more assertive in approaching customers and improving the management of the operation, and consequently reducing flight delay time with the operating procedures of resettling. This process will minimize frustration knowing the customer's preferences. The airline will avoid payment of no-volunteer denied boarding penalty fee and reduced the compensation paid for volunteers. This also results in a personalized flight to the passenger and an update of passenger contact information to airlines. Besides, this information helps optimize the airport process, and we propose an optimized flow in the outcomes.

CONCLUSIONS AND RECOMMENDATIONS

This project motivation was ANAC's resolution 400, more precisely based on 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. This project's main goal is to minimize the number of involuntarily denied boarding, reducing the total compensation amount spent by the airline companies and improving the airport process. The proposed way to tackle this problem is to create a plugin to identify possible volunteers in advance, avoid obstacles at the check-in counter, and reduce legal costs.

Based on the presented analysis, more than 60% of passengers transported are sensitive to use this Plugin to make the check-in. 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 **boarding** is also something that the front line of an airport needs to deal with, using the new process improvement proposed in *Figure VII. 8 –New Disruption Recovery Process.*

In summary, this research presented a way to identify the type of passengers prone to volunteer. We initiated Internal process changes for the airline as soon as they have the passenger information while the I.T. development guides and channels to communicate with passengers. Roll out plan's suggestion is to put the Plugin 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.

The Plugin's practical implementation has statistics to validate the process's improvement and characterize the cost reduction. For this, the airlines should also be more flexible and disseminate data to promote future studies 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 an increase in the average rate per flight (Basa & Kedir, 2017).

A practical example of the application of this project can be identified in the case below:

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

While the results of this research are applicable to all airlines in Brazil, the results can be generalized to any other country with comparable information technology infrastructure. Areas for future work would involve enhancement to the use of the application. It's also essential to conduct a consumer survey to see how the passengers react to the plugin questions.

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