PERSPECTIVES FOR AERONAUTICAL RESEARCH IN EUROPE

PARE

CHAPTER 15

Regional and International Air Travel

Final Report

WWW.PAREPROJECT.EU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769220. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Table of Contents

List of Figures

List of Tables

Chapter 15 – Regional and International Air Travel

15.1 SATA: Seven Decades of History and Experience

The Azores archipelago has an undeniable geostrategic position and value. The first air crossing of the North Atlantic occurred during the First World War, passing through Ponta Delgada (PDL, São Miguel island) on 20 May 1919. Several landmarks in the history of aviation intersect with the contemporary history of the Azores, demonstrating the importance of the air transport sector at the global and regional level. It is also in this context that the role of SATA in the development of the Azores and its autonomy is highlighted, in promoting the unity of the Azoreans (islands and diaspora); the social, economic and cultural progress of the archipelago; and the Azorean identity.

The Sociedade Açoriana de Estudos Aéreos was created on 21 August 1941 to study the feasibility of exploring air routes over the Azores and from the archipelago to other destinations. Its designation passes to Sociedade Açoriana de Transportes Aéreos Ltd. (SATA) on 17 February 1947, and the commercial activity and baptism of the aircraft "Açor" (a Beechcraft with registration CS-TAA) began on 15 June 1947, with the first flight operated between Ponta Delgada (PDL) and Santa Maria (SMA) with 7 passengers on board.

The company started as the connection to the World, at a time when air transport was only for the elites: it connected the islands of São Miguel and Terceira (which represented 75% of the archipelago's population) to the island of Santa Maria, where the European and American airlines crossing the Atlantic used to make stopovers (Imperial Airways, Pan American Airways, TWA, Canadian Pacific, Air France and TAP).

The expansion to all islands in the Azores was gradual, according to airport constructions. First, the island of Faial, in 1971, followed by the island of Flores, in 1976; the aerodromes of the islands Graciosa, Pico and São Jorge were opened between 1981 and 1983. Corvo would be the last island to have regular connections operated by SATA starting in 1993. From Beechcraft, SATA evolved to DOVE, then Dakota, Avro, ATP and, currently, to Bombardier.

The reality of an air operation in an ultra-peripheral region such as the Azores includes challenges that arise from the need for self-sufficiency, which leads to vertically integrate all activities related to air transport, namely, flight operations, maintenance and engineering, assistance services in each station, aerodrome management and specific training of human resources.

Since air transport is an international business, SATA had to maintain rigorous industry standards, both in its operation and commercialization processes, as well as in-ground handling services (SATA has developed due to the commercial and technical stops of the large international companies operating on the island of Santa Maria).

When stopovers in Santa Maria began to decrease, SATA established a direct bridge with immigrant communities in North America, creating two tour operators in 1985, one in Canada and the other in the United

States, which chartered local planes to transport passengers to the Azores. A decade later, the company acquired the first Boeing 737-300 and started flying outside the archipelago.

It was then, from the end of the 1990s that SATA evolved into the Business Group that it is today, composed of five companies: SATA Air Açores, the parent company that ensures the connections between the islands of the Azores with the Dash 8 aircraft, Q200 and Q400; SATA Internacional - Azores Airlines, the company that flies outside the Region, with jet aircraft, Airbus A320 and A321; SATA Gestão de Aeródromos, which manages the airport infrastructures of the islands Graciosa, São Jorge, Pico and Corvo; and the two tour operators, SATA Vacations Canada and SATA Vacations America.

Figure 15. 1 SATA Air Açores Fleet

Figure 15. 2. SATA Internacional – Azores Airlines Fleet

The liberalization of air transport in Europe, also known as open skies, took place only after the third legislative package of 1993. In 1995, SATA acquired a medium-haul aircraft and, while unable to access the market between the Mainland and the Azores, gained experience operating in Madeira. SATA Internacional was created in 1998; in 1999, the company won the tender to explore the public service routes between Lisbon, Porto, Funchal and Ponta Delgada. In 2000, it started operating in Boston and Toronto, where a large Azorean community resides. Currently, the creation of a hub in the Azores is consolidated with the increase in the number of frequencies and connectivity through a new generation of more efficient aircraft, the Airbus A321neo (new engine option) and LR (long-range).

The company continues to have ground handling services on all islands, has aircraft maintenance and engineering services, both basic and line (assisting third parties inline) and has the Atlantic Aeronautical Training Centre (in Santa Maria). SATA's history has been built to service the Azores, an internationally recognized service as demonstrated by ICAO by awarding the company a medal of honour on its 50th anniversary, due to its relevant contribution to civil aviation.

SATA emerged in a context of expectations regarding the advantages of air transport for the material and cultural progress of the islands' population and represents a regional purpose in its condition as a public company (since 1980). The contribution to the unity of the Azoreans, to the social and economic development of the Azores and the cultural promotion of the different islands, is undeniable. It also makes commitments to serve the diaspora; attract tourism flows to the Region; and boosting traffic in Macaronesia – materializing, therefore, its internationalization and inter-regionalization strategies.

In 2020, SATA celebrates 79 years of foundation and 73 years of the first flight. There are more than seven decades of history and life, a case of longevity in terms of world civil aviation. It presents as its current mission (and vocation) "to unite the Azoreans and to break their isolation from the world, through the activity of a group of companies and complementary business areas whose importance for the Azores constitutes an indisputable reality" [1].

15.2 Destination: The Future

SATA Internacional – Azores Airlines is a full-service airline operating within a broad geographic area; its network includes the Azores, Madeira, Portugal Mainland, the Canary Islands, Germany, Cape Verde, the USA and Canada. The value propositions the company offers to its customers include the transportation of passengers, cargo and mail; passenger service is available in business and leisure classes, in both domestic and international routes. The company's mission is to bring the world to the Azores and take the Azores to the world centred on values of friendliness, reliability and innovation.

Today SATA is a small regional airline with large strategical and operational ambitions. It is no longer focused on uniting each of the nine islands of the Azores but, rather, take each island out to the World and bring the World to each of the nine islands, collective and individually. The availability of such air transportation services in a unique regional context has a substantial positive impact on the economic growth of the region; airport activities generate jobs, influence firms' decisions in terms of exportation and importation and, especially, nourish the much-needed individual islands tourism industry. Flows of passengers and cargo enable the flows of goods, services, knowledge, opportunities, investment and employment, and can affect the region's GDP, demand and business environments.

Strategic management of an airline should be based on the identification and establishment of key long-term competitive advantages, which ensure the creation of new opportunities for development and growth; the company's performance would be a successful one when focusing on the relationships with passengers, alliance partners and supporting organizations. An airline needs to focus on the improvement of transportation processes and construct a chain of added value formation in the development of all operating stages; this will enable the establishment of competitive advantages to achieve long-term objectives and attain the desired results at an optimal cost.

To guarantee its strategical long-term success, SATA must have control and know-how of operational capacities to maintain a balanced combination of flexibility and stability. The company´s aim must be to gain and maintain a high strategic and operating management system, such as: in the development of the airline route network; optimization of aircraft fleet; developing of efficient tariff policy; cost and revenue management; development and implementation of airline strategy according to long-term objectives; employment of resource potential; creation of airline's positive image; enhancement of airline's product quality; and implementation of modern IT to optimize airline's business processes.

In summary, the airlines' regional strategic mindset should be based on the value proposition, the market segmentation and the value chain (service/ operational quality, commitment and safety; innovation) and, lastly, the profit structure (fares, low-costs, cost control and profitable growth). The challenges for a small regional airline competing with much broader-based giants, especially for major international routes, are countless and immeasurable, mainly due to the small regional airline's peripheral geographical location, in which the airline is positioned primarily obligated to perform a public service, in this case, that is mandated to serve a group of nine islands. The secret to success is to know precisely how to combine a public service commitment with profit growth.

15.3 CO_2 Emissions: Reduction Path

*Flightpath 2050 goal 9:" In 2050 the technologies and procedures available allow a 75% reduction in CO_2 emissions per passenger kilometre and a 90% reduction in NOx emissions. The perceived noise emission of flying aircraft is reduced by 65%. These are relative to the capabilities of typical new aircraft in 2000".

Fleet Change – A321LR

SATA Internacional – Azores Airlines has decided to renew its fleet in October 2016. The main motivations for this renewal were related to adapting the long-haul fleet to the market needs; also, the capacity of the A330 (an aircraft part of the fleet) was excessive, mainly in low season. The factors identified as the most advantageous for this fleet change were:

- Reduction of operating costs (-20%).
- Reliability.
- Commonality with A320 (pilots share the same certification).
- Simplified maintenance (95% of components are common between A320 and A321 families).
- Lower seating capacity of the A321LR (enables the airline to adjust the schedules to meet specific daily or seasonal demand).
- Flexibility in the scheduling of most domestic flights (being possible to choose between the A320 and A321 without additional costs).

Figure 15. 3 A321 neo (from www.airbus.com)

Dimensions

Overall length	44.51 m
Cabin length	34.44 m
Fuselage width	3.95 m
Max cabin width	3.70 m
Wing span (geometric)	35.80 m
Height	11.76 m
Track	7.59 m
Wheelbase	16.90 m

Capacity

Pax	Max seating	244
	Typical seating 2-class	180-220
Cargo	LD3 capacity underfloor	10 LD3-45W
	Max pallet number underfloor	10
	Water volume	59 m^3

Performance

Range	7400 km
Mmo	M0.82
Max ramp weight	97,40 tonnes
Max take-off weight	97.00 tonnes
Max landing weight	79.20 tonnes
Max zero fuel weight	75.60 tonnes
Max fuel capacity	32 940 litres

Figure 15. 4 A321 neo specifications (from www.airbus.com)

Length: **44,51 m** Height: **11,70 m** | Cruising Speed: **900 km/h** Fuel Cap.: **30 292 L** | Wing Span: **35,80 m** Passengers: **190** | Cruising Alt.: **11 900 m** Max. Range: **8 200 km**

Figure 15. 5 A321 neo LR SATA Internacional – Azores Airlines

Figure 15. 6 A321 neo SATA Internacional – Azores Airlines

The benefits of reducing fuel consumption and CO_2 emissions (financial and environmental components) have been estimated in comparison to the A310 (the replaced aircraft); the A321LR shows a reduction in fuel consumption and CO_2 emissions of 45% per flown kilometre, -35% per passenger transported, or -22% per tonne of cargo carried.

The company has also implemented three new operational procedures to lower fuel wastage and CO_2 emissions during aircraft taxiing and turnaround:

1. After landing, immediate turning off the APU (Auxiliary Power Unit).
2. Taxiing in on one engine.
3. Reduced onboard weight (adjusted individual catering and water requirements to all specific routes to lower the aircraft's' weight).

Presently, the fleet of SATA Internacional – Azores Airlines is composed of 3 A320 and 3 A321. The airline expects to complete the fleet change with three more A321LR until the end of 2021.

CO_2 Emissions

Aviation is a relevant sector to climate change. Thus, it is necessary to evaluate the sector's environmental performance. Europe was the first region to include aviation in the Emissions Trading Scheme (ETS) in 2012, a regulatory system to reduce emissions of greenhouse gases, stating that all airlines departing from or landing in Europe would have to comply with the European Union's emission reduction plans.

CO_2 Emissions Control

SATA Internacional – Azores Airlines has created CELE Department (Comércio Europeu de Licenças de Emissão – European Emission Allowance Trading) in its organizational structure following Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 (amending Directive 2003/87/EC to improve and extend the greenhouse gas emission allowance trading scheme of the Community). The purpose of this Directive is to promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner. This implies the increasing of efforts by the Community, the quick involvement of developed countries and encouraging the participation of developing countries in the emission reduction process (Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009).

Aviation is contributing to these reductions through its inclusion in the Community scheme also following Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions (under Directive 2003/87/EC of the European Parliament and the Council). This Regulation sets down rules for the monitoring and reporting of greenhouse gas emissions and activity data in the trading period of the Union emissions trading scheme commencing on 1 January 2013 and subsequent trading periods.

The monitoring plan, setting out detailed, complete and transparent documentation concerning the methodology of a specific installation or aircraft operator, should be a core element of the system established by this Regulation. Regular updates of the plan should be required, both to respond to the verifier's findings and based on the operator's or aircraft operator's initiative. The main responsibility for the implementation of the monitoring methodology should remain with the operator or the aircraft operator (Commission Regulation (EU) No 601/2012 of 21 June 2012).

CELE Manual

SATA Internacional – Azores Airlines CELE Manual states the means adopted to ensure the process management and monitoring of CO_2 emissions. This control was created to respond to Directive 2009/29/EC, which indicates that all air transport operators included in the European Greenhouse Gas Emissions Trading Scheme (EU ETS) must monitor and report CO_2 emissions per tonne. These reports must be verified by independent and accredited entities.

The Portuguese Environment Agency (APA) is a public institution (within the scope of the Portuguese Ministry of the Environment and Energy Transition). Its mission is to propose, develop and monitor, on an integrated and participated manner, the public policies for the environment and sustainable development, in close cooperation with other sectoral policies and public and private entities. APA is responsible for the approval of all Portuguese airlines' Monitoring Plans of CO_2 Emissions.

The Manual describes the inherent procedures of CELE Department, namely the Flight Process Activity and the CO_2 Monitoring Activity, its inputs and outputs and the departments involved in the various phases of the processes. In terms of Risk Assessment regarding data monitoring, there are some possible errors enumerated, being the highest occurrence probability related to errors in the refuel density information and lack of data from ACMI (Aircraft Crew Maintenance Insurance) flights; all errors have corrective actions associated.

The monitoring process counts with an internal control: Planning and Scheduling Department executes some tests to check possible errors before the close of each month (Fuel on Board, Fuel Trip, Fuel Burn, Fuel Required, Actual Time of Departure/Arrival and Schedule Time Departure/Arrival); Financial Department controls and checks EUROCONTROL invoices versus flights operated; after the close of each month, CELE Department extracts the month report and analyses the errors detected (invalid density, unavailable uplift, invalid burn, CO_2 sub-zero or burn out of range); finally, CELE Department takes the necessary corrective actions.

The Emissions Sources, List of EU ETS Flights, Flights covered by CELE, Operating Fleet, Fuel Consumption, Determination of Fuel Density, Monitoring of Suppliers' Equipment, Determination of Error between Refuel and On-Board Information, Audits and Improvement Actions are all described in the manual for the smooth execution of distinctive procedures which involve different departments.

Monitoring Plan of Annual Emissions

The Monitoring Plan of Annual Emissions for SATA Internacional – Azores Airlines is approved by APA following Commission Regulation (EU) No 601/2012 of 21 June 2012 (on the monitoring and reporting of greenhouse gas emissions). The Monitoring Plan (MP) is very complete as per its Contents: Guidelines and conditions; Monitoring Plan versions; Identification of the aircraft operator; Contact details; Emission sources and fleet characteristics; Eligibility for simplified approaches; Activity data; Uncertainty assessment; Emission factors; Simplified calculation of CO_2 emissions; Data Gaps; Management; Data Flow Activities;

Control Activities; List of definitions and abbreviations used; Additional information; and Member State-specific further information. Directive 2003/87/EC as amended by Directive 2009/29/EC requires aircraft operators who are included in the European Greenhouse Gas Emission Trading Scheme (the EU ETS) to monitor and report their emissions and tonne-kilometre data, and to have the reports verified by an independent and accredited verifier.

The Monitoring and Reporting Regulation (Commission Regulation (EU) No 601/2012) defines additional requirements for monitoring and reporting and sets out specific requirements for the content and submission of the monitoring plan and its updates. "The monitoring plan shall consist of a detailed, complete and transparent documentation of the monitoring methodology of a specific installation or aircraft operator and shall contain at least the elements laid down in Annex I" (Commission Regulation (EU) No 601/2012, Article 12). Moreover, Article 74 (1) states: "Member States may require the operator and aircraft operator to use electronic templates or specific file formats for submission of monitoring plans and changes to the monitoring plan, as well as for submission of annual emissions reports, tonne-kilometre data reports, verification reports and improvement reports".

The file made available by APA constitutes the template for monitoring plans for emissions of aircraft operators developed by the European Commission; it includes the requirements defined in Annex I as well as further requirements to assist the aircraft operator in demonstrating compliance with the Monitoring and Reporting Regulation.

The MP is submitted to ANAC (the Portuguese Civil Aviation Authority) and APA (the Portuguese Environment Agency). The Competent Authority (CA) may contact the aircraft operator to discuss modifications to the MP to guarantee the accuracy and confirmable monitoring and reporting of annual emissions. Upon notification of approval from the CA, the aircraft operator will use the latest approved version of the MP as the methodology to determine annual emissions and implement data acquisition and handling activities and control activities; it will also serve as a reference for verification of the annual emissions report. The CA must be notified in the case of significant changes to the MP for further approval; modifications must be implemented and records of it kept.

In the Emission sources and fleet characteristics field of the MP, the fleet list should include all aircraft types operated at the time of submission of the MP and the number of aircraft per type (including owned and leased-in aircraft). For each aircraft type, it is necessary to specify which fuels will be used (which "source streams" will be associated with the emission sources) – jet kerosene (Jet A1 or Jet A); jet gasoline (Jet B); aviation gasoline (AvGas); Biofuel; or other alternative fuel.

The following excerpts from the MP exemplify the type of detailed information furnished by the aircraft operator:

Details about the systems, procedures and responsibilities used to track the completeness of the list of emission sources (the aircraft used) over the monitoring year:

Title of the procedure – Emission Source

Brief description of the procedure – Ensure the update of aircraft operational data in AIMS, the software application.

Post or department responsible for data maintenance – Planning and Scheduling Department is responsible for processing the data sent by the Flight Operations Department by entering it into the application; CELE Department should verify and analyse data extracted from AIMS; Data integrity is ensured by IT Department.

Details about the procedures to monitor the completeness of the list of flights operated under the unique designator by aerodrome pair:

Title of the procedure – Determination of the List of Flights EU ETS

Brief description of procedure – Ensure the creation of flights in AIMS application with indication of the respective aerodrome pair, guaranteeing the identification (with error message) of the duplication of flights. The data entered with IATA codes shall be converted into ICAO codes.

Post or department responsible for data maintenance – Planning and Scheduling Department is responsible for setting up flights in AIMS, either as a result of planned changes to flights (including cancellations) or as a result of unforeseen flights; Flight Operations Department must enter flight data into AIMS; Data integrity is ensured by IT Department; Financial Department periodically verifies the consistency of the EUROCONTROL invoices with the flights entered in AIMS; CELE Department performs the verification and analysis of data extracted from AIMS.

Details about the procedures for determining whether flights are covered by Annex I of the Directive, ensuring completeness and avoiding double counting:

Title of the procedure – Flights under European Emission Allowance Trading

Brief description of the procedure – Ensure the confirmation in AIMS of the flights to be covered by the European Emission Allowance Trading. The following flights [among others provided for in Annex I to Decree-Law No 93/ 2010 of 27 July (European Emission Allowance Trading – Portuguese Aviation Diploma) are excluded from monitoring: flights performed exclusively for the transport on an official mission of Heads of State, Heads of Government and Ministers of State of countries other than the Member States; flights ending at the aerodrome from which the aircraft took off, without intermediate stops; training flights; and flights operated under the public service obligations following Regulation (EEC No 2408/ 92) to routes in the outermost regions specified in Article 2. 299 of the Treaty, or routes where the capacity offered does not exceed 30,000 seats per year.

Post or department responsible for data maintenance – CELE Department shall verify that the procedure for confirming flights to be covered in the European Emission Allowance Trading is in compliance with the standards by verifying the CO_2 Monitoring Application and the correct filters to be applied; Data integrity is ensured by IT Department.

The estimation/prediction of the total annual fossil CO_2 emissions from the activities previously mentioned are calculated in tonnes of CO_2. The calculation of CO_2 emissions may be performed using two possible methodologies to measure fuel consumption for each aircraft type:

Method A

Actual fuel consumption for each flight (tonnes) = Amount of fuel contained in the aircraft tanks once fuel uplift for the flight is complete (tonnes) - Amount of fuel contained in the aircraft tanks once fuel uplift for subsequent flight is complete (tonnes) + Fuel uplift for that subsequent flight (tonnes)

Method B

Actual fuel consumption for each flight (tonnes) = Amount of fuel remaining in the aircraft tanks at block-on at the end of the previous flight (tonnes) + Fuel uplift for the flight (tonnes) - Amount of fuel contained in tanks at block-on at the end of the flight (tonnes)

The data source used to determine fuel uplift is as measured by the fuel supplier; the methods for transmitting, storing and retrieving data are recorded in the aircraft technical log.

Regarding the information about the systems and procedures to monitor fuel consumption per flight in both owned and leased-in aircraft, this must include the selected tiers, a description of the measurement equipment and the procedures for recording, retrieving, transmitting and storing information. The CO_2

Monitoring Application calculates the fuel consumption per flight based on the information from the Journey Log and the fuel receipt, using the method approved by APA.

The procedures for the measurement of the density used for fuel uplifts and fuel in tanks (in both owned and leased-in aircraft) must include a description of the measurement instruments involved or the justification for applying the standard value (in cases when measurement is not feasible). The fuel supplier shall provide the fuel density information; if this information cannot be obtained, the standard value of 0,8 kg/ l shall be assumed. There are possible deviations from the general methodologies for determining fuel uplifts and fuel contained in the tank and density for specific aerodromes; the MP must include the information regarding the conversion of measurement units, for example, from gallons to litres (1 gallon = 3.785 l).

The MP must also contain information about the procedure used to ensure regular crosschecks between uplift quantity as provided by invoices and uplift quantity indicated by on-board measurement.

Details about the procedure for regular evaluation of the monitoring plan's suitability, covering any potential measures for the improvement of the monitoring methodology must be provided. The internal audits are performed to assess the application and suitability of CO_2 emissions' control procedures through objective verification of existing practices; these audits are performed by certified audit organizations.

CORSIA

ICAO's CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) is a global offsetting mechanism that intends to assist address any annual increase in total CO_2 emissions from international civil aviation above 2020 levels.

All ICAO Member States with aircraft operators conducting international flights are required to monitor, report and verify CO_2 emissions from these flights every year from 2019, independent of their participation in CORSIA. An aircraft operator shall monitor and record its fuel use from international flights in accordance with an eligible monitoring method approved by the State to which it is attributed and shall use the same eligible monitoring method for the entire 3-year compliance period [2, 3].

There are three phases of implementation – pilot phase (2021-2023); first phase (2024-2026); and a second phase (2027-2035). Participation of States in the pilot phase and the first phase is voluntary; in the second phase from 2027, all States with an individual share of international aviation activity in the year 2018 above 0.5% of total activity or whose cumulative share reaches 90% of total activity, are included (Least Developed Countries, Small Island Developing States and Landlocked Developing Countries are exempt unless they volunteer to participate) [2].

The CO_2 offset requirements are calculated as the Operator's annual emissions multiplied by the Growth Factor. The Growth Factor changes every year considering both the sectoral and the individual operator's emissions growth; it is the per cent increase in the amount of emissions from the baseline to a given future year, calculated by ICAO. After the calculation of the offsetting requirements, the aircraft operator reports the use of sustainable aviation fuels for the compliance period; the State deducts the benefits from the use of sustainable aviation fuels and informs the operator's final offsetting requirements for the 3-year compliance period; the operator purchases and cancels eligible emissions units equivalent to its final offsetting requirements for the compliance period; and the operator provides a validated Emissions Units Cancellation Report to the State, who checks the Report and informs ICAO. Each operator will need to develop an emissions monitoring plan that should include information on the operator, its fleet and operations; the methods that will be used to monitor fuel use and calculate emissions; and all associated data management [2, 3, 4].

CORSIA is a global market-based initiative established to offset international aviation CO_2 emissions to stabilize the levels of such emissions from 2020 onwards. Aircraft operators will achieve this objective through the acquisition and cancellation of emissions units from the global carbon market. The more States join CORSIA, and the earlier they join, the more emissions are covered, increasing the environmental integrity of the scheme.

ICAO has agreed on two ambitious goals for the international aviation sector – 2% annual fuel efficiency improvement through 2050 and carbon-neutral growth from 2020 onwards. The following areas were identified as possible contributors to the achievement of the global goals: aircraft technology and standards; operational improvements; sustainable aviation fuels; and CORSIA [2, 3].

Present Actions

As per APA instructions, SATA Internacional – Azores Airlines will submit its 2019 Annual Emissions Report (CELE) and Monitoring Plan (CORSIA) in a common form, following Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions (pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012); Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers (pursuant to Directive 2003/87/EC of the European Parliament and of the Council); and Commission Delegated Regulation (EU) 2019/1603 of 18 July 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards measures adopted by the International Civil Aviation Organization for the monitoring, reporting and verification of aviation emissions for the purpose of implementing a global market-based measure, until 31 March 2020.

The usual process of CO_2 Emissions reporting consists of the following steps:

- Reporting the tons of CO_2 emissions as per CELE requirements to APA until 31 March, referring to the previous year of operations (this report must be certified by an accredited entity).
- After APA's validation, the airline must buy Carbon Licenses (1 T CO_2 = 1 License) from certified brokers.
- Annually, SATA Internacional – Azores Airlines receives 580 free Carbon Licenses from APA (under Free Allowances Allocation to be issued for the period 2017-2020, according to the Regulation 2017/2392 of the European Parliament and of the Council of 13 December 2017 amending Directive 2003/87/EC to continue current limitations of scope for aviation activities).
- After acquiring all the necessary licenses, the airline must submit the licenses in the European Commission's convenient platform until 30 April.

Table 18.1 and Figure 18.7 present some data on SATA Internacional – Azores Airlines CO_2 emissions in the period from 2013 to 2018. The figures for 2015 reflect the decrease in the number of international flights, namely the European routes departing from PDL and the closure of FNC base. The values have increased again in the following years due to the increase in international routes and the use of ACMI flights for long haul routes. There has been a new decrease in 2018 due to the effective exit of the A310s from the fleet and the entry of the A321s.

Fleet/ Year	2013	2014	2015	2016	2017	2018
DH4*	4	4	4	4	4	4
A310	4	4	3	3	3	1
A320	4	4	4	3	3	3
A330	-	-	-	1	1	1
A321	-	-	-	-	-	2

* ACMI operations

Table 15.1 SATA Internacional – Azores Airlines: Fleet composition

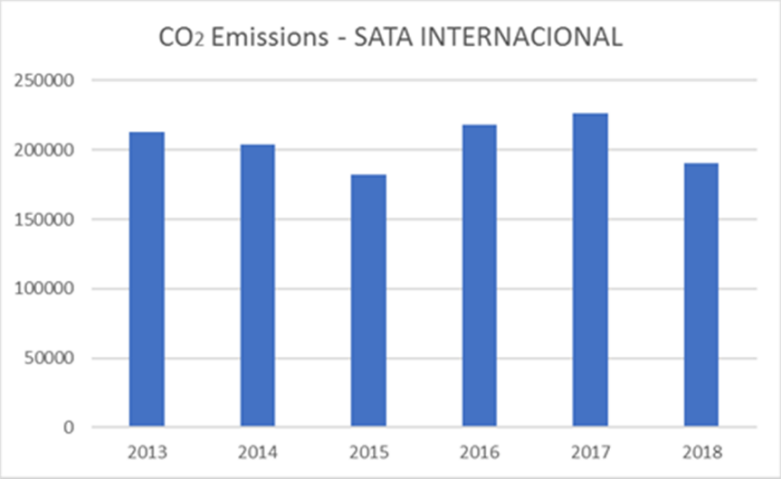

Figure 15. 7 SATA Internacional – Azores Airlines: CO_2 emissions from 2013 to 2018.

Future

The future is very challenging for all the stakeholders involved in the aviation industry. One of the main challenges is the control of CO_2 emissions as per its global impact on environmental changes. In fact, important efforts and work are still needed to meet the expectations about emission reduction targets, especially in an era where the aviation fuel use and CO_2 emissions are expected to increase due to the tendency of aviation demand growth in the next decades.

Decarbonization of the transport sector is a proclaimed goal as ¾ of CO_2 emissions from tourism are related to transport means. There is a need to systematically collect and analyse data to support the decision-making process based on evidence (World Tourism Organization and International Transport Forum, 2019). The strong growth rate of aviation and its resultant CO_2 emissions are of policy concern in combating climate changes. Notwithstanding aviation being a resilient industry, the mitigation of its emissions is a complex process.

Airlines were made aware of the aviation impact on emissions and climate change issues and SATA Internacional – Azores Airlines is fully aligned with the current practices. Fuel efficiency contributes to the reduction of emissions: new aircraft models entering the fleet tend to have better fuel performance as this result directly on operating costs; also, efficiency in terms of load factors.

Technological and operational improvements related to the fleet option of A321 LR are expected to result in traffic efficiency for the airline, contributing to the desired emission reduction for air quality improvement and control of greenhouse gas emissions' impact on the global climate. Carbon trading and voluntary carbon offsetting are also part of the airline's orientation on the development and implementation of appropriate responses to mitigate the impacts of its activity on the environment. There is a general willingness to act in a context where climate changes are evident and cannot be ignored. Aviation should develop a decreasing part in global emissions and be an example of positive accomplishments, working on long-term solutions.

15.4 Safety Management

*Flightpath 2050 goal 14:" European air transport system has less than one accident per ten million commercial aircraft flights".

Safety Management System (SMS)

The notion of safety management evolved from a compliance approach to a systematic approach, where potential safety risks are identified and managed to a tolerable level as the industry matures and develops. The Safety Management System (SMS) is more than a manual or a practice, requiring its integration into the daily activities of the organization. It adopts a business-like approach to safety, with safety plans, safety performance indicators and targets and continuous monitoring of the safety performance of the organization.

A Risk Management process is essential for the SMS; it identifies hazards and assesses and mitigates risks, therefore providing for effective risk management based on decision-making processes across the business. This process requires the development of an organizational culture that replicates the safety policy and objectives. SMS is a top-down driven system, meaning that the Accountable Manager is responsible for the implementation and continuing compliance of the system.

The present and desirable Safety Management model is a proactive and predictive one. The purpose of a proactive and predictive safety program is to detect hazards and mitigate them before an undesirable event occurs. The proactive approach methodology resides in analyzing existing situations through audits, reporting and evaluating, to identify latent unsafe conditions and implement appropriate defences. The desired management level of the SMS, though, is the predictive level. This methodology involves data gathering to identify possible negative future consequences or events, examining system processes and the environment to identify potential future hazards and initiating mitigation actions.

SMS Implementation in SATA Internacional – Azores Airlines

The implementation of the SMS in SATA Internacional – Azores Airlines resulted from a regulatory imposition (Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations), applicable from October 2014. The company started preparing this implementation in 2012 (with October 2014 as the deadline reference date). More than a legal requirement (Compliance only Attitude), this process was identified as an opportunity to improve its risk analysis and operation efficiency processes (Safety).

There were some determining factors in the SMS implementation process:

- the involvement and leadership of top management (Board of Directors; Accountable Manager).
- the significant enhancement of the Safety Department's resources in terms of qualified staff and credible technical resources.
- an internal program of continuous training.
- the active participation of operational areas and their leaders in the implementation of SMS throughout the structure of the company (top-down approach).

During the implementation process, the company sought to comply with the program initially defined by the Safety Department (Gap Analysis composed of 4 phases), in a gradual and phased implementation.

The SMS addresses aviation activities that are related to the safe operation of an aircraft. The direct scope of SATA Internacional – Azores Airlines includes Flight Operations, Maintenance, Training and other organizational activities that support operational or product development; indirectly, the scope includes finance, human resources and legal (when appropriate).

The SMS implementation is a process of cultural change that involves medium to long-term objectives (5 to 10 years). It is now clear that there is a greater awareness of this theme through the organization, and that the work developed in the meantime will allow continuing to strengthen the process (Figure 18.8):

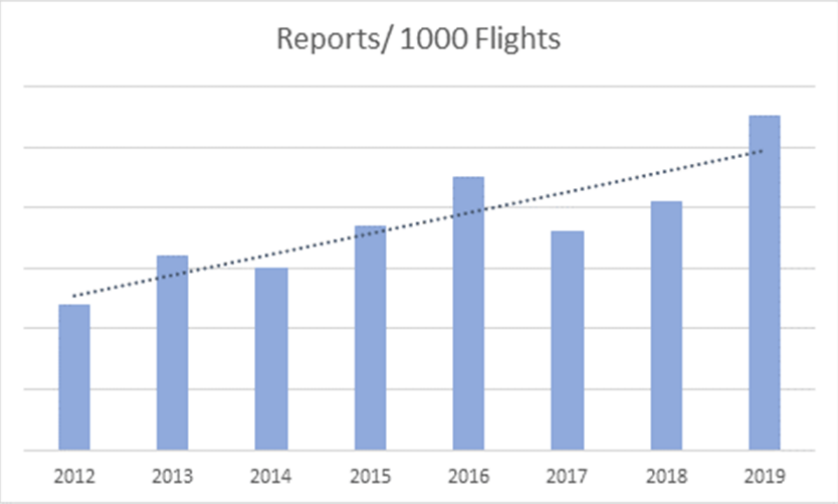

Figure 15. 8 Evolution of Safety Culture (reports).

In terms of future goals and challenges, the company needs that Top Management continues to assume its leadership responsibilities, to create the conditions to strengthen the evolution of a Safety culture that allows evolving from a bureaucratic and administrative culture (compliance-oriented) to a Safety performance-oriented culture.

Safety Management Manual

The Safety Management Manual (SMM) is the main instrument for communicating the approach to managing safety within SATA Internacional – Azores Airlines. The SMM substantiates all aspects of safety management, including the safety policy, procedures and individual safety accountabilities and responsibilities. The manual replicates current international best practices and knowledge acquired and represents an important step towards a mature and integrated SMS. All employees should work thoroughly to uphold and follow the guidance in the SMM to manage safety risks and help promote a positive safety culture in the company. The manual covers chapters on Safety Policy and Objectives, Safety Risk Assessment, Safety Assurance and Safety Promotion; it has been developed following international, European and national regulations.

Safety Policy and Objectives

The Safety Policy defines the methods and processes used to achieve the desired safety results. It states the fundamental principles and philosophies for the safety culture and is communicated to all staff throughout the organization. SATA Internacional – Azores Airlines attempts to achieve a safety culture that is informed, reporting, learning, just and flexible.

The achievement of safety objectives and the implementation of effective safety management and safety improvement process are based on clear and correctly allocated safety accountabilities and responsibilities. Safety responsibility is the obligation to carry forward an assigned safety-related task to its successful conclusion. With responsibility goes authority to direct and take the necessary action to ensure success. Safety accountability is the obligation to demonstrate the task achievement and take responsibility for the safety performance in accordance with agreed expectations. Accountability is the obligation to answer for an action.

Within the SMS, the Accountable Manager (AM) is ultimately responsible and accountable for ensuring the safety of the company's operations; other senior managers that follow the AM in the organization's structure (Flight Operations, Training, Airworthiness and Ground Operations) are also made accountable for operational

safety in their specific departments. The Safety Manager is responsible for the development, administration and maintenance of an effective SMS. The Compliance Monitoring Manager is responsible for the Assurance Program, which covers the monitoring of compliance with relevant regulations and standards, and the evaluation and continuous improvement of the operational safety performance. There is a strong and trustful collaboration between Safety and Compliance Monitoring departments. As safety is a transversal matter and responsibility, all employees should be aware of their safety roles and responsibilities.

The SMS also considers in its structure the Safety Review Board (a high-level committee that supports the AM in strategic safety functions); Safety Action Groups (composed by experts from operational areas to assess safety issues, found possible solutions and develop action plans); Safety Officers (appointed by functional areas); and the Emergency Response Planning Coordination. In terms of documentation, SMS includes: Control of Records; Safety Management Manual; Emergency Response Plan; Work Instructions; Procedures; Flight Data Monitoring; Safety Reporting System; Risk Management Documentation; Management of Change; Safety Promotion; and Safety Forms.

Safety Risk Management

The Safety Risk Management is the process of identifying hazards, analyzing, assessing and controlling their corresponding safety risks. Its main objective is to assure that all risks remain at an acceptable level, but also to contribute to the Safety Performance Monitoring by setting risk based on Safety Performance Indicators (SPIs).

Hazard identification is the first step in the safety risk management process and provides the input for risk assessment; its data sources can be Accident/Incident Investigation Reports; Mandatory Occurrence Reports; Voluntary Safety Reports; Fatigue Safety Reports; Audits; Flight Data Analysis; Safety Assessment of Foreign Aircraft program; Safety Publications; and Safety Meetings. Hazards are categorized by area, according to their source, and documented in a Hazard Log; this Hazard Log/ Risk Register identifies the manager and area of risk, and the responsible area to eradicate or mitigate the risks of the identified hazard. Hazards are periodically reviewed (at Safety Action Groups' meetings).

The purpose of occurrence and hazard reporting is to ensure that safety-relevant information is reported, collected, stored, protected and disseminated, mainly to prevent accidents and incidents. Complying with Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation, the internal reporting system comprises both Mandatory and Voluntary Occurrence Reports. IQSMS is the web-based application used for the management of the reporting system.

The Flight Data Monitoring (FDM) is the systematic, pro-active use of digital flight data from routine operations to improve safety; data is periodically downloaded and stored in a database for analysis and monitoring, resulting in reports and SPIs. The FDM looks for possible deviations from flight manual limits, standard operating procedures and good workmanship; retains information from every flight to determine trends before there are statistically significant movements in event-level; and generates rate and trend information. The results from the FDM program are analyzed and discussed in Flight Safety Action Group meetings, where appropriate safety actions can be defined.

Safety risk can be defined as the projected possibility and severity of the consequences of an existing hazard or situation. The process of evaluation of the probability and severity of the damage inherent to the identified hazard is the risk assessment. SATA Internacional – Azores Airlines uses a qualitative methodology of risk assessment to determine the level of risk posed by the identified hazards; then, identified risks are prioritized to allow the prioritization of resources to mitigate their effects.

Safety events are screened for urgency, confidentiality and the need for further investigation. The urgency assessment process uses an Event Risk Classification (ERC) matrix. Following the Hazard Identification (usually events), a quick screening is done to evaluate their risk; the event risk measures how disturbing the event was.

The first step is to evaluate what would have been the most credible accident type if the event had become an accident (this will position the event in one of the lines of the ERC Matrix); the second step is to evaluate how close the event got to the most credible accident scenario, evaluating the remaining safety margin (this will position the event in one of the columns of the ERC Matrix). After this evaluation, an event risk value is assigned to the event; the corresponding colour reflects the urgency of dealing with the subject (red – Investigate immediately and take action; yellow – Investigate or carry out a further risk assessment; or green – Use for continuous improvement).

Events and Safety Issues are different and so require different types of risk assessment. SATA Internacional – Azores Airlines uses a versatile risk assessment technique, widely used in the industry and considered as a best practice. This technique reflects all aspects of risk management and highlights the direct link between the controls and elements of the management system (Figure 18.9):

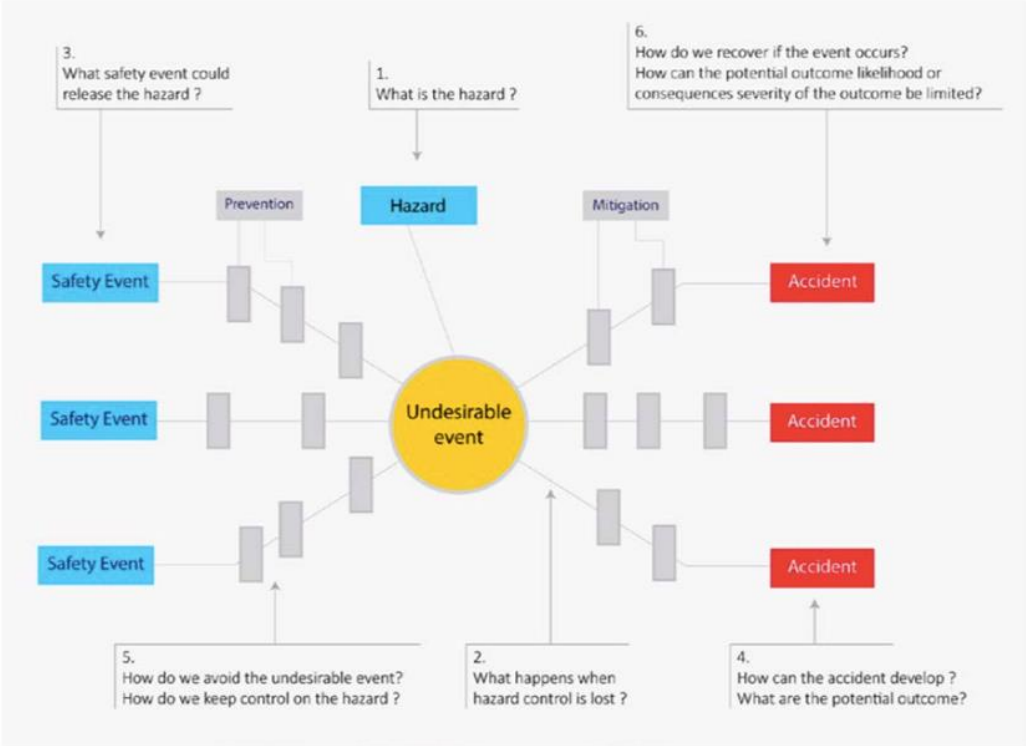

Figure 15. 9 "Bow-Tie" Diagram (from ECAST Guidance on Hazard Identification).

To assess the likelihood of the events (Undesirable Event), it is necessary to consider the exposure to the hazard. Exposure is a necessary condition for a hazard to become a risk; as exposure increases, so does the potential risk. As so, the likelihood that an Undesirable Event occurs is estimated based on the following definitions and expert judgment (Figure 18.10):

RISK LIKELIHOOD	MEANING	VALUE
FREQUENT	**Likely to occur many times.** Has already occurred in SATA (Freq. >= 3 times per year). Has occurred frequently in the history of the aviation industry.	5
OCCASIONAL	**Likely to occur sometimes.** Has already occurred in SATA (Freq. < 3 times per year). Has occurred infrequently in the history of the aviation industry.	4
REMOTE	**Unlikely to occur, but possible.** Has already occurred in SATA at least once or has seldom occurred in the history of the aviation industry.	3
IMPROBABLE	**Very unlikely to occur.** Not known to have occurred in SATA but has already occurred at least once in the history of the aviation industry.	2
EXTREMELY IMPROBABLE	**Almost inconceivable that the event will occur.** It has never occurred in the history of the aviation industry.	1

Figure 15. 10 Risk Likelihood.

Built on the identified potential outcomes, the most credible outcome is identified. Subsequently, severity – the extent of harm that might reasonably occur as a consequence or outcome of the identified hazard – is calculated considering the following definitions and expert judgment (Figure 18.11):

RISK SEVERITY	MEANING				VALUE
	PERSONNEL	ENVIRONMENT	MATERIAL VALUES & ASSETS	REPUTATION	
CATASTROPHIC	Multiple fatalities	Massive effects (pollution, destruction, etc.)	Catastrophic financial loss Damage > 30 M€	International impact	10
HAZARDOUS	Fatality	Effects difficult to repair	Severe financial loss with long term effects Damage < 30 M€	National impact	8
MAJOR	Serious injuries	Noteworthy local effects	Substantial financial loss Damage < 10M€	Considerable impact	5
MINOR	Light injuries	Little impact	Financial loss with little impact Damage < 500K€	Limited impact	3
NEGLIGIBLE	Superficial or no injuries	Negligible or no effects	Financial loss with negligible impact Damage < 50K€	Light or no impact	1

Figure 15. 11 Risk Severity.

After assessing the likelihood and severity, the following step in the process is to assess the safety risk tolerability. A safety risk index (R) results from combining likelihood (L) and severity (S): R = L x S (Figure 18.12):

	RISK SEVERITY				
RISK LIKELIHOOD	NEGLIGIBLE (1)	MINOR (3)	MAJOR (5)	HAZARDOUS (8)	CATASTROPHIC (10)
FREQUENT (5)	5	15	25	40	50
OCCASIONAL (4)	4	12	20	32	40
REMOTE (3)	3	9	15	24	30
IMPROBABLE (2)	2	6	10	16	20
EXTREMELY IMPROBABLE (1)	1	3	5	8	10

Figure 15. 12 Safety Risk Index.

The index obtained from the Safety Risk Assessment Matrix must be exported to a Safety Risk Tolerability Matrix. This matrix has five different risk levels; safety risks are classified as tolerable, intolerable and acceptable. Risks evaluated as intolerable are unacceptable under any circumstances; tolerable risks are acceptable if appropriate mitigation measures are put in place; and acceptable risks are acceptable as they are, notwithstanding any additional controls being implemented.

A reported occurrence/event or an event detected in FDM analysis may require some form of follow-up investigation. A safety investigation is an essential process that takes place when safety defences, barriers, checks and counterbalances in the system have failed; the purpose is to generate the necessary corrective actions to prevent a recurrence. It is conducted for accident/incident prevention and includes the gathering and analysis of information, the drawing of conclusions (including the determination of causes and/or contributing factors) and, when appropriate, the creation of safety recommendations. The main purpose of the safety investigation process is the prevention of accidents and incidents, in support of safety management.

Safety Assurance

Safety assurance resides on processes and activities performed to determine if the SMS is operating according to expectations and requirements; it specifically monitors the effectiveness of safety risk controls. The airline is required to implement an SMS, measure its performance and ensure its effectiveness. The information used to measure the organization's safety performance may be generated through a Safety Reporting System; Safety Studies; Safety Reviews; FDM; Safety Surveys; and Audits.

The SMS performance is confirmed by safety performance indicators (SPI) and safety performance targets (SPT). Each SPI measures the performance of a process. The SPIs provide evidence of the effectiveness of the SMS and monitor the achievement of Safety objectives.

The effectiveness of SMS can take several years to achieve. Before it reaches the mature level, it will pass through different stages of development. Primarily, it will be required to achieve compliance with the applicable requirements and SPIs will focus on complying with the regulatory framework. Following, the SMS should be operating and effective and SPIs shall reflect this. The ultimate and desirable state is striving

towards excellence as part of a continuous improvement process. SATA Internacional – Azores Airlines' SMS is not only operating and effective but is also a recognized best practice.

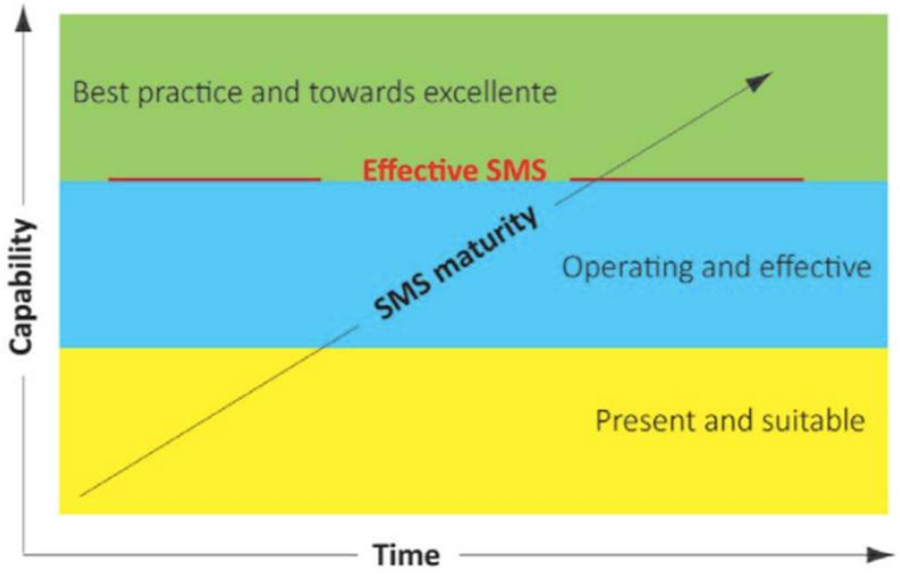

Figure 15. 13 The SMS Journey (from SMICG Evaluation Tool V1.0).

SPIs can be high-consequence or lower-consequence indicators (having a different weight in the determination of the Acceptable Level of Safety Performance). Also, they can be lagging (measure events that have already occurred) or leading (provide information on the current situation that may have a positive or negative effect on future performance) indicators. The procedure "Safety Performance Monitoring and Measuring" specifies the guidelines for the definition and implementation of SPIs and SPTs.

Management of Change is a process to identify external and internal changes that may affect established processes and services. This procedure establishes a formal process of managing operational and organizational changes in the company that may affect the safety of the services to be delivered, by proactively identifying hazards associated with those changes, applying appropriate mitigation actions that reduce the safety risks, and ensuring continuous evaluation and monitoring of the changes.

The changes that may trigger a Management of Change analysis include, but are not limited to: new aircraft/ fleet; new technologies/ innovations in operational practice; new routes/ destinations/ type of operation; new contracts or changes to existing ones; organizational changes; changes in key personnel; changes in the work environment or conditions; regulatory or procedural changes. Monitoring the SPIs along with internal and external SMS audits help to evaluate the continuous improvement of the SMS.

Safety Promotion

SATA Internacional – Azores Airlines believes that the provision of training to appropriate staff, regardless of their level in the organization, is an indication of the management's commitment to an effective SMS. Initial safety training is given, strengthened by recurrent practice and feedback, and sustained by continuous reinforcement that this is part of the corporate culture. The main purpose of the SMS training is to ensure that personnel, at all levels of the organization, maintain their competence to fulfil their safety roles.

Since effective communication is essential for any successful management system, SATA Internacional – Azores Airlines is committed to maintaining an effective safety communication throughout the company which guarantees that all personnel are aware of the company's SMS; contributes to the improvement of the company's safety culture; delivers safety critical information; and elucidates the reason for particular actions

and for the introduction or change of safety procedures. Internal communication can take the form of Safety Procedures and Processes, Safety Newsletters, Safety Infos, Safety Alerts and Safety Reports for Management. Regarding external communication, as the exchange of safety information within the aviation community increases awareness and is essential to raise aviation safety worldwide, the organization acknowledges the benefits of sharing best practices and safety lessons learned with other parties, thus, attempting to participate in safety working groups (e.g. EOFDM), seminars (FSF/IASS) and workshops.

Conclusion

Aviation safety is presently the result of significant and concrete development throughout the last decades. The identification, investigation and fundamental elimination of the major causes of accidents have increased. Safety is an on-going process, which concentrates all efforts in investigating accidents, finding corrective actions and proving its implementation.

Today, and more so in the future, this system must focus on concepts and practices geared towards strategic and operational decision-making based on leadership, responsibility and accountability. Companies will need to review or renew processes to better identify processes and control risk, and measures to prevent losses and system breakdowns.

15.5 Weather, a Mission Factor

*Flightpath 2050 goal 15:" Weather and other hazards from the environment are precisely evaluated and risks are properly mitigated".

SATA – Climatic Patterns as a Mission Factor

Air operations in the Azores are subject to unique weather conditions and patterns. Therefore, this is part of the daily reality of SATA International – Azores Airlines, which can be quantified in terms of the number of delayed, diverted or cancelled flights due to severe weather conditions, affected passengers and costs associated with these irregularities.

The weather conditions of the Azores archipelago have a most penalizing effect on the airline's operation; the company's ability to respond to flights delayed, diverted or cancelled due to climatic conditions is based on a certain policy for the replacement of flights and the re-routing of passengers.

Internal data is available for the analysis of the number of diverted and cancelled flights, passengers affected, and flight hours affected in the period 2014-2019. For example, in 2019, from the total of flights operated to and from the Azores, 28 flights were diverted and 44 flights were cancelled due to weather conditions; the most affected routes were LIS/PIX/LIS (Lisbon/Pico/Lisbon) and LIS/HOR/LIS (Lisbon/Horta/Lisbon).

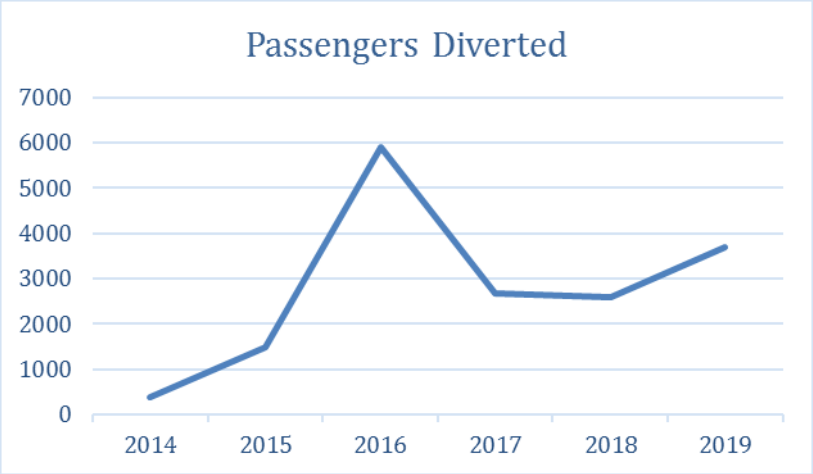

Figure 15. 14 Passengers affected by diverted flights due to weather conditions, 2014-2019.

Figure 15. 15 Passengers affected by cancelled flights due to weather conditions, 2014-2019.

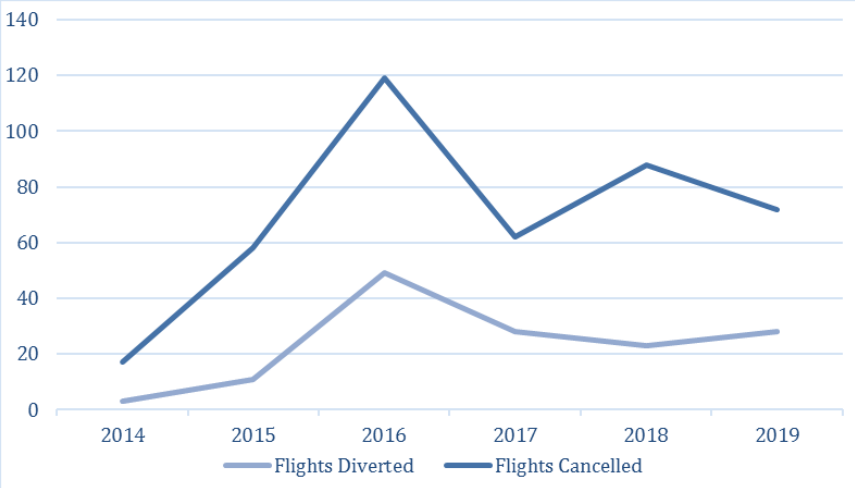

Figure 15. 16 Flights diverted and cancelled due to weather conditions, 2014-2019.

With regards to the company's response capacity, when faced with this type of irregularity, one of the main tasks of Operational Coordination and Control (OCC) is to "mitigate the effects of irregularity and recover the operating plan as quickly as possible, taking into account the safety, the comfort of passengers and at the lowest associated cost". To achieve this, it is necessary to identify the number of passengers affected and their final destination.

Considering the number of passengers affected by the irregularity, the following alternatives are evaluated for the protection of passengers (in the following order):

- SATA Internacional – Azores Airlines (S4) scheduled flights with seats available on the day or the day after.
- TAP Portugal (TP) scheduled flights from the affected airport on the day of the irregularity.
- In the case of flights operating from Horta (HOR) and Pico (PIX), routing by maritime transport (HOR-PIX or PIX-HOR) and SATA Internacional – Azores Airlines (S4) scheduled flights with seats available on the day or the day after.
- Routing via SATA Air Açores (SP) to SATA Internacional – Azores Airlines (S4) scheduled flight with seats available on the day or the day after.
- Routing via SATA Air Açores (SP) to another airport with TAP Portugal (TP) scheduled flights on the day or the day after.
- Full reschedule of the affected flights by creating extra SATA Internacional – Azores Airlines (S4) flights on the following day or the day after.

Considering the operational limitations of HOR and PIX airports, occasionally, there may be no internal alternatives to deal with irregularities at these airports; the alternative may be to protect passengers by "distributing" them in the available scheduled flights in the following days, directly or via Ponta Delgada (PDL), Terceira (TER) or Santa Maria (SMA).

When drawing up a schedule, airlines should not neglect commercial and operational aspects, which include weather conditions. In this sense, and as SATA Internacional – Azores Airlines operates in some airports with extremely peculiar operating restrictions (recurring adverse weather conditions, without artificial lighting, short runways, among others), in a mission spirit, the schedules are built with some "buffers", which allow to wait for climate improvements and recover delays.

Operations are rather adjusted in the morning time band to ensure greater operability, as well as some situations where the combination with other means of transport (maritime) is promoted. Similarly, the least penalizing fleet equipment (brakes, payload, containerized) is allocated so as not to increase further restrictions on operations.

The operation under adverse weather conditions in the Azores should be considered a strategic mission factor for SATA Internacional – Azores Airlines, especially in terms of monetary compensation for all the costs imputed to the company related to passengers' assistance under Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 (establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights).

Airport Restrictions

The operation in the Azores is led by several operational constraints related to meteorological conditions. In terms of studies developed regarding these weather constraints, the following has already been developed: approaches by RNAV/RNP-AR in Faial Island (HOR); installation of ILS equipment and grooving on Pico Island (PIX) runway; and the certification of additional pilots for the operations in Faial and Pico.

SATA Internacional – Azores Airlines accesses important information that can be shared to contribute to the increase of knowledge and clarification regarding an operation in very particular weather conditions. The Grooving of the Pico Island Aerodrome Runway is an excellent example:

Project Designation: Execution of the Grooving of the Pico Island Aerodrome Runway

Main Purpose: Increase the flow and movement of goods and passengers, using the air and maritime system

Beneficiary Entity: SATA GESTÃO DE AERÓDROMOS, S.A.

Description: To improve the conditions of adherence, as well as the conditions of runoff of surface water from the runway of the Pico island aerodrome, it was necessary to proceed with grooving through perpendicular cuts of the pavement, perpendicular to the runway centerline axis, between the thresholds, for a total area of 1,580 meters long by 30 meters of width, 15 meters on each side of the runway centerline.

Results: The investment is aimed to improve the operational and safety conditions of the Pico island aerodrome with wet runways to meet international operational safety standards. The works of the contract under consideration allowed the creation of technical conditions for the operation of aircraft and enabled an improving quality of the service provided. This intervention was oriented towards meeting the needs of air transport users and having in mind the attractiveness of the sustainable regional transport system.

Figure 15. 17 Grooving in Pico runway.

Figure 15. 18 Grooving in Pico runway.

Figure 15. 19 Grooving in Pico runway: detail.

Figure 15. 20 Grooving in Pico runway: detail.

Pico Aerodrome was served only by a non-precision approach to RWY27 based on a locator. This was a limitation of an all-weather operation to the airport and some flights cancelled to Pico could have potentially landed if an approach with lower minima was available.

In order to reduce these cancellations and provide a precision approach, it was decided an ILS (Instrument Landing System) should be installed. This kind of approach could not only lower the operating minima of the aerodrome but provide lateral and vertical guidance during an approach to land. This guidance gives the crew the capability of monitoring their approach profile with great precision, which can help detect deviations from track and glide path caused by turbulence and/or wind shear generated by the interference of island terrain, improving the situational awareness of the crews during approaches in windy conditions. The ILS approach to RWY27 at Pico became operational on 13 September 2018.

Also, it is possible to find information on navigation systems by RNAV and RNP AR in ICAO publications and studies online, as the one from Medeiros [2], "Sistemas de aproximação RNAV e RNP AR. Estudo para Aeroporto da Ilha do Pico". The study demonstrates the possibility of implementing the new emerging approach technologies, RNAV (Area Navigation) and RNP AR APCH (Required Navigation Performance Authorization Required Approach), at Pico Island airport; these new types of approach technologies could be implemented at Azorean Islands' airports in accordance with ICAO rules, providing for increased security and reducing minimum approach altitudes, and reducing the costs associated with the operation and maintenance of existing approach systems [2].

New types of emerging approach technologies have the potential to provide precision and non-precision procedures with safety levels equal to or higher than the systems currently used, for only a part of their costs, since these are satellite-based procedures. The RNAV and RNP systems are similar. The main difference is the requirement for on-board performance monitoring and warning: a navigation specification that includes this requirement is referred to as an RNP specification; one that does not include this requirement is referred to as an RNAV specification [2].

Figure 15. 21 Pico Runway (photograph by Rui Medeiros, SATA Gestão de Aeródromos)

Meanwhile, EASA requires, according to Regulation No 2018/1048, that by 3 December 2020 all instrument runways without precision approaches must have published new performance-based approaches, and that by 25 January 2024, all instrument runways with CAT I ILS must have performance-based approaches. To achieve these requirements, NAV Portugal has established a transition to PBN (Performance Based Navigation) plan that includes the design and publishing of new PBN approaches to all Azorean airports using the new technologies described above.

Weather Products

To better anticipate the conditions that can be encountered during an approach, the crews should be provided with accurate weather forecasts and reports. Taking into account the example of the Norwegian weather services, which provides turbulence predictions for the aerodromes situated in challenging terrain environments, SATA Internacional – Azores Airlines worked with Instituto Português do Mar e da Atmosfera (IPMA), the Portuguese weather service, to produce an experimental turbulence forecast for the approach area of Pico Airport, which is being evaluated by crews and by the monitoring of flight data [6].

Automatic Weather Observation Stations

Since the end of 2017, Pico Airport has been equipped with modern weather sensors, coupled with a powerful software developed by Vaisala to produce a state of the artful annex 3 compliant weather reports for aviation. This ensures the crews can count on standard, precise and timely information about the weather conditions at the aerodrome and plan the operation accordingly. SATA Group is now working with IPMA to ensure the system can obtain certification to produce fully automated weather reports to be disseminated when the aerodrome meteorological station is not staffed (at night) so that the more precise evolutionary history of the weather conditions can be available to the crews during the dispatch of early morning flights.

Future

Flight in severe weather conditions (for example, wind, rain, lightning, storms and another meteorological phenomenon) is an area of knowledge that needs to be enriched by all possible research contributions. Airlines should share precise and relevant data from their flight experiences in adverse weather and the possible effects on aircraft to support the development of aeronautical technologies and contribute to the

prevention of accidents. Also, operators should use sophisticated and improved systems to quickly reschedule routes and flight plans to minimize costs associated with delays and cancellations. It is necessary to better understand weather patterns and anticipate adverse weather conditions to mitigate revenue losses.

15.6 Flying Through Turbulence: the COVID-19 Pandemic

"Please return to your seats and fasten your seat belts. We are flying through a turbulent area." And so, here we are, all the airline community (all the aeronautical industry indeed!) waiting for the turbulence to pass. The scenario is real and much more than a bad dream – it has been our daily life since March 2020. Forced to pause for too long and in a context of uncertain demand considering the economic and financial impact of the COVID-19 pandemic – a demand that is likely to return slowly and differently from before with direct implications for the whole aviation industry.

The state of the aviation industry was the same as the entire world – an unimaginable lockdown. It has been 3 months of businesses without businesses, no planes, nor passengers and very scarce flight movements. There are some emergency priorities to help industry, generating cash and cutting costs besides financial relief measures, all these to ensure the sustainability of companies. Consumers are willing to travel again, although under certain conditions. Price and virus safety measures are now in the same path of consideration, presenting a new type of traveller. Although people are restricted in their travels now, they still make plans and this new travelling era must follow a simple motto: trust to fly again!

Airline industry stakeholders have been following the regulatory standards and international pandemic recommendations set by the local authorities and international industry associations to continue providing services as safe as possible. All cost base structures have been severely impacted due to both the operational decrease and the regulatory requirements, but now it's time for recovery. These are challenging times, being necessary to determine how to survive in the short-term, how to plan for the medium-term and how to position for the future. This pandemic has changed how most people work daily; many business professionals are now reliant on technology and remote working more than ever. Leadership will be a core asset in business environments, establishing logical plans to allow for flexibility and a quick adaptation to changes.

As the world starts to reopen carefully, the aviation industry is also starting to get back to business, reconnecting with customers and creating campaigns to raise awareness of their offerings. It is necessary to know how consumers are thinking about travel and tourism (one of the most affected sectors by the pandemic) and what the journey back to pre-COVID-19 levels of activity might look like. These times urge to look much further ahead and envision how the crisis will continue to affect businesses and societies. Public and private organizations around the world need to work together to manage the impact of the coronavirus, focusing on rapid responses and strategic shifts.

Airline passenger volume and traffic decreased during the first months of the pandemic, foreseeing a continued flat demand for air travel for as long as COVID-19 remains a public health issue. The consequent economic and financial fallout calls for budget reviews and costs adjustments to deliver high quality and efficient services, especially when recovery is expected to be slow. Following an extremely difficult period for the aviation industry, airlines are now starting to increase flights, particularly to holiday destinations during the next few months. While the aviation scenery may be very different moving forward, skills and knowledge are necessary to make the most of new market opportunities, whether maximizing fleet utilization or taking strategic decisions.

Chronology: SATA and the Pandemic

The Covid-19 pandemic has disrupted normal business operations on a global scale. The impact of this unprecedented crisis resulted in many industries being forced to reduce or cease their business. Worldwide travel restrictions have been imposed due to the necessary containment of the virus and these have disturbed the aviation industry.

Back in December 2019, the first information available about COVID-19 was monitored, and in January 2020, SATA started to establish a daily contact with the IATA Medical Advisor and daily information update from the World Health Organization. Informational content for internal use and information to customers and passengers was created; and internal procedures for information and promotion of more frequent hygiene gestures were implemented. The distribution of disinfectant gel and information leaflets onboard aircraft was adopted at this time and all procedures on board were reviewed; the stocks of protection kits, masks and gloves were reinforced. The airlines also established a network of contacts with the Regional Health Directorate, General Health Directorate and Civil Aviation Authority, and reviewed the Safety, Health and Hygiene at work procedures based on the SARS 2003 case, and Flu Outbreaks in 2005, 2009, 2013 and 2015. This was the Surveillance Phase.

The beginning of March has revealed an increase in the number of cases in all countries and the subsequent retraction of economies. SATA used all communication channels to inform passengers about preventive measures taken by the Group's airlines. Also, a working group was created to implement measures related to the crisis of the new Corona Virus COVID-19. As tight circulation containment measures were in force globally, the commercial rules were changed to allow the change of trips to a later date, without penalty or increase of fare. This Alert Phase was marked by daily monitoring of the general situation and the communication to business partners and passengers about USA flight restrictions; in addition, the reinforcement of operational procedures onboard, the placement of COVID-19 information on all public access places (terminals, aircraft and workplaces) and the replenishment of disinfectant gel in all exposed locations and communication of mitigation principles of contagion.

The Contingency Phase begins with the World Pandemic Declaration from the World Health Organization. The rapid spread of COVID-19 and deaths caused made it very clear that actions must be taken, and preventive measures reinforced among all SATA employees. Specific plans for cleaning and decontamination of all aircraft were defined as well as specific contingency plans for the Handling/Airport areas. Preventive kits and protective material on board were replaced and a mitigation plan was triggered to prevent material shortages. Risk assessment was performed for exposed employees and business travel for training. The Contingency Plan was published.

The announcement of the suspension of entry of non-resident passengers in the USA was a clear indicator of demand contraction on international flights, specifically on the leisure and tourism segments. By mid-March, SATA announced the suspension of flights to 3 of the 5 gateways in the Azores, concentrating its operations in Ponta Delgada (PDL) and Terceira (TER) airports. Meal service was suspended on board (alternatives offered) and SATA sales offices were closed to mitigate the risk of contagion and to strengthen the Contact Center (telephone and online service). SATA's commercial flight network was redesigned and internal agents, partners, passengers and the general public were informed. New commercial solutions were created to streamline passenger accommodation processes (for example, the creation of a non-flown ticket replacement voucher).

March 15 was the date of the first confirmed case of COVID-19 in the Azores. Also, on this date, SATA Internacional operated a repatriation flight between Lisbon (LIS) and Punta Cana (PUJ). On March 16, the restriction of flights to Terceira was imposed and SATA maintained Ponta Delgada gateway only – SATA Air Açores' operation was reorganized without passing through Terceira Island (passenger flights); a daily cargo flight between Ponta Delgada and Terceira was scheduled. SATA Internacional also operated a repatriation flight between Terceira (TER) and Toronto (YYZ).

March 18 was the day of the declaration of a state of emergency by the President of the Portuguese Republic. All safety procedures were reviewed given the need to transport cases of force majeure and to adapt to new circumstances. Due to the reduction in air operations, services and structures were duly adapted and the Contingency Plan updated given the emergency period. Full suspension of flights to Boston and Toronto was prepared.

The Emergency Phase brought the communication and implementation of new preventive and more restrictive measures on board as restriction of seats (social distance) and the limitation of cabin baggage

allowed on board; the implementation of new measures to mitigate contagion in the operational areas; the transfer to teleworking regime of 100% of the administrative human resources; the suspension of all SATA Group commercial flights; the reorganization of the network to allow for force majeure and cargo transportation flights; and the creation of an application to be integrated into the reservation and check-in system in order to allow prior screening of passengers bound for Ponta Delgada.

Repatriation flights were organized in cooperation with the Government of the Azores, the Government of Cape Verde and Tour Operators (Shanghai – PVG; São Vicente – VXE; Praia – RAI; Fortaleza – FOR) and operated by SATA Internacional. SATA Air Açores' Q200 aircraft was converted to a combi version in order to ensure the transport of additional cargo within the Azores archipelago, SATA Internacional's A321 Neo cabin was adapted to transport hospital supplies between Lisbon (LIS) and Ponta Delgada (PDL). Specific procedures were created to be adopted by the areas still active (maintenance, handling and crews), and the establishment of medical support contact lines and advice for SATA employees was actioned.

By the end of March, IATA forecasts point to a 44% impact on revenue; SATA revenue is projected to drop 49%. SATA adhered to the tax and contributory measures announced by the Government of the Portuguese Republic to grant the payment of social security and withholding IRS and requested for a moratorium on all credit lines contracted. Mandatory training was reorganized in an online training regime. All non-mandatory training, internal mobility processes and recruitment processes were suspended. The company met with all Unions and Workers' Commissions to agree on Lay-Off measures, with the Lay-Off period (total or partial) beginning on April 7.

Two important cargo flights were operated by SATA Internacional in early April, one in China and another in Cape Verde. In mid-April, the airline operated a flight to transport Portuguese workers returning to Austria. A cargo transportation record has been achieved from operating with A321 Neo: 11 tons of food items between Ponta Delgada and Lisbon (mainly fresh fish and pineapples).

Following the communication on the extension of the suspension of flights until May 15, 2020, and in order to prepare the second period of Lay-Off, the Social Partners are consulted to identify possible improvements to be implemented in the process. On April 30, the President of the Regional Government of the Azores communicates how the suspension of the state of emergency in the Archipelago will be implemented and the suspension of flights until May 31, 2020. The change of state of emergency to the state of public calamity for the entire national territory occurs on May 1.

The Calamity Phase marked the month of May and registered the suspension of flights until the end of May (inter-islands) and until mid-June for international routes duly communicated to partners and passengers. All employees were clarified about the current situation. Some new cargo and repatriation flights were operated to Cape Verde.

Flights resumed within the Azores Archipelago on May 29, operated by SATA Air Açores. Flights operated by SATA Internacional to Portugal mainland and Madeira resumed on June 15; international flights to Boston (BOS) and Toronto (YYZ) on July 1 (although with traffic restrictions imposed by the EU), and to Frankfurt (FRA) on July 2. During June and July, besides its regular operation, SATA Internacional – Azores also operated charter flights for repatriation (Bermuda - BDA/ Ponta Delgada - PDL and Fortaleza - FOR/ Praia - RAI) and for humanitarian purposes (Havana - HAV/ Bissau - OXB and Accra - ACC/ Barbados -BGI).

Conclusion

The novel coronavirus paradigm presents new management challenges as work resumes. More than ever, companies must concentrate on their high standards of performance, management and health safety. Summer, a usual strong period for leisure travel, will not correspond to all the expectations created by business stakeholders. Vacation plans will be postponed or focused on short-distance getaways (international travel is still quite limited). Leisure travel is very much missed and passengers should be encouraged to travel – destination management organizations play a vital role in this matter, but airlines also must be aware of travellers' concerns on infection rates and government restrictions' evolution to better assist its customers and promote enjoyable and safe trips.

The travel and tourism sector creates jobs, drives exports and generates prosperity across the world, but it must be responsive to change. Hotels, airlines and other travel segments are particularly vulnerable to economic conditions. As SATA Group companies emerge from lockdown, they are determined to ensure the safety of their people and passengers, and the continuity of their operations, making it cost-effectively and looking for transformation and renewal.

SATA faced (is facing) a reduction in passengers' demand and a consequent revenue loss. Besides all the arrangements to control the transmission of COVID-19, the company needs a new restart – it needs to be able to react quickly to marketplace dynamics, rationalize to transform and rethink the business based on strategic compromises. Real-time data, short-term planning and optimization of processes and procedures are essential for a good performance. This "new now" can result in new opportunities and business value creation in a significantly disrupted travel environment worldwide, prospering in a devastating global economy. Passengers' experience must be reshaped having safety and trust as core values.

References

[1] Peixoto, E. (2012): SATA – De Sociedade de Estudos a Sociedade de Participações Sociais, Génese e Desenvolvimento Operacional. SATA – junho 2012.

[2] ICAO (2019), CORSIA, Carbon Offsetting and Reduction Scheme for International Aviation, Implementation Plan – Brochure, https://www.icao.int/environmental-protection/Documents/CorsiaBrochure_8Panels-ENG-Web.pdf

[3] World Tourism Organization and International Transport Forum (2019), Transport-related CO2 Emissions of the Tourism Sector – Modelling Results, UNWTO, Madrid, DOI: https://doi.org/10.18111/9789284416660

[4] IATA (2019), An Airline Handbook on CORSIA, https://www.iata.org/contentassets/fb745460050c48089597a3ef1b9fe7a8/corsia-handbook.pdf

[5] Medeiros, D. (2010): Sistemas de aproximação RNAV e RNP AR. Estudo para aeroporto da Ilha do Pico. Dissertação para a obtenção de grau de Mestre em Engenharia Aeronáutica, Universidade da Beira Interior, http://hdl.handle.net/10400.6/3635

[6] Maruhashi, J., Serrão, P., Belo-Pereira, M. (2019): Analysis of Mountain Wave Effects on a Hard Landing Incident in Pico Aerodrome Using the AROME Model and Airborne Observations. Atmosphere, 10(7), 350, https://doi.org/10.3390/atmos10070350