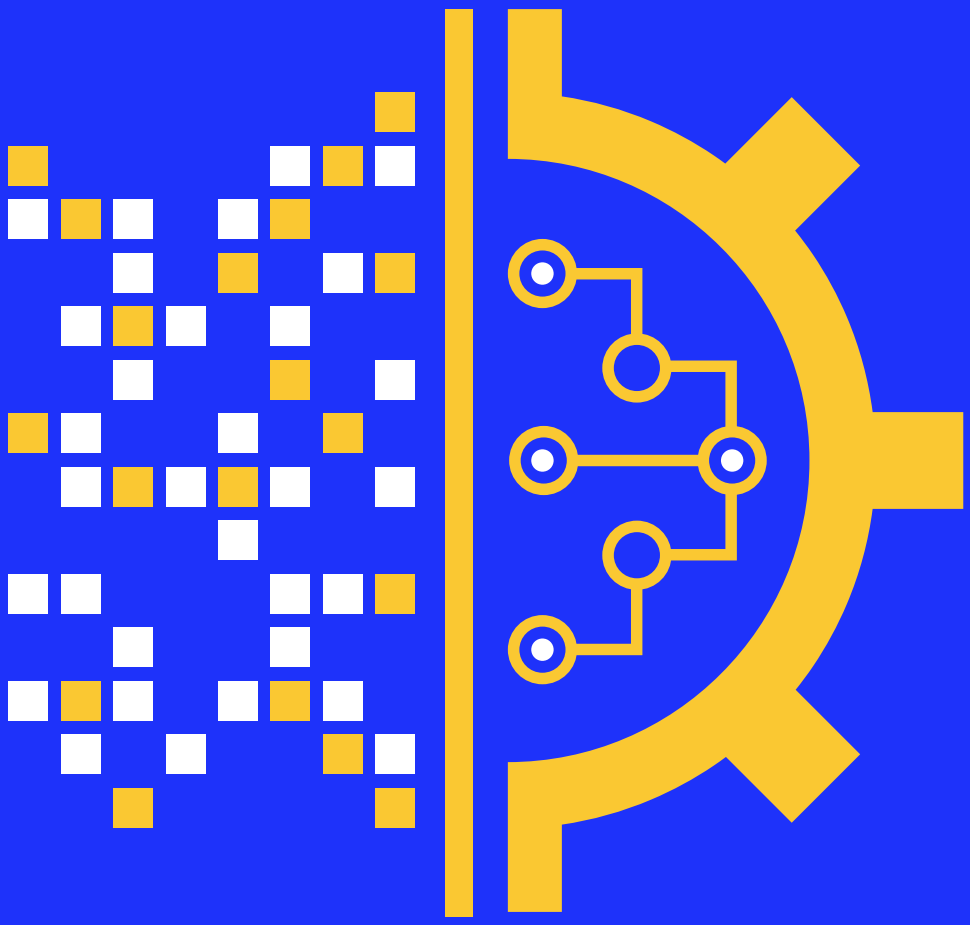
Digital & Data Think Tank
White Paper
2021



IATA

Foreword

Stephan Copart
Head, Digital Transformation

Digital is more than the latest buzzword; it is the future. In the past few years, the growth of digital across all industries has increased. It is especially prevalent in the aviation industry and clearly, the aim and focus of all aviation players. Whether it be the digitalization of customer processes or the digitalization of aircraft operations, there is opportunity to apply digitalization across the airline and more so, across the entire aviation industry to enable a true, cohesive digital experience for the customer.

Digital transformation helps organizations to become more agile, efficient, and profitable. It has to be driven by the business with the digital teams providing the proper technology enablers to support this journey. With the support of its Digital Transformation Advisory council, IATA has developed the Digital Airline Ambition 2030. The vision is ultimately to transition away from legacy process and systems. It compasses the future state of each key business dimension of the airline achieved through digital transformation.

The Covid-19 crisis has also accelerated the need for digitalization of processes and systems. It has been a huge catalyst for this transformation. Collaboration across airlines, and the entire industry on the digital journey is also critical to expedite the process across the board. IATA's role in this area is key. We bring airlines and industry players together to collaborate on the common digital goal. One way is through the Digital and Data Think Tank. Launched in 2021, this new Think Tanks unleashed so many opportunities within the digital space that the think tank could brainstorm and develop.

This year, the team has focused on three diverse areas: customer, shopping, and environment. The customer idea aims to create a truly customer centric journey, enabled by technology. The shopping data provides a powerful data architecture to enable customer-tailored service and adding value to both the customers and airline ecosystem. Finally, the environment idea focuses on advanced analytics and digital technology to model and measure their operational optimization programs and environmental initiatives.

As you will read, the ideas are quite diverse and further proves the opportunity the industry has to grow in the area of digitalization. It also further proves the value of the Digital and Data Think Tank and necessity to collaborate and work together to brainstorm ideas that will accelerate airlines on their path to become true digital airlines.

I am looking forward to sharing these ideas across the industry and the conversations they will spark as well as the potential initiatives they will enable.

I would like to thank the airlines, partners and IATA colleagues that took part in the first edition of this Digital and Data Think Tank and I look forward to 2022!

Executive Summary

Data and digital are the top priorities for every airline. The Digital and Data Think Tank was launched this year. Together, the team focused on brainstorming and designing ideas with the aim to transform airlines into digital airlines.

This year, the team has worked on three areas:

1. **Customer first**
2. **Shopping data and customer insights**
3. **Artificial intelligence (AI) and environment**

The ideas are articulated within this paper and will be presented at the 2021 IATA Digital, Data and Retailing Symposium.

Overview of content

Digital and data overview

Background

While being at the forefront of technology 50 years ago, airlines continue to rely on legacy processes and technology, making it more difficult for the industry to embrace digital transformation fully as an agile response to COVID 19 and to realize the benefits associated with this transformation. This ongoing complexity and keeping the past and modern systems in both IATA and the industry, with limited access and control of its data, high barriers of entry for innovation prevent airlines from anticipating and rapidly responding to changes on the market. They may fail to become customer centric, and data driven organizations, which contribute to business success and financial sustainability.

The future is digital. The industry is operating in a highly distributed and resilient data ecosystem based on open modern technology. Every participant in the value chain transforms business processes to run a resilient and robust enterprise responding in real time to changes on the market. Every business transformation is customer and data driven leveraging most relevant technology. Data is received directly from the source and specific to intended use. Where airlines can derive new value through aggregation (such as using AI / ML techniques to derive business intelligence), both the aggregation process and the associated value distribution are under direct control of airlines avoiding technology intermediaries.

The airline industry is embracing digitalization and data driven decision making and incorporating digitalization vision in strategies and day to day operations. IATA supports airlines' ambition to become 100% digital, maximize the value of data and digital transformation, enable open data ecosystem and trust frameworks, support an agile transformation for restart and a legacy free industry.

Vision and horizon

IATA members built the digital airline vision on the ambition 2030 of 100% digital airlines. The digital airline vision furthers the industry ambition for airlines to reach full digital maturity by having a clear digital transformation strategy and by reaching the proposed end state for each business dimension. This aims at progressively transitioning away from legacy processes and technology.

This vision also includes the 2024 target of digital readiness for 20% of the industry. In other words, this translates to 20% of IATA airline members representing at least 20% of traffic have implemented Open API and identity management in restart-critical business processes.

Scope

Digitalization impacts all areas of the airline activity. To add some perspective, airline activities impacted by digitalization can be broadly classified as follows:

- Planning and execution orchestration across the enterprise (i.e., demand, scheduling, and disruption management).
- Commercial (i.e., offers, distribution and payments).
- Flight and aircraft operations (i.e., flight planning, engineering, and maintenance).
- Environment (i.e., technology and impact).
- Back-office (i.e., order to cash, procure to pay).
- End-to-end customer journey (i.e., digital identity, engage and experience and cargo flow).
- Ground operations (i.e., baggage, aircraft turnaround).

Activities

IATA Digital, Data and Retailing Symposium
A major event, launched in 2021, with a focus on the industry restart plan and how airlines can further reduce and optimize costs, adapt to new customer needs / demands / preferences, and plan for new revenue generation using the power of data and retailing.

Digital and Data Think Tank
See detail below.

Digital and Data Think Tank

Vision

The vision of the DDTT is facilitated by IATA as a space for industry partners to brainstorm ideas that support airlines to advance on their digital journey. The think tanks allow airlines to address individual challenges, share innovation activities and to achieve this by focusing on common priority major areas to be digitalized.

Scope

Digitalization touches on every area of the industry and successful innovation activities such as think tanks need to remain very open to a wide range of ideas. For the think tank activity, the IATA Digital Transformation Advisory Council frames the scope by identifying priority areas to focus on.

Members

The DDTT consists of IATA airlines, strategic partners, and IATA subject matter experts. It is open to all.

Structure

Normally, the think tank meets face-to-face, four times a year. It is important to have the physical element since brainstorming, especially with a new group of people, is much better in person. We have seen that it allows people to be more creative and ideas to bounce off each other much better.

Unfortunately, Covid-19 has continued to impact travel plans for most members in 2021 and we had to make all the meetings virtual. In 2021, we started in April and had monthly virtual meetings.

During the initial two meetings, the team spent some time being pitched by start-ups, like the activity we would normally do at the first face-to-face meeting of the normal think tank.

The start-ups provided some inspiration for the brainstorm activity that was completed by the second virtual meeting.

IATA provided the DDTT with potential themes that were derived from the DTAC priority list and the DDTT selected three.

Output

The output for the 2021 DDTT is this industry White Paper and demos presented at the 2021 IATA DDR Symposium. The aim is to turn these ideas into IATA projects that can in turn lead to industry standards and mass adoption. Also, the aim is to speed up the process of industry buy-in and implementation.

DDTT, Airline Industry Retailing (AIR) and Financial Think Tanks

The DDTT was newly launched in 2021 along with Financial Think Tank (FTT) to complement an established Airline Industry Retailing Think Tank (AIRTT). The aim was for the DDTT to identify data and digitalization opportunities anywhere across the wide spectre of airline activities while, AIRTT would seek innovations in retailing and distribution and FTT would focus on cash management and payments.

The AIRTT has been running for three years, while the DDTT and FTT were both new. The DDTT and FTT were initiated because of the high demand and success of the AIRTT. All three think tanks consist of different members and teams.

While each of the three think tanks had distinct perspective on the subject, resulting themes and ideas often complement and build on each other. For example, one of the themes of the AIRTT explored how to better meet customer needs pre- and post-flight by foreseeing demand and supply of goods and services. This would be achieved by considering time of day, traveller profile, routine, and preferences and it would result in an improved airport experience and overall customer journey satisfaction.

In parallel, one DDTT explored how to create a truly customer-centric traveller's journey where the customer, enabled by technology, can own, control, and proactively share his current preferences to improve the retail experience without being bombarded by irrelevant offers. The outcome was very interesting since they both started with the customer as the centre of focus but from very different perspectives resulting in complementary concepts.

2021 New Ideas

1. Customer first

2. Shopping data

3. AI and environment

2021 New ideas

1. Customer first

Customer first is an extension of work done in two previous AIR Think Tanks. The 2019 "TrulyMe" imagined a connected travel ecosystem with smart objects stored in digital wallets that allow the traveler to share information selectively with service providers. This concept places the customer at the center and removes the reliance on amassing data for second guessing with precision on what the customer wants.

The 2020 "customer as the reference" proposed using recently published standards on verifiable credentials and decentralized identifiers to enable customers to selectively reveal his or her travel information and preferences in a privacy preserving manner. Fast forward to 2035, and we can imagine a world where all digital activities will be 100% secure and we don't have to worry about trust. The use of privacy preserving communications using decentralized identifiers (DIDs) will be ubiquitous and verifiable credentials will have replaced many forms of Know-Your-Customer (KYC).

Vision

Create a truly customer-centric traveler's journey where the customer, enabled by technology, can in his or her travel and retail experience enjoy maximum benefit with minimal effort.

Vision description

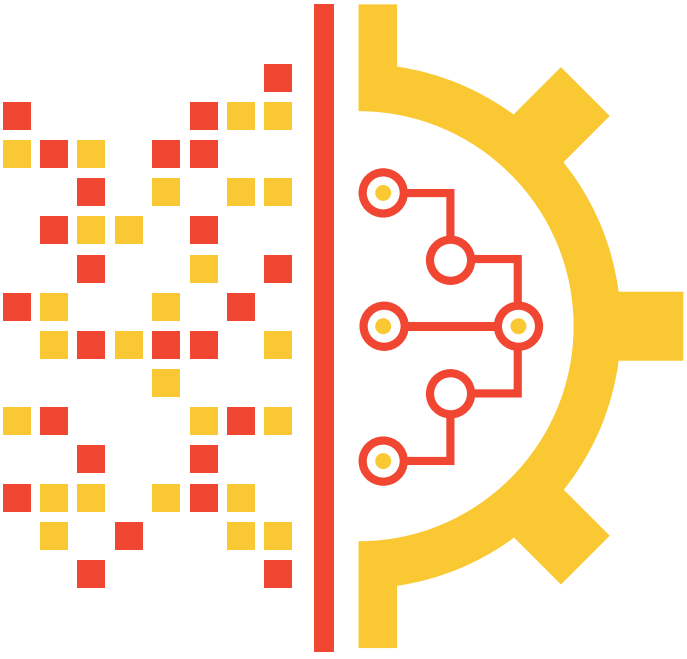
Create a KYC hassle-free and contactless customer journey where the traveler, using verifiable credentials and intelligent agents, can have easy access to all the services they have booked from getting on a flight all the way to checking into their hotel room. It will be like having a magic key that opens all doors.

Furthermore, the retail experience will also be totally different. Instead of being spammed with second-guessed recommendations, many of which may not even be relevant, the traveler can now publish their needs and preferences at a marketplace in a privacy preserving manner and receive relevant product and service offerings.

Current situation

The current customer journey is rather like driving on a supposedly fast highway without speed limit, but then you are stopped at multiple inspection points, and each time you have to explain who you are and present documents to prove your identity. The concept is to use verifiable credentials and zero knowledge proof to make the journey across all touch points as seamless as possible.

In today's retail ecosystem, the focus is still very much on using behavioral and contextual customer data as well as analytics and algorithms to make recommendations. This takes place with limited active involvement of the customer, as if the retailer needed to guess despite the customer's wishes. The customer too often needs to invest time and energy to shield themselves from irrelevant marketing spam thrown at them by companies vacuuming up their data. But this need not be the case when retailer and customer agree to collaborate. retailer can go directly to the source and have the customer reveal their preference. Hence, the idea to have the customer self-issue credentials on their travel needs and preferences such that suppliers can more accurately offer goods and services that meet those needs and use intelligent agents to "represent the customer" and search the market for offers.



2021 New ideas

1. Customer first

Recommendations

The recommendations are split in five areas:

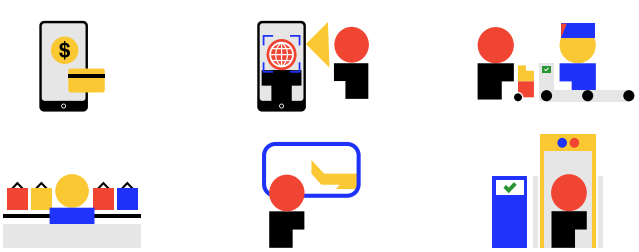
- Defining travel-ready application
- Using intelligent agents to improve retail experience
- Enabling contactless travel experience
- Managing disruption
- Architecture and trust framework required to put the vision in place

Travel-ready application for the entire journey

The vision described in this document is enabled by a mobile application used by the traveler. The mobile application consists of a digital wallet where the traveler can store all required travel documents and travel-related information, and intelligent agents acting as the traveler's concierge service facilitating the traveler's decision making and interacting on behalf of the traveler with the larger travel ecosystem, including providers of travel services or border control authorities at all stages of the journey.

Although it is assumed that most passengers will carry a mobile device and most of the interaction will take place through such a device, the use of a mobile device is not necessary. Passengers who do not or cannot use mobile devices will be able to benefit from similar capability online in the Cloud, using a digital provider of their choice. The same capability will also remain available when the mobile device is not in use or unable to connect to the local mobile or Wi-Fi network. Without an online mobile device at hand, the customer journey could remain contactless via iris or face recognition technologies identifying the customer, authenticating them via the Cloud and automatically allowing them through the various gates and even communicating with the customer as they walk through.

Contactless customer journey



Using intelligent agents to improve the retail experience

The 2020 IATA AIR Think Tank worked on a concept to improve retail experience called "customer as the reference". Instead of relying completely on collecting and analyzing data to second guess customer needs with precision and to thereby make relevant recommendations to the right person at the right time through the right channels, it would be more efficient to have the ability to go directly to the source and have the customer reveal their needs and preferences.

The idea is to have the customer selectively disclose their needs for an upcoming trip (which may be unique and different from previous behavior) to their chosen suppliers or to a marketplace so that suppliers that can match those needs can respond by making spot on proposals.

Use data to predict the next best action:

- Ingest data to create data lake.
- 360° customer view.
- ML, tree modeling, clustering.
- Behavioral analysis.
- Recommend, nudge.

... But still **second guessing** what the traveler truly needs.
Hence...

Customer as the reference (TrulyMe):

- Go directly to the source and have the traveler reveal their needs and preferences.
- Selective disclosure.
- Privacy preserving.
- Reduce search cost.
- Better matching of D&S.

Paradigm shift from second guessing to having the customer as the reference.

Putting this concept into practice, we can create a retail experience where travelers and suppliers can interact through a marketplace as described below and illustrated below.

1. Firstly, the traveler needs to make known their needs and preferences in a privacy preserving manner. This can be done through a self-issued credential with information on all the needs and preferences listed in a standard parameter sheet. For example, "family of four, need (a) large car from airport to hotel because of luggage, (b) small car during stay at hotel, (c) adjoining hotel twin rooms with ocean view, (d) a day return guided tour in English, (e) budget: 4-5 star.

2. The information, in a privacy preserving manner, will then be published at a digital marketplace, where suppliers can view and submit product and service offerings. A goal-based agent can be used to help suppliers search for demand that matches with inventory.

2021 New ideas

1. Customer first

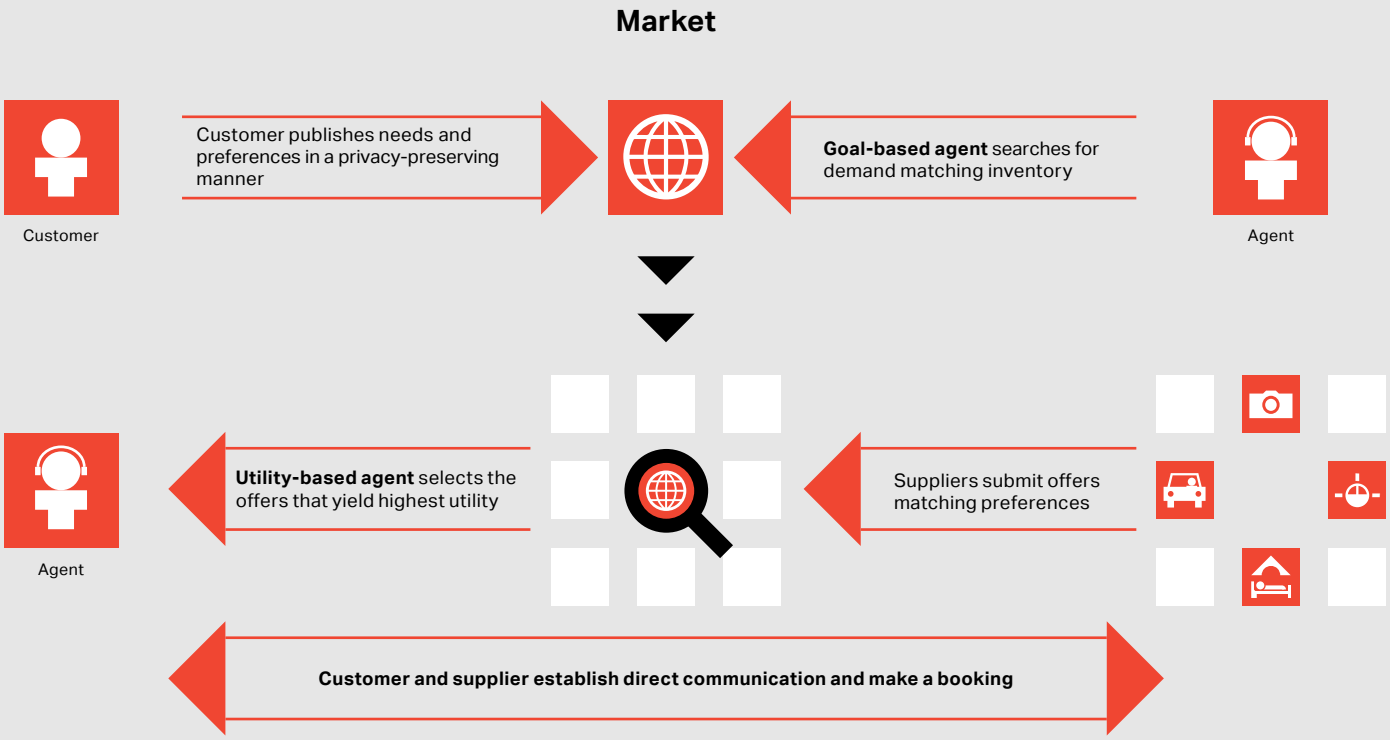
3. The traveler upon receiving multiple offers can use a utility-based agent to identify or short list feasible offerings from trusted providers to reduce the search cost of going through all options and facilitate the traveler's choice.

4. The utility-based agent can then also establish direct and private communication between the traveler's device and one or multiple suppliers to obtain more information if needed, and to make a booking with the desired supplier(s). When the booking is made, a booking credential is placed in the traveler's wallet. Once direct communication using DIDComm protocol has been established, the traveler and their service provider retain the ability to enter into secure communication any time throughout the journey.

The technical challenge in the above scenario is to have a utility-based agent (or multiple agents) that could find within the environment (which in this case is the marketplace) an offer or combination of offers that would satisfy the maximum constraints to achieve the goal. Constraints can be the price, the hotel room type, the date range or whatever is listed in the preference credential. The agent will also need to consider the following.

- Episodic vs sequential, for example, whether each action needs to depend on a previous action, or whether the choice of an action in each episode depends only on the episode itself. An example would be to find the right budget range first and then find the preferred room type.
- Static vs dynamic, for example if the environment changes frequently, then the agent will need to keep on looking to find what it seeks.
- Competitive vs cooperative, for example, multiple agents could be used to speed up the search in a cooperative manner, or multiple agents launched by different stakeholders could compete with each other.

If the intelligent agents can perform the matching tasks well enough to satisfy the traveler and the supplier, and especially in allowing the traveler to make better purchase decisions, then there will be sufficient incentive for the retail ecosystem to make a paradigm shift from a second-guessing type of retailing to a customer first one.



2021 New ideas

1. Customer first

Contactless travel experience

Planning	Pre-travel	Departure airport	Arrival airport and destination
• As a passenger, I use a reputable contactless travel mobile app that follows the defined aviation industry standards. • The app is using One ID standard **along with** my official identity (verified with the passport) **and / or** my driving license. • **Booking** details **can be imported into the app (verified by the supplier's system)**. • From that moment on, my device can securely communicate with the airline at any time. • I also import **details** of my hotel, car renter / airport transfer, **home-to-airport travel information** and attraction details into the **app**.	• My flight details (timing, origin, destination, etc.) are available in the app and my app uses this information to guide me throughout the journey. • With my consent, it sends my negative PCR test / **vaccination**, my itinerary, visa and passport to the destination country. The destination country returns "OK to travel" that my application shares with the airline. • My app informs me that the airport of departure and arrival both provide fully contactless experience **using biometric data for boarding**, **bag drop**, **etc**. • **I know that** I don't need to show any ID or boarding pass once at the airport since I have successfully authenticated.	• When I enter the airport, the contactless services are expecting me. • The app **gives** me **direction on how and where to drop / check in my baggage**. • When I arrive at the baggage drop area, I go to the baggage self-drop. The baggage self-drop recognizes me and I place my baggage in the self-drop. I follow the instructions on my app and my baggage is accepted. • I head towards my gate. The contactless travel solution will communicate with the app to provide directions of where my gate is **and how to get there**. • I reach the gate and walk towards the bridge. A camera captures my face, green light signals that I have been already expected and my identity has been confirmed, I board the flight.	• I arrive at the destination airport and **continue using the app with the contactless** travel solution **in the arrival airport**. • The contactless travel solution will communicate to the app if I need to perform a PCR test at the arrival and where to go to perform the test. • I head to the automated border control **gate who already has my identity and I am allowed to pass**. • Once I leave the restricted area, the app can offer suggestions on how to travel to my hotel / destination. • By having the right equipment that utilizes QR code in the mobile app or NFC, I can easily (in the airport) check in for the rental car, or board the hotel transfer, and then in the hotel I can check in and get my room details.

Managing disruptions	
	• When I bought my airline ticket, my application has established a secure communication line with the service provider. This is now very handy because the airline can inform me that my flight will be delayed. • Since I have allowed information about my travel plans to be shared in the event of disruptions, the information about my delay will be communicated to the hotel where I plan to stay and to the limousine service I booked. • The service provider can acknowledge this and revise charges or suggest alternative arrangement. • I arrive at the destination airport, and when I switch my mobile on, the app will recognize that I have arrived and will update my location to my onward service providers.

Architecture and trust framework

Business parties and their roles

Passengers

- Passengers use a contactless travel mobile app consisting of a wallet and intelligent agents.
  - The digital wallet, like our good old physical wallets, can hold all credentials required for the journey (passport, vaccine test or indeed an airline ticket) or those issued by the traveler himself such the preferences or indeed a selfie taken on a mobile phone. All credentials are digitally signed by their issuer and the wallet can combine data from different credentials and providing a zero-knowledge-proof (ZKP). That means that the wallet can present digital claims confirming required credentials without disclosing unnecessary personal data. For example, the wallet can confirm that I am a holder of a military card to obtain a military discount without giving away my birthdate that may be contained in the card because this information is not relevant to the question.
  - Intelligent agents represent the business functionality, they are the ones who go shopping on your behalf, remember when to submit what credentials to whom and take care of identifying the best options for rebooking my travel during disruptions.

2021 New ideas

1. Customer first

- When the passengers use a contactless travel mobile app that follows the above-mentioned standard, then the passengers can continue using this single app during their entire journey regardless of the different airports or different contactless solutions.

Contactless travel mobile app and digital wallet providers

- Different mobile app providers can create an app that is able to follow the standard to connect with the different contactless travel solutions from different providers in different airports.
- Hence, this contactless travel mobile app can be used in the entire journey even if it crosses over two or more airports.
- The contactless travel mobile app will simply connect to the ecosystem including contactless solution in any airport and will offer the available features and enable the passenger to navigate the airport in a contactless mode. This app does not store any data, only facilitates the transfer of information from the passengers' wallets to the suppliers.
- A digital wallet will store all the verifiable credentials that will be needed for the journey. The user will be required to explicitly consent the supplier to access the relevant data.
- Information from different verifiable credentials can be combined and used in a ZKP manner (e.g., passport information and PCR test result).
- Airlines can also develop these contactless travel features in their official mobile app by following the standard.

Airport

- Airport is a facility with infrastructure often managed by an airport authority where many different stakeholders including government authorities, airlines, and ground handlers all cover different aspects of the passenger experience.
- This paper assumes that all stakeholders agree what solution components and technologies are required and who will operate what to offer contactless experience at. different touch points of the airport in both the arrival and departure areas.

Contactless travel solution providers

- One or multiple providers together can create a full solution that offers contactless travel interactions for passengers in the airports and allows airlines, border control and airport security to facilitate the movement of passengers at airports.
- These contactless travel solutions will cover different touch points in the airport including entering the terminal, check in counters, border control (in the arrival or departure areas), baggage drop (self or manned), aircraft boarding, baggage claim, etc.
- These contactless travel solutions can include the relevant required equipment at each touch point that is able, for example, to capture and read biometric data (such as facial recognition) or communicate wirelessly and remotely with mobile apps to obtained or verify selectively disclosed passengers' information that is required (e.g., reading the passenger ID possibly using One ID standard, flight details, verified PCR test or vaccination, etc.). Since these contactless travel solutions will follow global industry standards, the interoperability is offered across any systems platform and across many different locations.

Airlines

- During travel search, airline systems can respond to requests presented by intelligent agents on behalf of passengers. While at this stage airlines may not know the exact identity of the passenger, the airline will know that the queries are presented on behalf of potential passengers, who are real humans.
- Airlines can establish an integration to the available contactless travel mobile app by adopting the standard, and their passengers can retrieve their bookings and other details into the contactless travel mobile app.
- Once the order has been accepted and ticket deposited in passenger's wallet, airline systems can access the wallet for credentials that may be required for the journey (such as Ok to travel received by passengers from governments). Since airline systems will be securely connected to wallets, airline systems can also push updated service status information and offer alternatives.
- Airlines can also add the contactless travel features in their official mobile app.

2021 New ideas

1. Customer first

Hotel

- Hotel can join in this ecosystem and be informed of the passengers' status during a disruption event (e.g., if there is a flight delay or a passenger misses their flight).
- Preferences can also be stored and shared with the hotel for advance information.
- Hotel can securely communicate with the passenger as soon as the booking has been issued to the wallet.

Car rental

- Rental companies can join in this ecosystem and be informed of the passengers' status during a disruption event (e.g., if there is a flight delay or a passenger misses their flight).
- Preferences can also be stored and shared for advance information.

Other transportation providers

- Providers of airport-town transportation may integrate into the app to provide travel suggestions.

Attractions

- Major attractions (theme parks, destination focus attraction etc.) may also choose to join.

In order for the traveler to pass information selectively to hotels, transportation providers in the journey, the passenger can simply configure permissions in their application. The secure and private connection will be created during the first interaction between the application and the provider.

What about travel agents?

Travel agent is an intermediary between the travel service provider and the traveler. Intelligent agents in our conceptual architecture can represent real life agents. They can search for travel on behalf of the passenger, they can compare and offer the best options and provide the service necessary to prepare for travel.

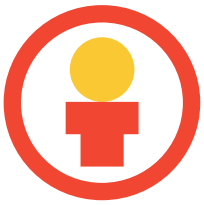
This example illustrates that intelligent agents are already in the retailing environment.

One example could be Airbuy : A startup dedicated to enhance retail experience at airports.

Airbuy acts as an intelligent mediator

Airbuy's powerful technology aggregates the comprehensive set of airport inventory types (i.e., duty-free, retail, food and beverage) and funnels it intelligently to a variety of channel partners (i.e., airlines, OTA's, payment vendors, etc.) to deliver the right recommendation to the right passenger.

2021 New ideas



1. Customer first

Standards

Contactless travel standard

- This standard will define how the various components that make up the contactless travel solution will enable communication and interaction amongst parties / systems / equipment concerned, including APIs and DIDComms. It will also define the rules and the mechanisms for the use of data and associated consent.
- For example, the minimum necessary information to complete a specific process in contactless travel should be specified in the standard.
- The interfaces and integration through this Standard can consist of different technologies such as airport wireless local area networks, near field communication (NFC) with specific equipment, or beacons for geolocation services.
- This standard will be adopted by the contactless travel solution provider (including equipment manufacturer) and the contactless travel mobile app, and it will serve as a common language to ensure interoperability between all parties.
- This standard will adhere to the ToIP governance and technology stack.

Trust Framework

- Our vision assumes an ecosystem where travelers and services providers can identify each other and establish trusted bilateral communications.
- When I search for a service on the market, my application can use ecosystem trust features such as Verifiable Credentials issued by a recognized authority to validate that I am indeed ordering a service from a bona fide commercial airline, hotel, or a registered taxi service.
- When I receive an order confirmation such as a ticket from the airline, it is deposited in my digital wallet as a verifiable credential. My application and the airline systems also establish a secure private connection (DIDComm). From that moment on, the airline systems know where to locate my personal data required for the journey and my application knows where to ask for any updates about the travel status. Also, the traveler can prove the possession of a ticket for example to a border control authority which requires to know that they have a ticket before receiving a visa.
- With the ticket, the traveler also receives an itinerary. This itinerary contains more than the usual information for the travel, it also contains the information about the identity of border control authorities' systems and airport solution that the app may need to access in order to prepare the traveler for the travel. When the time is right, the app can simply refer to this information to establish a secure DIDComm connection and exchange the credential needed.
- To allow for optimal communications in a trusted environment, there will be configurable parameters so that the traveler can select which data to pass to which supplier. The traveler can also pre-select sharing preferences when connected, and even assign delegation scenarios -someone doing part of the work for the traveler (an example would be performing tasks on behalf of small children and elderly).
- This standard will adhere to the ToIP governance and technology stack for global interoperability with the trust ecosystem including W3c Decentralized Identifiers (DIDs) and verifiable credentials.

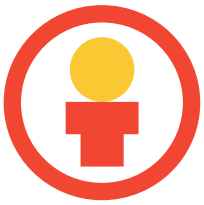
Digital safety and ecosystem trust

A potential risk one needs to consider is cybersecurity and sabotage as it is not unthinkable that when robots are deployed to act on behalf of human agents, and robots on behalf of robots, it becomes hard to discern which ones are real human initiated requests, which suppliers have legitimate interest to receive information, and which ones are robots launched to collect information or create dummy information to sway search results. Without an efficient and effective mechanism, the multi-agent systems could also generate massive amount of otherwise unnecessary communication among parties within the ecosystem.

As mentioned in the previous section, there needs to be trust so that parties in the ecosystem can communicate and transact with one another. Offers provided to customers who take part in this ecosystem are genuine and contracts to provide the services are no different from today's contracts.

2021 New ideas

1. Customer first



- We expect this trust to rely on the same business trust mechanisms we use today but upgraded to digital versions. Various state and industry organizations will issue verifiable credentials and / or operate registries confirming various business attributes of suppliers (i.e., registered business, holder of air operating certificate, accredited member, etc.).

- Bookings, tickets, and itineraries provided to customers can already contain digital references for airports and border control systems.

- Also, to ensure the legitimacy of requests and suppliers, a system of credit rating could be established through feedback mechanisms.

There is also the issue of data privacy and anonymity, which can only be sustained up to a point because when an intelligent agent makes a booking, it must represent a real person. So how can data privacy be preserved? Or to be more precise, how to allow for optimal privacy preserving such that it will satisfy a range of needs from the need for anonymity and selective disclosure to a secured detailed disclosure such as when making a booking? Parameters will need to be assigned so that intelligent agents can select the appropriate level of privacy for each task while providing suppliers the confidence that requests are being made on behalf of genuine travelers.

Consideration of environmental factors

There are number of environmental and sustainability factors to be considered when introducing new technology to offer end to end customer-centric experiences including contactless travel. Moving certain processes off airports could in the future reduce the environmental impact of the land and infrastructure used by airports, better data sharing and collaborative decision-making leads to more predictable flying and travel in general, less congestion and reduced emissions.

However, the choice of the technologies that enable this new digital experiences also have to factor in their environmental impact. When deciding on the scalable technology to use for this PoC, we have also considered the environmental impact of using energy intensive solutions such as a heavy reliance on Blockchain methods that could potentially consume large amount of energy, as is the case with mining activities in proof of work.

Consideration of accessibility

Contactless travel should be made available to all travelers, just as the use of the web content and applications should be made accessible to everyone, including people with disabilities. Hence, UI considerations, such as using captions for people who do not hear well, screen reader to read aloud for people who cannot see well, reduced dexterity for elderly users and so forth, will be taken into account to make the application as user friendly as possible. Chat bots using voice recognition could enhance the accessibility for travelers who cannot or prefer not to interact with a screen-based device. Different authentication methods can be used to facilitate authentication of a wide variety of users based on their accessibility needs.

For example, for people who do not have mobile devices, a wallet on the cloud can be accessed via any connected device such as a home computer or a common use device provided by the airport or airline. However, whilst it is ideal to be as inclusive as possible, we need to take a pragmatic approach in not assuming that the same level of seamlessness can be offered to travelers without mobile devices.

Benefits

All parties will benefit from participating in this contactless travel ecosystem.

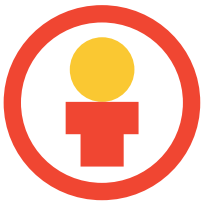
- From customers who would have control and autonomy over their own data by dictating who, how and when to share their information. The contactless experience is also a preferred method in this era of heightened health alert.

- The usage of a virtual assistant and selective disclosure guarantees a level of anonymity with the benefit of a pre-filtering of the options in the market, making it more precise and efficient for the traveler.

- For service providers of all levels, joining this ecosystem will widen their distribution network. With the information and customer preferences gathered from customers along their journey, it will allow providers to provide more customized offer and unique services which will increase customer satisfaction. The information provided in a disrupted scenario allows for better inventory planning and management.

2021 New ideas

1. Customer first



- Service providers would also have access to a wider database to use for analysis of customer behaviors without having to rely on only their own customer base as reference, service providers would receive real time information about buying intent as opposed to making a guess based on past behaviors. The signal information is more valuable and thus creates less need to store historical data.
- Contactless travel can also substantially reduce processing time and queuing time at various airport touch points.
- The technology and framework that are used for contactless travel can be expanded to other use cases such as in building a smart city, where with verifiable credentials and privacy preserving communications, people can perform all kinds of activities is a much safer environment where they have control over their identity and data.

Next steps

A journey to contactless experience has already started. Even before the Covid-19 crisis, travelers at many airports used biometric technologies to seamlessly board flights. The crisis has accelerated digitalization of passenger experience further, making contactless technologies one of the key enablers to minimize the risk of transmission. Today, many travelers already carry standard-based verifiable credentials confirming their health status in their digital wallets and some even carry a digital copy of their passport in the same format. Such rapid technology adoption was unimaginable in 2019.

1. Complete standards for contactless experience at airports

Rapid innovation however, occurred at many islands at once and many standards are missing or incomplete. This is especially the case for contactless experience at airports. Therefore, the immediate focus of our community must be on completing a full set of common standards to provide, for contactless passage through airports, standard APIs for airside access, self-boarding, and making airline tickets available in the form of a verifiable credential.

2. Standards bodies to rapidly establish interoperable trust frameworks

When building trust in a digital ecosystem, we do not need to start from scratch. Today's environment is already built on a trust framework relying on codes assigned to ecosystem participants based on their qualifications defined in agreed industry standards and verified by industry bodies. The future digital trust framework can build on this capability by complementing and eventually replacing the legacy codes with verifiable credentials that will allow travelers to establish trusted and private communications in confidence. Existence of readily accessible directories holding VCs of recognized providers is essential for the overall system. If I can get all the VCs I need and establish all the DIDComms in advance, I do not have to pause and stop at every touchpoint and it will be contactless but not seamless.

3. Experiments with intelligent agents needed to establish the foundations of the new market

His paper re-imagines a brand-new market where customers benefit from revealing their preferences and where intelligent agents service both the travelers and their services providers, search for best solutions on behalf of each party and collaborate to find optimum outcomes. There are many unknowns. What exactly will be the incentives for market participants? Why would travelers use the marketplace before it is fully established and proven? How will the market maintain a balance between the competing interests of buyers and sellers? What about the role of today's intermediaries, will they transition to the role of technology providers of intelligent agents? The answers can come only from real life experiences. This is why we call on technology providers and start-ups to take note of the rapid digitalization in travel, experiment with intelligent agents and share the lessons learn with the community.

4. Agile and collaborative approach

This paper describes a vision for the future and getting to this destination will require the many partners in the value chain to work together. Investment and technology decisions have far reaching impacts on passengers, airlines, airports, ground handlers. Agile innovation and small-scale testing should precede any major technology investments. Technology choices should always be consulted with all stakeholders before decisions with far reaching implications are made.

2021 New ideas

2. Shopping data

Vision

By leveraging the future airline capabilities based on offers and orders only, and by linking legacy and new sources of data (previously not available to airlines), a powerful data architecture can provide better tailored service and added value to the flying public and the airline ecosystem.

Vision description

The global aviation industry saw unprecedented growth in 2019 with 4.5 billion air travel segments flown. The spread of Covid in 2020 largely decimated the industry's progress across multiple dimensions – revenue, networks and capacity, customer satisfaction. While we are currently observing leisure travel demand returning in some markets like North America, global patterns are largely inconsistent due to changed traveler behavior and choices, and due to complex and sometimes conflicting guidance by health regulators. Additionally, corporate travel demand continues to lag as a result of extended work from home policies and often elimination of travel budgets for 2021. Consequently, airlines will struggle to drive revenue growth for the foreseeable future in what is already a very competitive industry.

It is clear that individual airlines have to develop a new approach to understanding, selling to, and servicing customers, not only to buffer themselves from the chaotic impacts of the pandemic and other unpredictable events, but also to drive consistency and have the ability to evolve as business models and traveler needs change.

Data on customers can be the greatest enabler for airlines like it is for any other retailer. Airlines have historically produced voluminous data across various business functions but have generally struggled to harness this data in a meaningful manner in time frames that drive agility. Data silos have been created over decades as a consequence of systems architectures of yesteryear and are a great impediment to driving higher customer and employee satisfaction, revenue growth, and optimized costs.

We propose the development of a data mesh architecture that forms the connective tissue between the high-level business functions of an airline. This data mesh will bring together historical and real-time streams of internal / external data, partner data, and market signals, while employing AI technologies to drive actionable insights by separating signal from noise – an amalgamation of data originating from:

- Customer history insights (customer data platform) and loyalty independent of any specific airline.
- Real-time demand signals (travel search), social media.
- Market intelligence, shopping and commerce, partners.
- Operational data, airports.

This mesh architecture is extensible in concept as more nodes (data sets) can be added to the pool for inclusion in AI driven analyses and automated decisioning, for example, setting the price for a bundle, offering an upgrade to a traveler, re-accommodating passengers, managing irregular operations, reducing fuel costs. Today's very highly scaled and high-performance data science and analysis tools coupled with advanced AI algorithms can drive insights like never before – both in real time, and over time continuums. Access to advanced AI is easier than ever, and democratized across public clouds, with managed services and automation reducing the need for data science experts compared to the past. However, compliance with data residency requirements has to be kept in mind in order to build globally distributed data meshes that are compliant with the relevant data privacy and protection laws.

These powerful insights will, in turn, enable more accurate and more automated decisions across the spectrum of business activities, and will drive revenue / margin growth, new market opportunities, higher customer and employee satisfaction, and a continuously optimizing airline operation.

By definition, aviation is a complex business. A unifying data mesh / platform will abstract away significant complexity and deliver immense value to an airline, the flying public, and the travel ecosystem.

With a 2030 horizon, several changes will make such a data mesh possible and valuable. The main one is the aim, for airlines, to achieve "offers and orders only", i.e., to get rid of legacy systems and references. This will let airlines become true retailers and will massively simplify their IT landscape. Thanks to this, there will naturally be fewer silos, better quality of data (not constrained or fragmented by legacy processes), and more value in that data. Besides, the ongoing development of new technologies, especially in the machine learning space, will enable better and more efficient processing of data, resulting in insights that are valuable for both the flying public and the airlines.

2021 New ideas

2. Shopping data

Current situation

The average passenger journey (from idea to fulfilment) involves several parties that must work together in an orchestrated fashion to provide a meaningful and satisfactory journey with the passenger playing the central role around whom all the other parties will revolve. Such parties include one airline or more, other modes of transportation (train, bus, rental car, public transportation), hotel, tour operator, travel agents, search engines, advertising partners, identity providers, authorities, etc. Unfortunately, truly achieving this kind of orchestration can be very difficult in real life, and requires open, industry standard interfaces for this travel ecosystem.

While the passenger is the key element in this ecosystem, they usually are anonymous, or there is a limited amount of useful information or deep insights on them that can be utilized to offer personalized services from each party. Any specific airline will only know the passenger's historical travel and purchases with that airline alone, and hardly anything else beyond that.

The situation is even trickier with information only indirectly related to travel but that still have a great influence on the passenger's behavior. A passenger has activities in different areas in addition to air travel, like participating in social media, hobbies and interests that materialize in either online activity (searching, reading, writing in online platforms) or physical activities in the real world. All those interactions, happening or being logged on numerous digital platforms, contain a huge wealth of insights that describe the passenger in various aspects. Those sources are often not used by the parties involved in the travel journey and they are not shared between them, resulting in suboptimal and generic services offered to the passenger that do not entirely fulfil their desires.

Further, the different parties involved in the passenger journey usually act in silos and as disconnected steps of the passenger journey. Each party ignores crucial details of other steps in the same journey. An airline will not know that the passenger has a connecting train journey to reach the final destination, or a hotel reserved with specific room check-in period. A passenger can choose to book those different steps independently and separately, then manually link them to get greater flexibility of choosing different providers. This may result in disconnection between those steps: a single irregular event (e.g., flight delayed, lost baggage) may impact other steps; because other parties are not aware of such events, they are not able to mitigate the impact, leaving the passenger on their own to find a solution. It may result in missing a train, losing a room because the check-in window has passed, etc. Even if an airline provides a bundled offer to cover the ticket, train, and hotel, those will currently remain disconnected since the information does not flow between the parties. To better serve the passenger, events to synchronize and adapt all steps of the journey would need to flow up and down the journey steps, as changes can impact all other events in a journey. Future passengers should have the convenience that a journey is continuously optimized for dynamic changes, taking the passengers' preferences into account.

Case for change

Travel is strenuous, travel is fragmented, travel is one of the few areas where the management is manual by the passenger across many silos. We all know travel disruptions are unpleasant (and NPS scores / studies on what passengers' value beyond price?) – we also know we could do better.

Happy customers travel more. Next generations expect a different interaction, see insurance business – Gen Z has an app for that and books their insurance modules online, flexibly, just in time – travel is still more "old school" in 2021. And the reason is the lack of ability to have new ways to interact between the providers of each journey step.

This section outlines two main customer experiences, one about the shopping experience, the other about the multiple steps of a typical journey. These examples outline the desired end state, underpinned by an efficient data platform.

2021 New ideas

2. Shopping data

Personalized affinity shopping experience (customer journey)

Building the passenger's profile

The passenger's profile can include different aspects that define them (e.g., single or married with children), hobbies and interests (e.g., traveling, activities, adventures), etc. The profile can also include previous trips. This can be obtained from location data from social media / online activities or actual posts about those trips. With this data, trends or patterns of travel can be established (frequency, type of destination).

Sentiment analysis can be used to derive more details in terms of implicit interests not declared or clearly stated. For example, the social media posts can be analyzed to identify whether the passenger enjoys certain types of food / restaurants, likes particular places (e.g., beach, markets, gardens), or practices specific activities (skiing, bowling, hiking, etc.). This kind of analysis could even estimate the type of spender this person is, for example comments that products are expensive will indicate a thrifty person, and hence budget offers / discounts can be offered.

Leveraging the passenger's profile to provide personalized offers

The information included in the profile can provide deep insights into what the passenger is interested in and what future travel needs might be. This valuable information can be shared by the passenger with different parties to enable the latter to personalize and uniquely tailor the offered services. Of course, the passenger should have full control over what pieces should be shared and what pieces should remain private, along with providing explicit consent when sharing this information and for what purpose this information can be used. This sharing methodology has to be compliant with data privacy laws, most notably GDPR.

The passenger forming the idea of the trip

The passenger is searching for a holiday destination, for instance using a regular search engine with "where to travel this summer". The search engine, knowing their profile, can offer specific destinations that meet the passenger's interests or offer destinations that are similar to previous trips. It can avoid previous destinations that the passenger posted negative reviews about. It can also recommend destinations that were taken by other passengers with similar interests or background.

The passenger can go to the airline's website to search for a holiday destination. The airline can offer affinity shopping, where the passenger will look for destinations based on specific attributes. For example, the airline's website can ask simple questions to the passengers, like interests (hiking, cultural, night life, history, nature, etc.), budget requirements (thrifty, medium, splurge), visa requirements (visa on arrival, have Schengen visa, have UK visa, etc.). Based on the passengers' selections, the airline can offer some destinations that match those selections. If the airline offers the ability for the passengers to sign in with their search engine or social media accounts, the airline can either automatically derive the affinity shopping attributes or use the information from the passenger's profile to augment the selected search criteria.

The airline can also offer travel packages that will include tours, hotels, or particular ancillary services based on the additional information that is available from the passenger's profile.

Follow-up of the trip

Capturing the follow-up of the trip is important so as to build it into the profile of the passenger and help shape future recommendations and suggestions. The passenger might post about the trip in social media or post reviews about the tour or hotel on any website. Those could be collected and added to the profile either by the search engine provider or by the airline.

The airline can use positive feedback to make the same recommendation to other similar passengers, or to recommend something similar next time to the same passenger.

Another important aspect is learning from the negative experience. By the use of sentiment analysis, negative feeling can be derived along with identifying the cause, whether it is the flight, the tour, the hotel, or the destination in general. According to the outcome, future recommendations can be enhanced and improved, by avoiding similar destinations. The airline can also offer compensation (free upgrade or lounge access) due to negative feedback about the flight and it can leverage this offer to harness positive publicity online with the final outcome of retaining the passenger as a future customer.

2021 New ideas

2. Shopping data

Critical user journey

Preface

This critical user journey (CUJ) describes how a traveler would experience a trip, across multiple journey steps and means of transportation and hospitality. It is a means to collect some ideas on what a user might expect and enjoy in a future travel experience.

Imagine a traveler about to embark on a journey. This journey consists of multiple steps, and starts about two days before departure, from check-in via ground transportation to airport, airport procedures, departure, arrival, ground transportation to a hotel and hotel check-in. This journey ends when the traveler enters the hotel room.

Two core concepts of this CUJ make the major difference to the experience today:

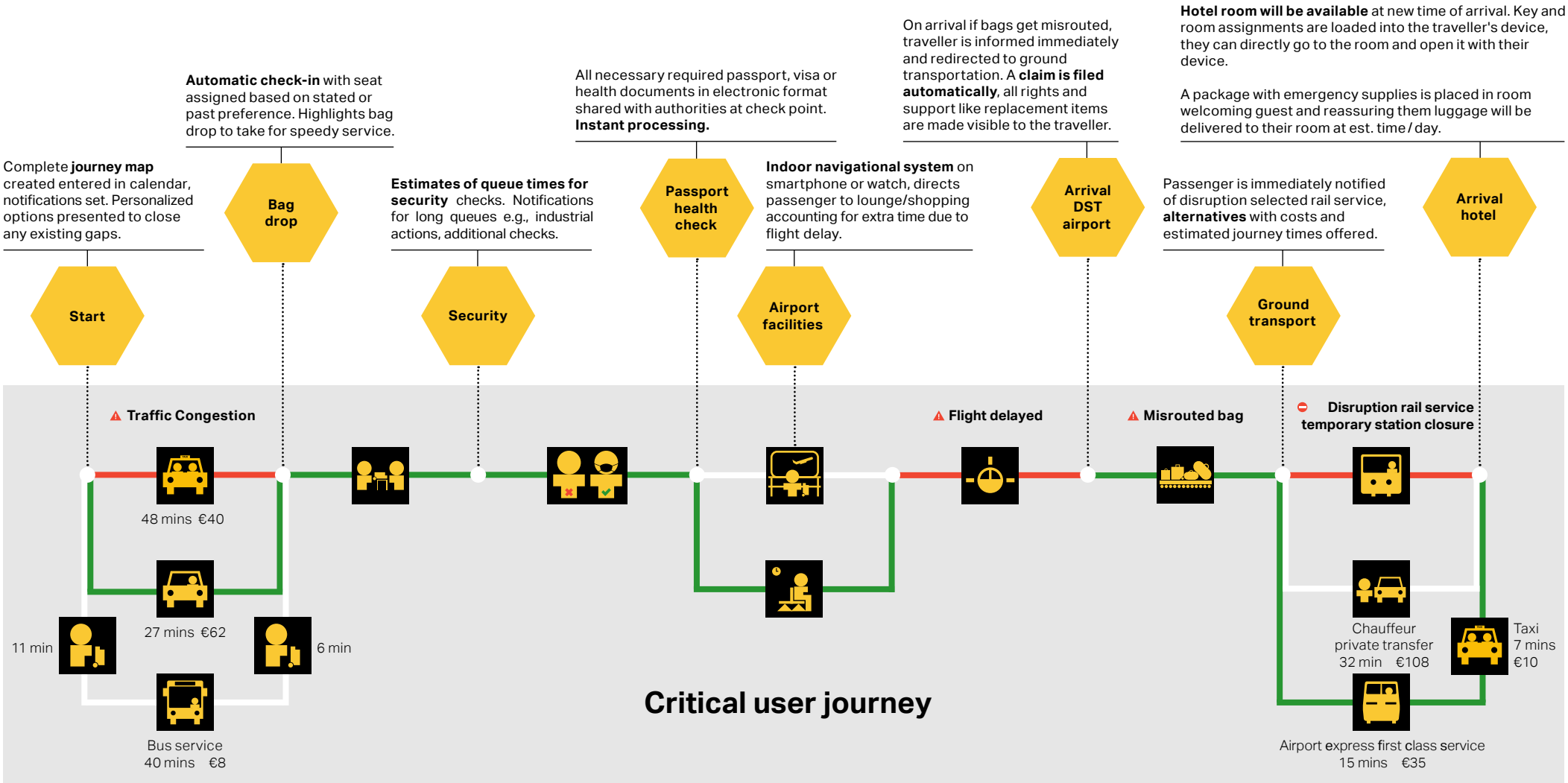
- Seamless interaction of journey steps through awareness of the previous and next step and the identity of the traveler across multiple steps (e.g., no need to show identification again at multiple steps).
- Two-way propagation of time requirements of each step, up and down the chain of steps continuously, with predictions on time needed by past data (e.g., traffic now and typical traffic / routing), current situation and traveler-specific data (like means of transportation, booking class, status etc.).

CUJ key steps

- A journey map is created and synched to passenger calendar with notifications set, all required steps to complete the entire journey including walking time, delays, latest travel regulations, must-meet times together with passenger preferences such as desire for use of lounge, shop before departure are considered.
- The system will propose suitable options to close any existing gaps, as well as providing best alternatives to minimize impact of disruptions such as road closures, severe weather conditions, planned industrial actions, overbookings.
- Journey map can be shared, and travel management actions can be delegated to a travel manager (travel agent, assistant, family member). Learned preferences can be modified at any point in time by traveler or travel manager. All downstream providers are kept informed of passenger journey status and any possible delays allowing them to make the necessary arrangements in advance mitigating risk of additional disruptions.
- Check-in is not required; seats are assigned by stated and past preference. Notification is sent to the user in advance, with an active step only required in case they do not want to travel as planned.
- The traveler departs at the planned time and travels to the airport via the optimal routing. Ground transportation options are selected based on known passenger's preferences be it fastest route, cheapest option, need for comfort, least hassles, minimum walking time, etc.
- The traveler navigates through the airport with an indoor navigation assistance (e.g., via a smartphone or watch), passengers are directed to best queues depending on wait times, class of service, airport, or airline status.
- Upon arrival, indoor navigation leads to bag claim, or directly to ground transportation if no bags are checked. If bags get misrouted a claim is filed automatically. The bag will be routed to where the traveler will be at the time the bag arrives. A visit to lost and found is no longer required, passenger is spared the unnecessary inconvenience of waiting at bag claim until the belt stops in hope that bag will show up.
- Ground transportation to the accommodation happens with the same features as before. In case of car rental, detailed specs of actual car brand / model / luggage space waiting for passenger can be shared hours before arrival, avoiding situations were customer finds out substitute car provided by car rental is inadequate upon arrival, necessary documents shared speeding up processing.
- Accommodation (e.g., the hotel) is kept informed of all updates, will not consider passenger as a no-show, room will be available at the right time no check-in is required as necessary documents shared. A package with emergency supplies is placed in room, welcoming guest, and reassuring them the hotel is aware of the luggage situation staff are ready to assist and will deliver luggage to room as soon as it arrives.

2021 New ideas

2. Shopping data



2021 New ideas

2. Shopping data

Benefits

The pandemic has established a new normal for travel and it is here to stay. Safety, cleanliness, health checks, no-touch scanners and smart devices are top of that list. Carriers and travelers have the need to know more about each other to make travel of the future safe and desirable. It starts with bringing together what travel providers and travelers know about each other and how they can be connected throughout the travel journey, sharing the intent of travel and insights that improves the quality of travel and makes travel journey safe and enjoyable without disruptions.

Customers are becoming more tech-savvy. From inspiration to completing travel happens mostly through digital channels using mobile devices (e.g., smartphone / watch). Airlines and travel providers need to compete on customer centricity to drive new customer acquisition, loyalty, retention, and superior customer service. Customers demand and respond to experiences that are timely, targeted, and tailored to their specific needs — and reject those that are not.

Customer data exists in different places and formats in various systems used for sales, operations, marketing, and finance to name a few. A customer data platform using the mesh model will enable setting standards, integrating customer data from multiple sources, unification of that data, enabling cross-device customer identification, segmentation and actioning based on insights.

There are four parts to the customer data:

1. Common data
   (public data about known and unknown users).
2. First party data — carriers and travel providers.
3. Collected and curated second / third party data - purchased from data providers or managed / controlled by first party.
4. Sensitive data — PI, PII, regulations attributes.

First party data, collected and governed by carriers and providers, can be extended by combining them with the other attributes to get insights and share with those involved in the journey (i.e., transportation services like Uber and Lyft, rental car companies, hotels, vacation rentals, etc.).

Second / third party data provides more context to the known [from first party] and unknown [anonymous] customer and can create a profile for each customer that will enable sharing this data with upstream and downstream touchpoints in the travel journey.

This model will also provide a way for the travel industry to share data and insights that are beneficial to everyone participating in the travel journey.

Data mesh paradigm

Data is growing exponentially, is duplicated a lot, ends up in multiple places (databases, warehouses, lakes) in silos and has become complex and hard to analyze. Extracting business value from it is a challenge. The data mesh architecture is there to address these points.

The data warehouses, data lakes and operational data stores of today will converge to a data mesh which will be more like a data centric version of microservices. Data mesh proposes federating the responsibility for creating high quality data assets to the people who are closest to the data and understands it best. Data domains are managed as data products and central data team will be enablers of federated data management. This domain driven data architecture and processing at the edge will drive the efficiency and provide seamless integration and scalability that is critical to power the travel journeys of the future.

In other words, with the data mesh paradigm, data is not gathered in a central place, but is hosted, maintained, and served by the relevant entity, i.e., data management remains within the domain that produced the data in the first place. These domain datasets need to be easily discoverable (this idea, applied to services, is explored in the AIR Think Tank) and interoperable, to make more data available to the value chain, with better quality and timeliness as well.

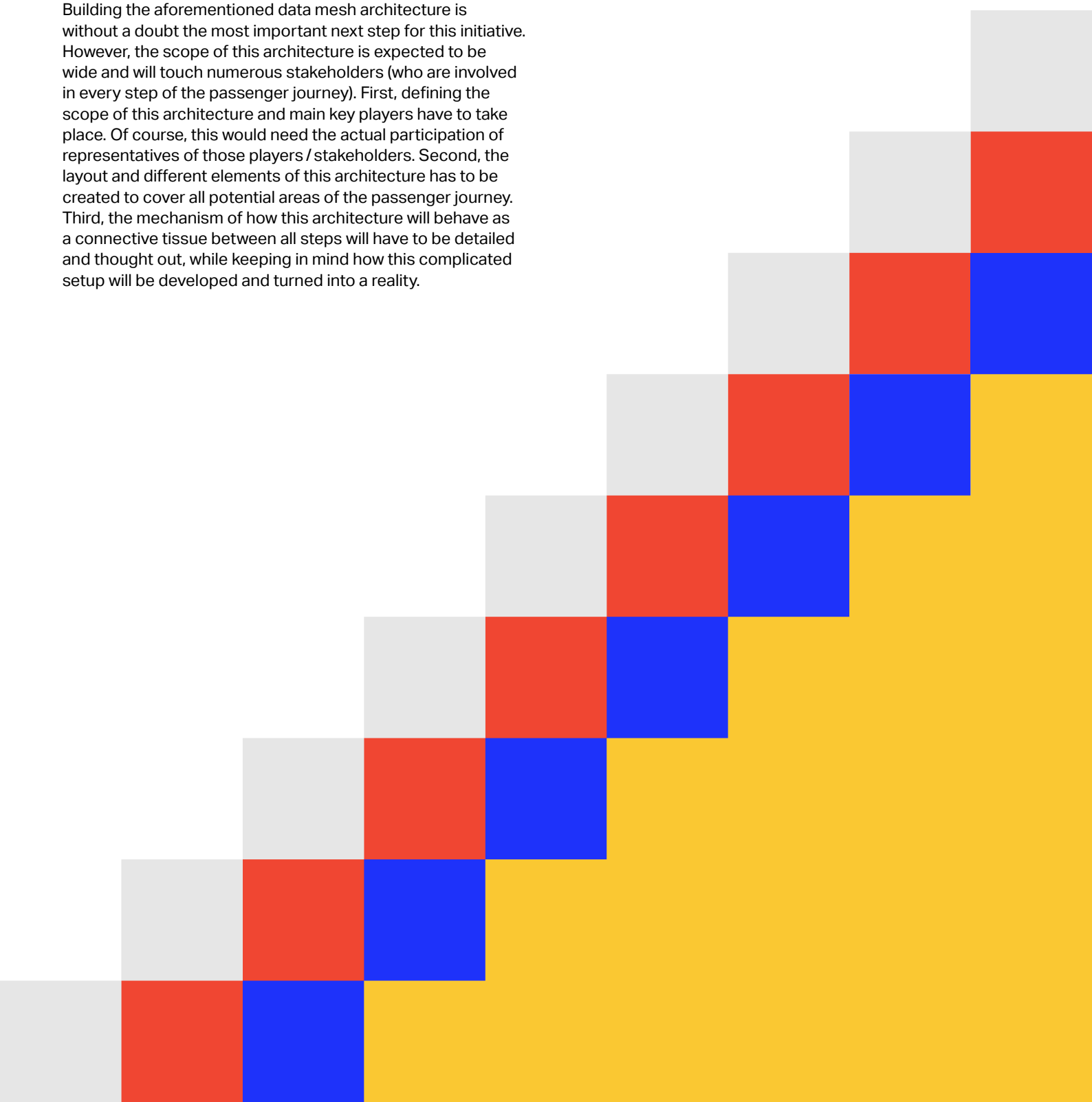
The data mesh will greatly diminish the analytics and operational data divide and provide the means to process data at the edge. Using cloud technology to build and operate the data mesh will provide for unlimited scalability, seamless integration, and advanced analytics with AI to process this data.

2021 New ideas

2. Shopping data

Next steps

Building the aforementioned data mesh architecture is without a doubt the most important next step for this initiative. However, the scope of this architecture is expected to be wide and will touch numerous stakeholders (who are involved in every step of the passenger journey). First, defining the scope of this architecture and main key players have to take place. Of course, this would need the actual participation of representatives of those players / stakeholders. Second, the layout and different elements of this architecture has to be created to cover all potential areas of the passenger journey. Third, the mechanism of how this architecture will behave as a connective tissue between all steps will have to be detailed and thought out, while keeping in mind how this complicated setup will be developed and turned into a reality.



2021 New ideas

3. AI and environment

Vision

Airlines are equipped to track, manage, and eliminate their environmental impact using AI and digital technology.

Vision description

In the future airlines use AI and digital technology to achieve operational excellence and reach their environmental goals [1]. Airlines effectively increase operational performance, improve safety, and deliver optimal service to customers, while reducing waste and fuel use. And their progress can be measured and effectively communicated.

With the fast adoption of new technology airlines increasingly have access to larger data sets derived from their own operations: Airline transactional data, customer data, aircraft operational data, image recognition datasets among others. And this wealth of data can be enlarged with data from partners across the value chain.

In this environment airlines use advanced analytics and digital technology to model, track and measure operational optimization programs and environmental initiatives. Enabled by IATA, airlines can access capabilities and industry platforms (inner source) containing big data and algorithms, at scale. With sufficient data and proofed AI / ML applications, airlines can fast track their operational efficiency programs; and monitor a series of major environmental contributing factors — beyond fuel use and emissions / CO_2 performance — using industry agreed definitions and airline best practices.

"What cannot be measured doesn't exist"

In the future, airline environmental activities are accessible and well understood by travelers and partners in the value chain (i.e., travel agents and system providers). As airlines are equipped to track optimized operations and their environmental benefits, this information is made available at a more granular level, say for an individual passenger itinerary, and easily integrated into shopping and order systems (sales and ticketing) taking advantage of new digital distribution technologies (example: NDC, One Order).

This makes it easier for passengers to understand the environmental impact of a flying activity which gives them the ability to make their own choice.

Current situation

External airline environment

In 2021, the industry is increasing the scope of their commitments to become net zero by 2050. Major decarbonization industry goals in the areas of technology, operations and infrastructure, sustainable aviation fuel (SAF), and carbon offsetting are set with a long-term horizon — 2050 [2] and require major industry shifts, therefore expected to advance only gradually. At the moment Fuel / CO_2 performance is at the centre of attention and driven by the industry — monitoring, reporting and integration of standard CO_2 metrics into airline systems is already underway (Airlines and IATA SEAC).

Aviation is widely perceived as a significant contributor to climate change, notwithstanding the importance of its contribution to local economies and global trade. And public pressure is growing about what the aviation industry is doing to become more sustainable. This requires a simple, engaging response. There is a story (several initiatives) beyond carbon footprint measuring and provision of carbon offset solutions.

Airlines' approach to environmental goals

Airlines are undertaking a series of complementary short / medium term initiatives to advance their decarbonization and environmental goals or as intermediate steps towards the long-term industry aspiration. These major contributing initiatives under implementation are growing fast, supported by the use of advanced analytics and new technology.

Despite their efforts, airlines struggle to convey the full story to their customers ("aviation is responsible for 2% of global CO_2 emissions" is not a good message). A lack of standardized definitions, metrics and performance indicators currently prevents proper performance measurements.

Big data and AI / ML experimentation

Individual airlines lack enough data sources to train their AI / ML applications at the speed and precision required. There is also a limitation on skilled resources to accelerate adoption of AI / ML applications.

Emerging data sources streaming from airline operations include digital twins data storage (i.e., jet engines), satellite / meteorological data and image recognition data sets.

[1] Industry decarbonization strategy — set at ATAG industry Waypoint 2050 and IATA industry net zero commitments for 2050. [2] 30 years (see Waypoint 2050).

2021 New ideas

3. AI and environment

With this wealth of available data, airlines are set to become data driven organizations. But there is a gap to bridge. The industry needs to easily access significant data sources at an industry scope to effectively accelerate the adoption of AI / ML user cases, aimed at reaching airline operational / environmental goals.

IATA SEAC and DTAC

IATA Sustainability and Environment Advisory Council (SEAC) is the main IATA body where industry policies are debated and agreed by airlines, under the framework of ICAO CORSIA, the carbon offsetting and reduction scheme for international aviation.

Priority projects sponsored by SEAC and facilitated by IATA in the data reporting and advanced analytics domain include: FRED+, the Aviation Carbon Exchange (ACE), CO_2 Offset standards / CO2NNECT project [3], Cabin Waste research: IATA Cabin Waste Handbook (August 2019) and Wildlife smuggling prevention [4] using AI. In addition, preliminary discussions are being held for SAF Scale Up — The SAF Accounting Reporting and Intelligence (SAFARI) project idea.

IATA Digital Transformation Advisory Council (DTAC) is the main airline sounding board for assessing digital transformation initiatives at an industry level in support of SEAC (and other business dimensions) ambitions. Main priorities include developing capabilities for open data ecosystem, trust frameworks and data access.

Idea [5]

Airlines in collaboration with IATA can develop an open exchange ecosystem, an inner source environment, or alike, designed to provide an industry platform for airline collaboration at scale, respecting antitrust regulations and security and privacy policies of the different stakeholders. With sufficient data and proofed AI / ML applications across different areas of the business, airlines can fast track implementation of operational optimization programs; monitor and measure operational KPIs and major environmental contributing factors — beyond fuel use and emissions / CO_2 performance — using industry agreed definitions and airline best practices developed by SEAC.

In addition, this idea considers the set up of an AI community for aviation sustainability for sharing of best practices on the environmental and sustainability area where AI is an enabler. Individual airlines are fast advancing on experimentation of AI / ML methodologies for environmental user cases, some examples are described in this paper.

Developing airline AI capabilities: data access and the exponential behavior dilemma

Most of the challenges airlines are facing are of "exponential" behavior. Which means that when airlines enlarge the scope of a problem (using bigger data volumes) it can take exponentially more time to solve the problem compared to the increase in data volume. Developing AI / ML algorithms on the "small" scope of an individual airline, might not be that beneficial. On the other hand, once in use, these AI / ML algorithms can reach an exponentially larger impact and benefits (than expected from the increase of the big data volumes).

So individual airlines using their own (limited) data scope to develop AI will have some benefits, but relatively / exponentially small compared to big data volumes. To utilize these algorithms the most, the volumes of the data sets should be increased, for example by combining datasets from different airlines or by combining different types of datasets.

However, while airlines can build and use more public datasets, access combined data sets might have legal constraints. In order to maximize the potential benefits on airline sustainability by applying AI, airlines need to experiment with AI on big data volumes, from a variety of public and private datasets. For this it makes sense to setup data and AI exchange ecosystems.

An important element of a successful AI / ML project is data quality:

- Data sets must include **relevant elements necessary** to learn what we want the system to accomplish.
- The quality of **models / algorithms should be optimal**, existing applications in the market (i.e., GoogleAutoML) can support training.

[3] About CO_2 Offset standards & CO_2NNECT project: Transparency has never been more important for passengers, corporates, and travel companies when it comes to understanding the per passenger carbon footprint when travelling by air. A proliferation of calculators has led to confusion by passengers, raising questions in regard to which methodology can be trusted, providing results that can be fairly and meaningful compared between airlines. The CO2NNECT initiative that takes a whole new best practices approach, offering for the first time a calculation methodology developed by the industry combined with the capability of distributing CO_2 emissions data to travel agents or corporate management companies using industry data connectivity standards. CO2NNECT leverages the IATA Aviation Carbon Exchange — ACE functionalities and provides a platform to directly and seamlessly reduce the carbon footprint calculated by investment in high quality carbon offset projects.

[4] ATA is pursuing the use of AI and aviation security data to identify the trafficking of wildlife out of South Africa — Project Vikela. This concept has the potential to decriminalize air transport and reduce customs and agricultural inspection fees, while contributing to reduce the risk of further pandemics.

[5] For the purpose of this paper, ideas are set for exploration, and they are not constrained to implementation, monetization, or local regulations and policies.

2021 New ideas

3. AI and environment

- Ensuring **bias-free learning**. Models can learn strong biases accidentally and then exhibit bad behavior, it does need attention to detect and prevent.
- **Labeled data**. "What we look for" should be explicit on a data subset. For example: AI may detect sunny skies on photographs, provided there is a set of images with sunny skies identified ("labeled") to tell the AI "this is what I look for".

Sharing of best practices

The goal of the data and AI exchange ecosystem is to combine and share data and algorithms to exploit them the most. Of equal importance, a dedicated community of human experts sharing their knowledge about the data (quality) and the algorithms, is needed to support and animate this ecosystem. Three user cases are described below to illustrate areas where airlines are experimenting with AI to achieve operational efficiencies that have a direct positive impact on environmental goals [6]:

- Passenger predictions to achieve cabin / food waste reductions.
- Sustainable aviation fuel availability Modeling.
- ML using computer vision parsing of satellite data and meteorological data for contrail warming avoidance.

Use case: passenger predictions to support cabin / food waste reduction

To address food waste reduction, airlines have been looking at implementing optimization practices such as meal selection at time of check in, enabling frequent flier services to include customer food and drink preferences, and personalizing meals and toiletries on board. We examine the experience of KLM and Cathay Pacific.

Problem: How can airlines track better what passengers want to consume onboard? How can airlines use AI to help improve waste sorting?

To reduce the number of unnecessary meals taken onboard, KLM took the approach of improving its passenger forecasting system, not only for the day of departure itself but also for predefined moments before departure (7 days, 2 days, 4 hours before departure).

This to better cater for the expected meals. The already existing passenger forecast model was replaced by this more accurate model which incorporates and combines several data sources like schedule-data and flight-data.

The improved passenger forecasts result in a better service for the passengers, because KLM is better able to serve the right meals to the right passengers. This results in less unnecessary meals thereby reducing the food waste and reducing the fuel needed because of the lesser weight, with benefits from an environmental and cost perspective.

This KLM meals on board system has now been incorporated into KLM pathfinder, with an enlarged data set to model predictions affecting different operational teams. It includes information on last-minute bookings, about passengers that either did not show up or missed their connections and on schedule and aircraft changes. Pathfinder uses 10 data sources and can predict AT-gate passengers and baggage volumes and flight delays. These predictions are used for inflight catering, customs and security, baggage handling and other stakeholders.

To achieve its corporate goals, Cathay Pacific has implemented a process change around catering order cut off times. By balancing the time of receiving updates on expected passenger number data with operational constraints, the airline has been able to more closely match meals uplifted with the actual number of passengers on-board. Digital touch points such as the "choose my meal" capability for first and business class passengers to pre-select their meal options before flight, and the "smart serve" inflight app to help crew take meal orders also help collect granular data which can help future meal planning. To track performance, Cathay Pacific measures the percentage waste as the number of passengers catered for vs. those on-board.

To improve tracking of food wastage, suppliers offer food waste tracker that leverages on sensors and image recognition technology to weigh and categorize waste offloaded from aircraft (thrown away) thus helping airlines reduce their food waste. This technology might present limitations as image analytics is only available at certain points.

[6] Additional user cases identified: A. On route traffic optimization. B. Ground operations efficiencies: Minimize congestion, delays, taxing & turnaround times. C. Air navigation optimization. D. Recycling.

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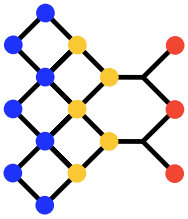
Pathfinder | Passenger and bags prediction model

How many passengers will show up at the gate? Many factors play a role.

Let a machine do the math, taking into account:

- Last-minute bookings
- No-show / missed connection
- Aircraft changes
- Overbooking
- Etc.

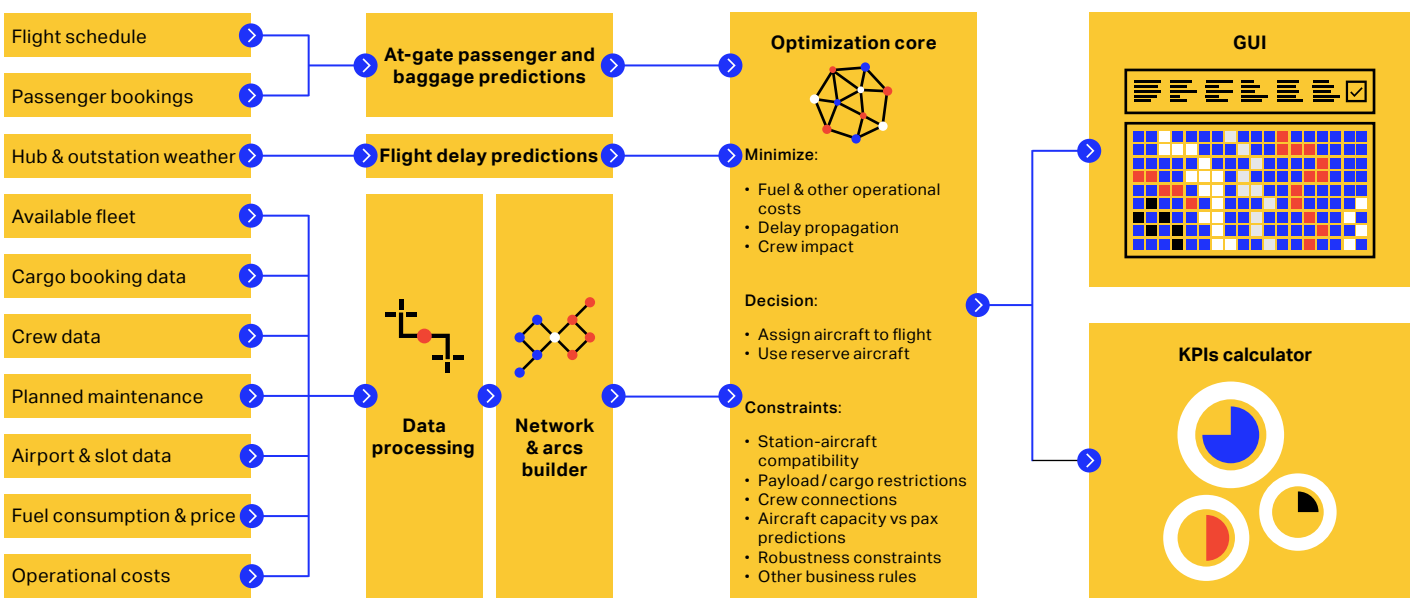


machine-learning algorithm (neural network — 21 outputs)

A multi output model was used to server all stakeholders

- Catering: inflight and KCS
- Schiphol: customs and security
- Human resources planning departure hall, etc.
- Cargo and load control
- Baggage handling
- Network, Pathfind, swaps

Pathfinder | Detailed schema



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Opportunities and challenges ahead

With passenger numbers remaining dynamic up to point of departure, combination of better passenger number predictions and catering company and airline collaboration can better match meals to consumers on board. Matching of meal supply to passenger demand is a priority of a more sustainable catering model. Volume of data, and consolidation of different data sources are important factors. Data can be extended by capturing individual's food preferences at different traveller journey points: Frequent Flier Programs (FFP), booking, check-in to improve the accuracy of the forecast. Improved food and water loading will also minimize excess weight on the aircraft providing marginal fuel savings.

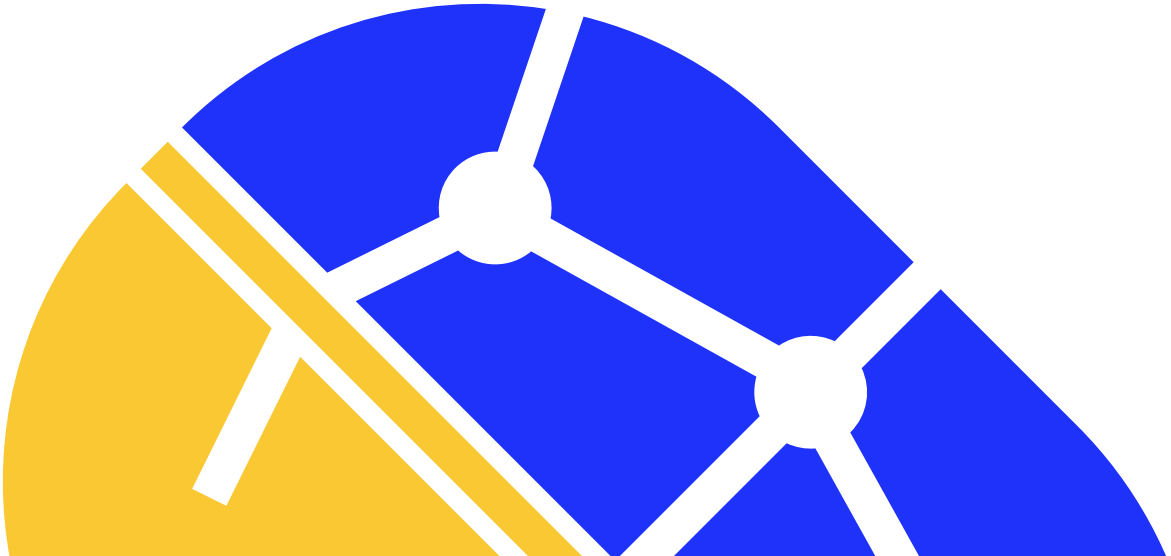
Airlines may however struggle to optimize food and beverage provision when uplifting meals as ancillary services. It is also challenging to quantify food waste not around a specific set meal (juice cartons / snacks etc.). Catering providers present another challenge. Catering contracts with operators should incentivise reducing food waste. Airlines holding own catering facilities may be in a better position to optimize supply.

Industry standardized metrics could give further visibility on catering waste but will face challenges due to different airline and caterer operating models. However, benchmarking against other service providers will help the industry manage environmental impact beyond the carbon emissions footprint. Less fundamentally aligned with airline financial priorities than waste reduction, measurement and benchmarking of recycling and upcycling of inflight waste may help drive further ancillary activities for the industry.

Use case: sustainable aviation fuel availability modeling

SAF represents a key aspect of Waypoint 2050's vision for reduced emissions in aviation. Depending upon the different scenarios that have been explored, SAF could contribute up to 75% of the emissions reduction that the industry is targeting. However, recent estimates suggested that only around 2% of total jet fuel use will be from SAF by 2025. Significant acceleration is therefore needed if the industry is to complete a transition to SAF and achieve the targets set.

Adoption of SAF is going to be dependent on many supply and demand factors. As a highly complex and regulated process, requiring significant investment of time and money, the emissions reduction may not be sufficient justification alone for switching to SAF.
So there remains a significant awareness campaign around sustainable aviation fuels and there is plenty of lobbying still to be done if aviation is to meet its targets. In this regard, one aspect of sustainable aviation fuels that has yet to mature is the availability of consolidated data. There remains, perhaps, a lack of awareness about the progress that has been made and scale of the challenge still ahead. The industry would benefit from a consistent and structured reporting mechanism to track the volume of SAF that has been made available to the airlines globally and to understand where that puts the industry towards target. In parallel there is also a need to build regulated mechanisms for tracking and accounting for Scope 3 reporting sustainable fuel use which is highlighted by the IATA work on SAFARI.



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Use case: AI / ML for contrail warming avoidance [9]

The radiative forcing effects of contrails are estimated to be a significant fraction of human caused global warming, roughly on par with all CO_2 emitted by the aviation industry since the Wright Brothers. Only a fraction of flight segments (<10%) form persistent contrails, and only a fraction of those segments produce the majority of the warming effect — often concentrated over highly populated and overflown areas. Conditions for persistent contrail formation (PCC) are understood, though at present difficult to predict accurately.

By 2030, Google anticipates that aircraft will routinely avoid contrail forming regions. We will see computer vision parsing of satellite data, better humidity data for numerical weather forecasts — along with better wind field data, which will have an ancillary benefit for fuel consumption — and applied machine learning to enable: (a) empirically, automated monitoring of global contrail effects; (b) real-time avoidance strategies that minimize cost and congestion; (c) contrail forecast predictions up to 24 hours in advance for flight planning and optimization. Route optimization to avoid the worst of the warming regions will be integrated into tools for flight planners, pilots, and ATC. Consumers will recognize the impact of contrails and choose airlines that fly responsibly. Avoidance will have a minimal impact to aircraft operations, with negligible fuel consumption overhead. There will still be improvements to make in predictions — and regions where operational considerations override avoidance — but the majority of contrail induced warming will be eliminated going forward. Proof of concepts with first airline partners are being set in 2021.

Recommendations

Decarbonization and sustainability goals are an industry top priority. Sharing of Data and AI / ML applications used to establish operational efficiency program supporting environmental goals is a smart way to accelerate "green" operations. Open collaboration among airlines (and aviation stakeholders) is the only way forward to reach net zero by 2050. Airlines are keen to work together to the ultimate benefit of consumers.

The following are main recommendations:

- Development of AI / ML capabilities: Airlines look at IATA for scaling up their individual efforts and congregate SMEs to explore and share data and algorithms within the appropriate legal proof and data governance. Areas of exploration should lead to industry reaching its environmental goals. In addition, IATA can be an agent for change - accelerate the adoption of AI / ML for operational excellence leading to airlines achieving their environmental goals.
- Sharing of best practices: Airlines are fast advancing on optimization initiatives with environmental benefits. IATA can establish a framework for airlines to share best practices on sustainability and environment. An AI community for aviation sustainability would allow airline SMEs to focus more on exploration of AI / ML methodologies – and used a unified approach to seek the support of other parts of the supply chain as needed. This community could catalog available airline environmental data sets and create an inventory of AI user cases under experimentation.
- Support the work of SEAC in the development of models and metrics for monitoring major environmental contributing factors– beyond fuel use & emissions / CO_2 performance.
- Industry benchmarks: Airlines should be able to measure, manage, communicate, harmonize through value chain. When addressing Food Waste reduction IATA SEAC should consider the need of an industry benchmark on food waste reduction and catering costs optimization using performance indicators (examples: food waste per passenger; % of waste recycled from a flight; unit costs per catered passenger). This should allow airlines to assess their progress and identify areas for improvements.
- SAF monitoring: IATA SEAC to consider a standard methodology for reporting and capturing the volume of SAF provided to the industry. In addition to a measure of volume, airlines and IATA should seek to understand the geographical distribution of SAF programs and track and project the overall contribution towards waypoint 2050 targets related to SAF.
- Collaboration with the value chain: aviation stakeholders such as ATC providers, airframe manufacturers, airlines and cloud providers are active in this area and currently engaged in a project to test contrail avoidance. There is room for further IATA collaboration, as airline data / AI will certainly play an important role.

[9] Provided by Google R&D Team. Refer to: Nature paper: www.nature.com/articles/s41467-018-04068-0, Eurocontrol Youtube Video: www.youtube.com/watch?v=oz4OyEFrD4Q.

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Benefits

- Advanced analytics and can allow airlines to make use of new emerging data sets for quantifying operational efficiencies and potential environmental benefits.
- AI / ML capabilities at industry level: While airlines can build from a variety of public and private datasets, access to combined data sets might have legal constraints. Airlines and IATA can work together on capabilities to maximize the potential benefits on airline sustainability by applying AI, allow for experimentation with AI on big data volumes in a collaborative environment, airlines will achieve more efficient and effective AI / ML development (better and faster) to market as well as an increased scale of innovations and code quality.
- With harmonized definitions and common operational performance KPIs, airlines can effectively respond to the public and provide visibility on the range of airline environmental initiatives they undertake across different stakeholders in the value chain.
- Awareness of SAF remains limited outside of the aviation industry. By tracking the progress and adoption of SAF, airlines and IATA will be well informed when lobbying industry to increase the availability of SAF as well as raising public awareness to help distribute the cost.

Next steps

There is an opportunity to continue exploring user cases of AI / ML supporting airline innovation towards achieving environmental industry goals beyond this paper. The conclusion of this group can be considered as building block.

It is proposed to bring forward the findings of this paper to the DTAC and SEAC, as the governance bodies within IATA overseeing digital transformation and environmental priorities.

The IATA 77th Annual General Meeting held on 4 October 2021, has approved a resolution for the global air transport industry to achieve net-zero carbon emissions by 2050. This commitment will align with the Paris Agreement goal for global warming not to exceed 1.5°C. Following this resolution, airlines and IATA will be working on concrete areas for exploration in 2022.

Conclusion

The launch of the IATA Digital and Data Think Tank proved that there is definitely an appetite to brainstorm this interesting scope and a plethora of topics to focus on.

We have learned from this year's exercise and hope to improve the structure and delivery of the Digital Think Tank in 2022.

All the ideas in this document will be shared and discussed across the industry and within IATA to be further developed within the respective areas.

Partnering for Success

A special thank you to the 2021 members.

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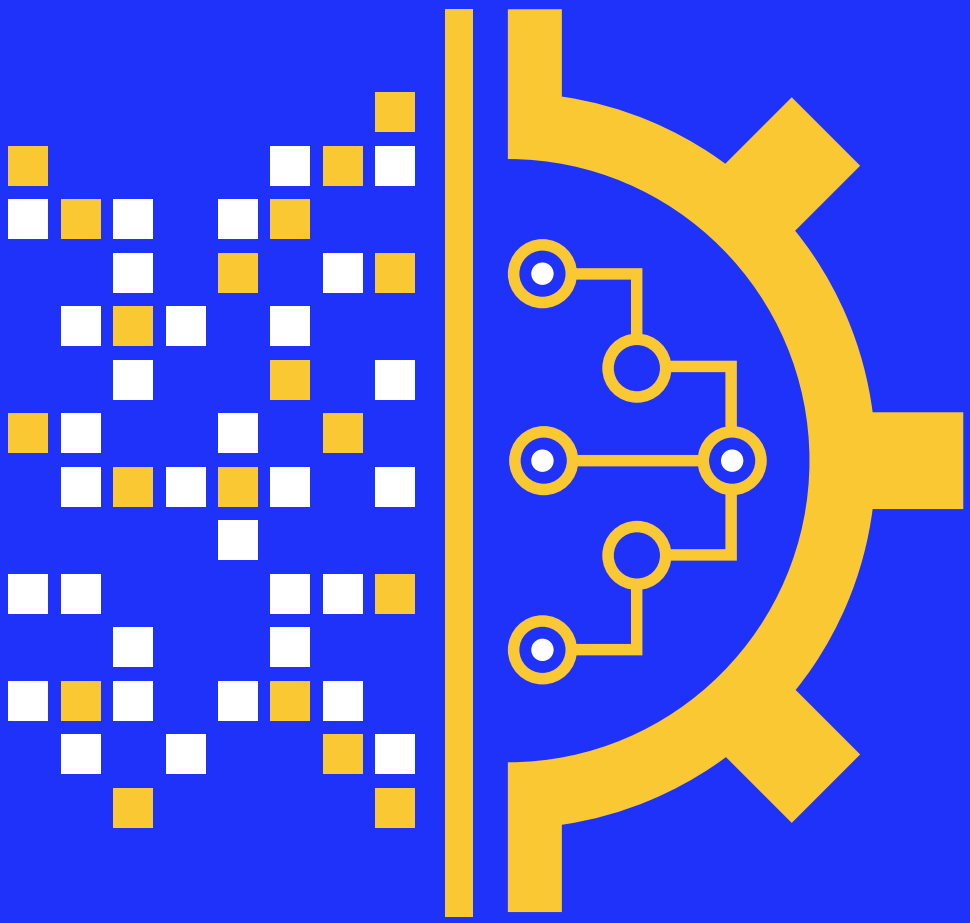

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