Universitat Autònoma de Barcelona

Improving passenger experience through delay communication: Developing videos for a new approach to explain delays and flight disruptions

Final Degree Project Report in Aeronautical Management

carried out by
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Escola d'Enginyeria
Sabadell, June of 2025

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CERTIFICA:

Que el treball al que correspon la present memòria ha estat realitzat sota la seva direcció per

Emma Buisan Schiaffino

I per a que consti firma la present. Sabadell, ***Juny*** de ***2025***

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ABSTRACT

Title of the Final Degree Project:

- Improving passenger experience through delay communication: Developing videos for a new approach to explain delays and flight disruptions
- Millorar l'experiència del passatger mitjançant la comunicació dels retards: desenvolupament de vídeos per a un nou enfocament en l'explicació de retards i disrupcions de vols.
- Mejorar la experiencia del pasajero mediante la comunicación de retrasos: desarrollo de vídeos para un nuevo enfoque en la explicación de demoras y disrupciones de vuelos.

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Mentor: Laura Calvet Liñan	
Degree: Aeronautical Management	

Keywords:

- Flight delays, passenger experience, aviation communication, delay announcements, Synthesia, AI-generated videos, airline operations
- Retards de vol, experiència del passatger, comunicación aeronàutica, anuncis de retards, Synthesia, videos generats amb IA, operacions d'aerolínies
- Retrasos de vuelos, experiencia del pasajero, comunicación aeronáutica, anuncios de retrasos, Synthesia, vídeos generados con IA, operaciones de aerolíneas

Summary of the Final Degree Project

- English: This project explores how airlines communicate flight delays to passengers, with the goal of developing messages that are clearer, more informative, and rooted in empathy. It outlines the various types of delays, examines their impact on both passengers and airline operations, and proposes an innovative communication solution: short, AI-generated videos, created using Synthesia. These videos were tested through surveys, offering insight into their potential effectiveness. The project aims to offer a real-life and scalable approach that merges empathy, messages regarding delays, and technological insights to improve the passenger experience.
- Català: Aquest projecte explora com comuniquen les aerolínies els retards de vol als passatgers, amb l'objectiu de desenvolupar missatges més clars, informatius i amb una base empàtica. S'hi exposen els diferents tipus de retard, s'analitza l'impacte que tenen tant en els passatgers com en les operacions de la companyia aèria, i es proposa una solució innovadora de comunicació: vídeos curts generats amb intel·ligència artificial, creats mitjançant Synthesia. Aquests vídeos han sigut avaluats a través d'enquestes, aportant informació sobre la seva possible eficàcia. El projecte pretén oferir un enfocament realista

i escalable que uneixi empatia, missatges sobre retards i coneixement tecnològic per millorar l'experiència del passatger.

- Castellà: Este proyecto analiza cómo las aerolíneas comunican los retrasos de vuelo a los pasajeros, con el objetivo de desarrollar mensajes más claros, informativos y con un enfoque empático. Se describen los distintos tipos de retrasos, se examina su impacto tanto en los pasajeros como en las operaciones de la aerolínea, y se propone una solución innovadora de comunicación: vídeos breves generados con inteligencia artificial, creados mediante Synthesia. Estos vídeos han sido evaluados a través de encuestas, proporcionando información sobre su posible efectividad. Este proyecto busca ofrecer un enfoque realista y escalable que combine empatía, mensajes sobre retrasos e innovación tecnológica para mejorar la experiencia del pasajero.

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ACRONYMS

- **AI:** Artificial Intelligence
- **ATC:** Air Traffic Control
- **ATFM:** Air Traffic Flow Management
- **EDP:** Engine Driven Pump
- **FDP:** Flight duty period
- **IATA:** International Air Transport Association
- **LVP:** Low Visibility Procedures
- **LVO:** Low visibility Operations
- **NLP:** Natural Language Processing
- **TTS:** AI text-to-speech

1. Introduction to the project

1.1. Introduction

Flight delays and disruptions are one of the main sources of frustration for airline passengers. Based on passenger satisfaction studies, delays are regularly ranked as one of the top passenger complaints and issues with commercial airlines [1]. Although most of the time, these delays are unavoidable, how these delays are communicated can have a significant influence on the passenger experience. Currently, airlines provide information about these delays through announcements, which tend to be vague, highly technical, lacking detail, and rushed. That can result in passengers feeling uninformed and unsatisfied.

The complexity of the operations that happen throughout the entire flight can make this communication challenging. These operations consist of the turnaround process, crew scheduling, flight planning, air traffic control, and the flight itself. These processes, combined with the external factors, such as weather conditions, technical issues, or air traffic congestion, that can affect it, can make explaining the situation clearly, understandable, and reassuring challenging for the airline. Although challenging, the lack of explanation, information, and transparency given to the passengers can have a negative impact on an airline's reputation [2]. When these passengers are left without clear communication and understanding of the situation, they may perceive the airline as unreliable or feel misled by the announcements. This perception can eventually make the passengers opt for the airline's competitors and manifest their dissatisfaction by leaving negative reviews or making social media complaints. This can lead to potential clients not choosing that particular airline, which can have an impact on customer retention, brand loyalty, and the airline's image.

Nowadays, many airlines tend to rely on traditional methods such as manual announcements done at the airport gate by the gate agent, generic and basic email notifications, or automated text updates. However, as mentioned before, these methods fail to provide the reassurance and understanding that the passenger needs. To be able to address this issue, this project proposes a new approach to explain flight disruptions and delays in a clear way.

The main idea of this project is the development and creation of short, informative videos that can visually illustrate the reason behind flight disruptions and delays in real-time, allowing passengers to fully understand what exactly is happening and why, so that they might not feel blindsided. These videos break down the complexity behind aviation processes and turn them into a simpler and more understandable concept, much easier to explain, that can make the passengers understand the circumstances, reduce their frustration, and improve their trust and experience with the airline, despite having any disruptions.

Beyond the creation of the videos, this project will also analyze the viability and effectiveness of this approach to evaluate how this change in the way the information is presented to the passenger can improve their experience and trust in the airline. Once the videos are created, they will be shared with a target audience that is mostly made up of frequent flyers and people who have no background knowledge in aviation or airlines. The type of validation done in this project will include analysis methods, such as surveys, to be able to measure the understanding of the concepts, the passenger's satisfaction, and the trustworthiness that the airline transmits.

1.2. Objectives

The general objective of this project is to overcome and make the aviation world more approachable. It aims to make delays and disruptions more understandable.

The specific objectives are:

1. Analyze the impact of delays on passengers, such as emotional and psychological and consider how these effects also extend to airline operations.

2. Evaluate the current delay communication methods, focusing on timing and clarity.

3. Develop an alternative method of communication to provide a better understanding and a more human-focused approach

4. Implement and test this alternative to assess the effectiveness and impact it can have on passengers

1.3. Motivation

For this final project, there are three main motivations that I have:

1. Enhancing the passenger experience

   One of the main goals of airlines and the aviation business is to ensure the satisfaction of the passengers. Delays in flights are one of the main causes of frustrations that customers have [1], and carrying out this project might be able to reduce this negative emotion and enhance the overall customer experience.

2. Overcoming the communication gap

   Delays and flight disruptions tend to raise a lot of misconceptions about the passenger's flight status if they are unaware of the causes. This project aims to fill the information gap by transforming technical aviation-related problems into simpler and clearer language.

3. Application of Aviation Management Knowledge

Throughout the academic years studying aviation management, various parts of the operational part of aviation and airlines are learned. This project is a perfect way to apply all the concepts learned to a real-life situation and be able to bring understanding to others who might not have the knowledge.

1.4. Risks

In this project, various risks need to be taken into consideration:

1. Not getting the necessary information from an airline
    a. **Probability:** High
    b. **Impact:** High
    c. **Preventive measure:** Contact relevant professionals early to explain the goal of the project and gather the necessary data. Seek alternative sources such as industry reports or government aviation authorities.

2. Challenges in simplifying complex aviation concepts
    a. **Probability:** Medium
    b. **Impact:** High
    c. **Preventive measure:** Break down the technical concepts into everyday language, use infographics and animations to support the explanations, and test the first drafts with people who are unfamiliar with aviation to ensure their understanding

3. Limited knowledge of recording and editing videos
    a. **Probability:** Low
    b. **Impact:** High
    c. **Preventive measure:** Take online courses or watch videos that explain video production or editing. Use beginner-friendly software.

4. Not being able to get feedback from experts
    a. **Probability:** Low
    b. **Impact:** Moderate
    c. **Preventive measure:** Create a long list of possible contacts in aviation. Reach out early to make sure there's time to get the answers.

1.5. Timeline

Task	Start date	Finish date
Overview		
Introduction	6/2/25	18/2/25
Objectives	10/2/25	16/2/25
Risks	12/2/25	13/2/25
Motivation	12/2/25	15/2/25
Timeline	10/2/25	14/2/25
Theorical framework		
Research: common delays	24/2/25	9/3/25
Research: impact of delays on passengers	27/2/25	11/3/25
Research: delays announcements and limitations	3/3/25	9/3/25
Theorical framework writing	10/3/25	23/3/25
Practical section		
Brainstorming and outline of the videos	24/3/25	13/4/25
Creation of the script	14/4/25	22/4/25
Research on creating and editing videos	23/4/25	29/4/25
Filming content	30/4/25	9/5/25
Creating visual effects	10/5/25	14/5/25
Editing video	15/5/25	25/5/25
Sharing video and conducting surveys	26/5/25	1/6/25
Analyzing responses	2/6/25	8/6/25
Drawing conlcusions	9/6/25	15/6/25
Practical section writing	16/6/25	26/6/25

2. Theoretical framework

2.1. Flight delays

2.1.1. Definition and classification

The definition of a flight delay is when an aircraft departs later than the initially scheduled departure time. Airlines are required to provide an explanation for both the cause and the duration of the delay. Each delay is reported and classified to ensure compliance with standards and to facilitate performance monitoring. According to the U.S. Department of Transportation, a flight is officially categorized as late if it has departed 15 minutes or later after the initially scheduled departure time [3].

Flight delays can be classified into different categories based on their origin and impact. The classification based on their origin focuses more on where the delay comes from and what caused it. This classification can be divided into two: internal and external delays. Internal delays are those that are caused by factors that are within the airline's control [4], such as crew scheduling, ground operations, or maintenance. External delays are those that are caused by factors that are outside of the airline's control, such as weather, medical emergencies, or ATC.

The classification based on impact can also be divided into two: primary and reactionary delays. Primary delays are those delays that are directly linked to a specific issue of that particular flight. On the other hand, reactionary delays are those that occur when an aircraft arrives late and causes delays to the next flights [5].

2.1.1.1. Importance of studying delays

Flight delays are a significant problem in the aviation industry because of the impact that it has on airlines, airport operations, and customers [6]. The consequences that these have on the industry can be both economic and operational, which is why it's important for an airline to analyze and study these delays. This type of analysis can help an airline determine root causes, recognize patterns, establish trends, etc., which can result in finding a more effective solution to reduce these disruptions and consequently reduce the impact that it has.

2.1.2. Categories of flight delays

Airlines and authorities use the classification of flight delays to analyze operational efficiency, improve scheduling, and improve the passenger experience. To ensure consistency between the airlines and the authorities when classifying flight delays, IATA has standardized delay codes, which are represented by numbers from 0 to 99. As mentioned before, these delays can be categorized into two, depending on the origin: external and internal delays.

As mentioned before, internal delays refer to those delays that are within the airline's control [4]. These delay codes include Passenger and baggage, cargo and mail, aircraft and ramp handling, technical and aircraft equipment, damage to aircraft and automated equipment failure, flight operations and crewing, and other airline-related causes [7].

External delays are those delays that are out of the airline's control [4]. These delays can be separated into 5 different categories: airport, En-route, governmental, weather, and miscellaneous. Inside the airport category, the delays code refers to ATFM due to restrictions at destination airport, Airport facilities, restrictions at the airport destination, and restrictions at the airport departure. In the En-route category, there are the codes about ATFM due to ATC En-Route Demand Capacity and ATFM due to ATC Staff Equipment En-Route. The governmental category refers to all incidents related to security and immigration. When talking about weather, there are two distinctions: any weather-related incident other than ATFM and ATFM due to weather at destination.

These two categories, external and internal, make up for almost all the delay codes that have been standardized, but they only refer to primary delays. Reactionary delays, which, as mentioned before, are those delays that occur when an aircraft arrives late to a destination and causes delays to the next flights, have their codes as well.

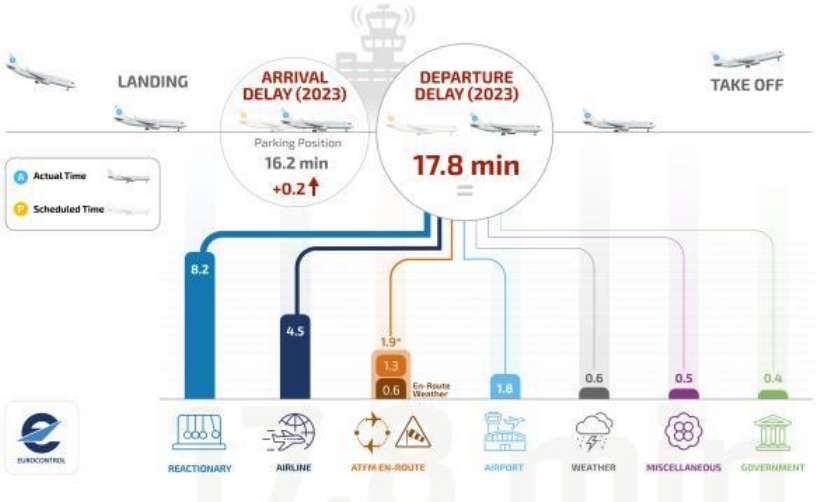


Figure 1: 2023 cause of flight delay

2.1.3. Internal delays

2.1.3.1. Passenger and baggage

In the Standard IATA delay codes, the category of passenger and baggage uses codes from 11 to 19 [7].

11. (PD) **Late check-in**, acceptance after deadline: This code is applied when a passenger arrives late for check-in and the airline decides to reopen the check-in for this specific passenger.
12. (PL) **Late check-in**, congestion in check-in area: This code is applied when the check-in area has excessive congestion, leading to long queues and processing time. This could be a consequence of a lack of staff, system failure, or an unexpected high volume of passengers. This can lead to closing the check-in later than established.
13. (PE) **Check-in error**, passenger and baggage: This code is applied when an error occurs during the check-in process. This error could be incorrect passenger details, document verification issues, or technical failures in the system.
14. (PO) **Oversales**, booking errors: Overbooking is when the airline sells more tickets than available seats in an airplane. This delay is applied when solving the seating arrangement between the overbooked passengers causes a delay.
15. (PH) **Boarding**, discrepancies, and paging, missing checked-in passenger: This code is applied when discrepancies occur during boarding, such as assigning the same seat to two different passengers (double seating) or when the number of passengers on board does not match the data the gate agent has recorded on the system.
16. (PS) **Commercial,** publicity, passenger convenience, VIP, press, ground meals, and missing personal items: This code is applied when the presence of a VIP passenger or media representative on board causes a delay. It's also applied when a disruptive passenger or a forgotten item has to be retrieved.
17. (PC) **Catering order,** late or incorrect order given to supplier: This code is applied when the catering order done by the airline or the service provider is done too late or there has been an error when placed, leading to delays.
18. (PB) **Baggage processing**, sorting, etc.: This code is applied when there are delays caused by issues during the handling of baggage. This can include problems with sorting, loading, or transporting the luggage to the aircraft.
19 (PW). **Reduced mobility**, boarding /deboarding of passengers with reduced mobility: This code is applied when additional time is required to board or deboard passengers who need wheelchair assistance or other mobility support.

2.1.3.1. Cargo and Mail

In the Standard IATA delay codes, the category of cargo and mail uses codes from 21 to 29 [7].

21 (CD). **Documentation**, errors, etc.: This code is applied when there are errors or missing information in cargo documents, and it causes a delay.
22 (CP). **Late positioning**: This code is applied when cargo is not delivered to the aircraft on time. This could be due to delays in transportation from the warehouse or terminal.
23 (CC). **Late acceptance**: This code is applied when cargo is accepted at the warehouse or terminal beyond the designated time limit, which leads to delays in processing and loading the cargo.
24 (CI). **Inadequate packing**: The code is applied when cargo is packed incorrectly, and it requires repackaging or additional securing before loading it into the aircraft.
25 (CO). **Oversales**, booking errors: This code is applied when cargo space has been overbooked and it requires reallocation, offloading, or rebooking of the shipment.
26 (CU). **Late preparation in warehouse**: This code is applied when cargo is not prepared within the time limit in the warehouse due to delays caused by sorting, labeling, or handling.
27 (CE). **Documentation**, packing errors, etc. (Mail only): This code is applied when errors in mail documentation or packaging, which could include incorrect addressing, missing costume forms, etc.
28 (CL) **Late positioning** (Mail only): This code is applied when mail is not delivered to the aircraft on time.
29 (CA) **Late acceptance** (Mail only): This code is applied when mail is accepted beyond the designated time limit, and it leads to delays.

2.1.3.2. Aircraft and ramp handling

In the Standard IATA delay codes, the category of aircraft and ramp handling uses codes from 31 to 39 [7].

31 (GD). **Aircraft documentation late/inaccurate**, weight and balance, general declaration, pax manifest, etc.: This code is applied when aircraft documentation, including weight and balance, general declaration, and pax manifest, is either delayed or contains errors, and it has to be corrected before departure, causing a delay.
32 (GL). **Loading/unloading**, bulky, special loads, cabin load, lack of loading staff: This code is applied when the loading or unloading of cargo bags or special equipment takes longer than planned due to the size of the items, the number of bags, or the insufficient loading staff.
33 (GE). **Loading equipment,** lack of or breakdown, e.g., container pallet loader, lack of staff: This code is applied when there's no loading equipment available or malfunctions.

This prevents the loading of baggage and cargo from being done on time and leads to delays.
34 (GS). **Servicing equipment,** lack of or breakdown, lack of staff: This code is applied when there is a lack of ground support equipment, such as stairs or ground power units and staff to operate it which can cause a delay in boarding or deboarding and other services that the aircraft may need during the turnaround process.
35 (GC). **Aircraft cleaning**: This code is applied when the cleaning operation takes longer than scheduled or the cleaning staff arrives late to the aircraft, causing a delay in boarding.
36 (GF). **Fueling/defueling,** fuel supplier: This code is applied when the fueling or defueling operations take longer than expected, there are fuel shortages, supplier-related issues, or there aren't enough refueling trucks to supply all the aircrafts in the airport.
37 (GB). **Catering**, late delivery, or loading: This code is applied when the catering staff delivers the meals and beverages late to the aircraft.
38 (GU). **ULD**, lack of o serviceability: This code is applied when there is a shortage of compatible ULDs with the aircraft.
39 (GT). **Technical equipment**, lack of or breakdown, lack of staff, e.g., pushback: This code is applied when ground equipment such as pushbacks or air start units is unavailable or malfunctioning.

2.1.3.3. Technical and Aircraft Equipment

In the Standard IATA delay codes, the category of technical and aircraft equipment uses codes from 41 to 48 [7].

41 (TD). **Aircraft defects**: This code is applied when an aircraft has technical defects that require repair before departure.
42 (TM). **Scheduled maintenance,** late release: This code is applied when scheduled maintenance takes longer than expected, and it delays the release of the aircraft.
43 (TN). **Non-scheduled maintenance,** special checks, and/or additional works beyond the normal maintenance schedule: This code is applied when unplanned maintenance, special checks, or additional works are required to be able to allow an aircraft to be released for operation.
44 (TS). **Spares and maintenance equipment,** lack of or breakdown: This code is applied when spare parts or maintenance equipment are unavailable or defective, preventing from completion of the necessary repairs the aircraft needs.
45 (TA). **AOG Spares,** to be carried to another station: This code is applied when an aircraft requires maintenance to be cleared for departure, and the station lacks the necessary spare parts for repair. As a result, the part is transported to that station on another flight, causing a delay until the spare arrives, and maintenance is completed.

46 (TC). **Aircraft change,** for technical reasons: This code is applied when an aircraft change is necessary due to technical reasons in the original aircraft, making it unable to operate safely. This causes the transfer of passengers, baggage, and cargo to the aircraft.
47 (TL). **Stand-by aircraft,** lack of planned stand-by aircraft for technical reasons: This code is applied when the airline doesn't have a stand-by aircraft available due to technical problems, which results in a delay until an aircraft becomes available.
48 (TV). **Scheduled cabin configuration version adjustments:** This code is applied when the aircraft requires cabin reconfigurations, such as changes in the seat layout or modifications affecting passenger accommodations, leading to a delay.

2.1.3.4. Damage to aircraft & EDP Automated Equipment Failure

In the Standard IATA delay codes, the category of Damage to aircraft & EPD Automated Equipment Failure uses codes from 51 to 58 [7].

51 (DF). **Damage during flight operations,** bird or lightning strike, turbulence, heavy or overweight landing, collision during taxiing: This code is applied when an aircraft sustains damage during flight operations caused by external factors.
52 (DG). **Damage during ground operations,** collisions (other than during taxiing), loading or unloading damage, contamination, towing, extreme weather conditions: This code is applied when an aircraft sustains damage during ground operations.
55 (ED). **Departure control:** This code is applied when the departure control system malfunctions, affecting the check-in or boarding of the aircraft, causing a delay.
56 (EC). **Cargo preparation documentation:** This code is applied when there is incomplete or inaccurate cargo documentation, causing a delay.
57 (EF). **Flight plans**: This code is applied when there's a failure or malfunction in the flight plan system that prevents the submission or approval of the flight plan required for departure.
58 (EO). **Other automated systems:** This code is applied when there's a failure in any other system not listed in any other delay code that prevents the flight from operating on time.

2.1.3.1. Flight operations and crew-related

In the Standard IATA delay codes, the category of Flight Operations and crew-related uses codes range from 61 to 69 [7].

61 (FP). **Flight plan,** late completion, or change of flight documentation: This code is applied when there is a late completion, modification, or unavailability of flight documentation, which prevents departure clearance.
62 (FF). **Operational requirements,** fuel, load alteration: This code is applied when there are last-minute operational adjustments such as changes in the amount of fuel needed, payload redistribution, etc.

63 (FT). **Late crew boarding or departure procedures**, other than connection and standby (flight deck or entire crew): This code is applied when the flight crew, which can refer to the pilots or the entire crew, has not boarded the aircraft or completed the departure procedures for reasons other than flight connections or stand-by duty.
64 (FS). **Flight deck crew shortage,** sickness awaiting standby, flight time limitations, crew meals, valid visa, health documents, etc.: This code is applied when the flight deck crew is not on board on time due to sickness, standby availability, time limitations, etc.
65 (FR). **Flight deck crew special request,** not within operational requirements: This code is applied when the flight deck crew makes special requests about certain services that are not part of the operational requirements, meaning that the aircraft could depart without those services.
66 (FL). **Late cabin crew boarding or departure procedures,** other than connection or standby: This code is applied when the cabin crew has not boarded the aircraft or completed the departure procedures for other reason than flight connections or stand-by duties.
67 (FA). **Cabin crew shortage,** sickness awaiting standby, flight time limitations, crew meals, valid visa, health documents, etc.: This code is applied when the cabin crew is not on board on time due to sickness, standby availability, time limitations, etc.
68 (FA). **Cabin crew error or special request** not within operational requirements: This code is applied when cabin crew make special requests about certain services that are not part of the operational requirements, meaning that the aircraft could depart without those services.
69 (FB). **Captain's request for security check,** extraordinary: This code is applied when there is an extraordinary security check requested by the captain that is beyond the standard procedures, such as baggage re-screening.

2.1.4. External Delays

2.1.4.1. Weather

In the Standard IATA delay codes, the category of Weather uses codes from 71 to 77 [7].

71 (WO). **Departure Station:** This code is applied when there are adverse weather conditions at the departure station, such as visibility, winds, or thunderstorms that prevent aircraft movements.
72 (WT). **Destination station:** This code is applied when there are adverse weather conditions at the departure station, such as visibility, winds, or thunderstorms that prevent a safe landing.
73 (WR). **En route or alternate:** This code is applied when the weather conditions throughout the route or at an alternate airport affect flight planning or air traffic control clearances.
75 (WI). **De-icing of aircraft,** removal of ice and or snow, frost prevention, excluding unserviceability of equipment**:** This code is applied when the de-icing process causes a delay. This process includes the removal of snow, frost, or ice from the aircraft and the application of anti-icing fluids. If the delay is caused by the failure of any of the equipment, this delay code is not applied.
76 (WS). **Removal of snow, ice, water, and sand from airport:** This code is applied when, due to weather, the airport has to remove snow, ice, water, or sand from certain surfaces, such as runways, taxiways, and aprons. This removal delays the aircraft's movements, which causes a delay.
77 (WG) **Ground handling impaired by adverse weather conditions:** This code is when ground handling activities cannot be done due to adverse weather such as lightning, strong winds, or heavy snowfall, that may compromise the safety of the personnel.

2.1.4.2. Air Traffic Flow Management Restrictions

In the Standard IATA delay codes, the category of Air Traffic Flow Management Restrictions uses codes from 81 to 84 [7].

81 (AT). **ATFM due to ATC en-route demand capacity**, standard demand capacity problems: This code is applied when there are restrictions applied due to high airspace congestion, where the number of aircraft exceeds the available ATC capacity in a specific airspace sector.
82 (AX). **ATFM due to ATC staff equipment en-route,** reduced capacity caused by industrial action or staff shortage, equipment failure, military exercise, or extraordinary demand due to capacity reduction in neighboring area: This code is applied when the en-route ATC capacity is reduced due to industrial action, staff shortages, equipment failures, military exercises or increased demand due to neighboring airspace restrictions.
83 (AE). **ATFM due to restriction at destination airport**, airport and or runway closed due to obstruction, industrial action, staff shortage, political unrest, noise abatement, night

curfew, special flight: This code is applied when a departure is delayed due to restrictions at the destination airport, such as runway closures, obstructions, staff shortages, industrial action, political unrest, noise abatement measures, night curfews, or special flight operations impacting arrivals.
84 (AW). **ATFM due to weather at destination:** This code is applied when the number of arrivals is limited due to adverse weather conditions at the destination airport. The weather conditions include fog, thunderstorms, strong winds, or poor visibility.

2.1.4.3. Airport and Government Authorities

In the Standard IATA delay codes, the category of Airport and Government Authorities uses codes from 85 to 89 [7].

85 (AS). **Mandatory security:** This code is applied when there are mandatory security procedures done, such as additional baggage or passenger screening, or aircraft security searches imposed by an authority.
86 (AG). **Immigration, customs, health:** This code is applied when there are immigration, customs, or health-related procedures. These procedures include passport control congestion, customs inspections, or health screening mandated by local or international regulations.
87 (AF). **Airport facilities,** parking stands, ramp congestion, lightning, building, gate limitations, etc: This code is applied when there are operational delays due to airport facilities. This includes the late connection or disconnection of a jet bridge, when there are no parking stands available, there is ramp congestion, etc.
88 (AD). **Restrictions at airport of destination**, airport, and or runway closed due to obstruction, industrial action, staff shortage, political unrest, noise abatement, night curfew, special flights: This code is applied when there's an operational delay due to restrictions at the destination airport, such as runway closures, obstructions, staff shortages, industrial action, political unrest, noise abatement measures, night curfews, or special flight operations impacting landing availability.
89 (AM). **Restrictions at airport of departure with or without ATFM restrictions,** including Air Traffic Services, start-up and pushback, airport and or runway closed due to obstruction or weather, industrial action, staff shortage, political unrest, noise abatement, night curfew, special flights: This code is applied when there are restrictions at the departure airport whether related to air traffic management (ATFM) limitation or other operational factors. This can happen due to congestion in the departure airspace, in taxiways, partially blocked taxiways, etc.

2.1.5. Reactionary delays

The delay codes mentioned above only refer to those caused by primary factors. However, when a flight departs late due to delays from its previous sector, reactionary delays, the applicable delay codes are from 91 to 96 [7].

91 (RL). **Load connection,** awaiting load from another flight: This code is applied when an aircraft is waiting for cargo, mail, or baggage from a connecting flight that has arrived late.
92 (RT). **Through check-in error,** passenger and baggage: This code is applied when an error occurs in a passenger or baggage transfer for a connecting itinerary. This includes missing baggage, miscommunication between connecting flights, or incorrect passenger records.
93 (RA). **Aircraft rotation,** late arrival of aircraft from another flight or previous sector: This code is applied when the aircraft assigned to operate the flight arrives late from a previous flight. As a result, the scheduled departure is delayed, impacting the next flights.
94 (RS). **Cabin crew rotation,** awaiting cabin crew from another flight: This code is applied when flight attendants are on a delayed inbound flight, preventing them from being able to be on time for boarding and departure of their next scheduled flight.
95 (RC). **Crew rotation,** awaiting crew from another flight (flight deck or entire crew): This code is applied when the flight deck crew or the entire crew is on a delayed inbound flight, preventing them from being able to be on time for boarding and departure of their next scheduled flight.
96 (RO). **Operations control,** re-routing, diversion, consolidation, aircraft change for reasons other than technical: This code is applied when the airline's operation control center makes adjustments such as re-routing or diversion for reasons unrelated to technical issues. This includes crew duty limitations, schedule optimization, or unexpected operational constraints.

2.2. Impact of delays on passengers and airlines

2.2.1. Introduction

2.2.1.1. Definition of impact

In this context, the word impact refers to how passengers are affected when a flight doesn't depart on time or arrive as expected. This can involve emotional distress, financial losses, physical discomfort, and trust issues between the passengers and the airline. The severity of the impacts can vary based on how long the delay lasts, what passengers anticipate, and the assistance and information they receive from the airline [8]. It also refers to the impact it has on an airline, which usually involves financial losses.

2.2.1.2. Importance of studying passenger reactions to delays

Researching the passengers' reactions when there are delays is essential for airlines to be able to improve customer satisfaction and operational efficiency. Understanding how the passenger feels in this type of situation can guide an airline to develop more efficient communication procedures and improve logistical strategies to handle disruptions [9]. It also enables airlines to offer more empathetic announcements and solutions to reduce dissatisfaction and frustration felt throughout the delay.

2.2.2. Psychological and emotional impacts

Delays have both psychological and emotional impacts on passengers, from frustration to anxiety and stress. When passengers have to wait for an extended period of time, they are likely to feel stressed, especially if they are waiting for an urgent travel, such as for work, medical appointments, or family emergencies [10].

Passengers can experience various emotional responses based on the length of the delay. Whereas short delays tend to lead to irritability and impatience, longer delays may lead to anxiety, frustration, increased fatigue, and ultimately anger [11]. If passengers experience frequent flight delays, it can develop negative associations with air travel as a mode of transport and has the potential to negatively impact their future airline bookings or overall trust in the reliability of the airline [12]. Vulnerable passenger groups, especially people with disabilities, older people, or families travelling with small children, may experience higher levels of emotional distress in delays if the delay adds logistical problems to manage [10].

Delays can also affect social interaction for passengers. Air travel occurs in crowded environments where there tends to be limited seating space. When faced with a situation where it's crowded and there's limited seating availability, it can create higher tensions for passengers who are waiting, and this can lead to arguments between other waiting passengers or frustration with the airline's employees, resulting in conflicts [11].

2.2.3. Financial impacts

Flight delays have various financial impacts that affect both passengers and the airline.

2.2.3.1. Passengers

Flight delays can cause an unexpected economic impact on travelers. The most immediate and common cost and consequence of a delayed flight is the risk of missing a connecting flight, especially when schedules involve short layovers. Depending on the cause of the delay, the passenger will have to cover the cost of purchasing an additional ticket to reach their destination.

In addition to a missed connection, delays can also have other unexpected economic impacts. If the delay involves a long layover or an overnight stay, the passenger might need to reserve and pay for accommodation, meals, and other transportation from and to the airport. This type of expense can vary depending on where they are delayed and for how long. It can also cause indirect financial losses, which include losing prepaid reservations for car rentals, tours, or accommodations at the destination.

Depending on the reason for travel, the type of financial impact can vary. For example, for business travelers, the financial consequences can come from missed meetings, lost productivity, or having to reschedule appointments.

2.2.3.2. Airlines

Flight delays can also have financial impacts on airlines, both directly and indirectly. Delays can increase direct costs due to additional fuel consumption during engine idling or taxiing, and overtime pay for crew and ground staff that may be required to remain on duty longer than planned. It also extends the aircraft occupancy at gates, which may delay other departures.

Departure delays can lead to airlines having to compensate their passengers. EU Regulation 261/2004 [13] is a European Union law that establishes the compensation and assistance that passengers can receive in case of a flight delay, cancellation, or denied boarding in case of overbooking. It applies to all flights departing from an EU airport, regardless of the airline, and to flights arriving in the EU operated by an EU airline. This law can be applied when a flight is delayed:

1. For two hours or more if the flight is 1500 kilometers or less

2. For three hours, in case of intra-Community flights of more than 1500 kilometers and all flights between 1500 and 3500 kilometers

3. For four hours, if the flight it’s not included in any of the other two options (1,2)

In this case, the airline has to provide meals and refreshments, two free communications, hotel accommodation if an overnight stay is required, and transport between the airport and accommodation. The passenger is entitled to financial compensation if the flight arrives at the final destination more than 3 hours late.
The airline is exempt from paying this compensation when the delay is caused by factors beyond its control, such as severe weather, political instability, security risk, air traffic management decisions, etc.

Delays can also have an indirect impact on costs if the aircraft and crew are delayed longer than anticipated. A delay can limit the airline's capacity to operate the next scheduled flights, which can reduce the aircraft utilization rate and cause cancellations and additional delays of other flights.
Another impact of being delayed longer than anticipated is when the crew exceeds their maximum allowable duty periods, known as FDP, which can lead to the activation of a standby. If the delay takes place outside of the crew base, the airline will be responsible for covering the crew's expenses, such as hotel accommodation, meals, and transportation, until they get the mandatory rest to be able to operate again.

2.3. Delays announcements and limitations

2.3.1. Objectives of delay communication

Communicating flight delays effectively is important to keep passengers informed about the situation and the impacts of the delays. Flight delays rank among the top complaints from customers to airlines [14]. As a passenger, when a delay occurs, there are various questions that arise, which are expected to be answered by the airline. The objective of delay communication is to answer these questions by providing accurate information on time, explaining the reason behind the delay, the estimated time of departure, and any other relevant information. By communicating the situation, an airline can not only lessen frustration, but they can also maintain trust. Understanding that delays are inevitable in travel helps the acceptance process when the passenger feels informed or at least knows what the situation is, so they are not left wondering what is going on.

2.3.2. Procedures

To be able to better understand how airlines communicate flight delays, an interview was conducted with the Customer Operations Lead at Vueling Airlines (full interview in Annexes). This perspective aims to understand the factors associated with airlines and the complexities faced when trying to be clear and accurate during delays.

2.3.2.1. Airline protocols

Airlines have their protocols to give passengers information about delays on time, while also trying to manage the airline's operations. As soon as a delay is confirmed, the airline will communicate with its passengers about the delay through multiple channels: app notifications and emails. The main goal of these communications is to keep a balance between informing the passenger and communicating reliable information.

An important part of this communication is ensuring the accuracy of the message sent. Before making any type of public announcement, the airline will check with the operations control center to verify accuracy and to avoid misinformation. Airlines in general are required to follow aviation regulations; for example, EU Regulation 261/2004, previously mentioned, provides passenger rights to compensation and assistance. For longer delays, various departments of the airline work together to ensure frequent updates and assistance for any claims or questions.

2.3.2.2. Timing and frequency

One of the challenges with delay communication is how often updates are given to passengers. Passengers often complain about not receiving any or enough information when delays are prolonged. The airline wants to update passengers as often as possible, but there are no preset timelines for updates, as it relies on live information to advise passengers of the estimated time of departure.

The airline will inform passengers when there are changes in the estimated time of departure or other operational updates. Changes may come suddenly, like when an

aircraft is ready to depart sooner than it was anticipated. In this case, a notification will be sent out through every possible channel to inform passengers, and the airline will notify ground operations to proceed to boarding as soon as they can. Customer service also works with the flight crew to ensure that the information provided to the passengers, in case of a boarded flight, is consistent.

2.3.2.3. Content

Maintaining a balance between transparency and reassurance is important when communicating delays. The airline wants to provide passengers with clear information regarding the delay and give honest explanations of the reason for the delay, without using too much technical language that may cause confusion or alarm. Usually, it provides reasons that are general, like adverse weather situations, air traffic control restrictions, or technical maintenance, instead of specific, complex reasons. This way, the passenger still understands the reason for the delay without getting into details that may confuse them.

2.3.3. Limitations

Airlines face various limitations when providing information efficiently and accurately. One of the first challenges is operational uncertainties, since it's difficult to estimate an exact departure time when operational challenges and changes can happen suddenly. This requires airlines to update the message sent out based on new information (e.g., new airspace restrictions, maintenance issues, etc.).

Another limitation can be the passenger expectations associated with the delay announcement. While airlines try to communicate situations with transparency, with the intention to provide the best possible information, it's also important to maintain a calm environment. This can cause passengers to feel like they are not getting enough information or updates on the delay from the airline, which can cause frustration and worry.

3. Practical Framework

3.1. Selection of delays to develop

When designing and creating video content to easily communicate flight delays to passengers, it is necessary to consider which causes and scenarios will be represented and how. The objective is not only to inform but also to make sure the passenger fully understands the situation by simplifying all the aviation concepts that are involved in the delays. Due to the large number of potential causes of flight delays, this project is restricted to the three most common and significant situations.

3.1.1. Criteria and selection

Several criteria guided the selection of delays to ensure that the videos are relevant and useful. This selection follows two criteria: frequency, referring to how often a particular cause of delay happens in Europe, and relevance, referring to the impact it has on the entire operation.

In this case, the delays chosen are airline-related and ATFM En-Route delays due to the high frequency with which they occur, and weather-related.

Although airport-related delays rank as the third most common cause of flight delay in Europe in 2024 [15], weather-related delays have a more significant impact on air traffic management, handling services, and flight operations overall. It affects not only flights departing or arriving at a single location, as it does with airport-related delays, but also multiple airspaces and routes. This means that the flights affected are not only those departing and arriving at a certain airport, but also those going through those airspaces or routes.

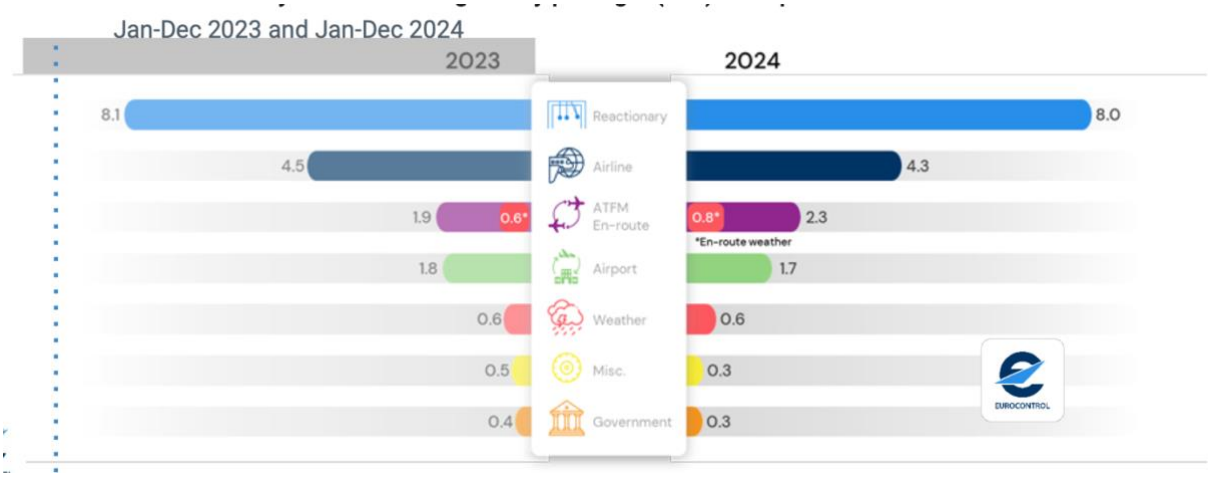


Figure 2: Average delay per flight (min) on departure [18]

3.1.1.1. Airline

Airline-related delays are those that are attributed to the airline's operations. This type of delay can be due to passengers and their baggage, handling, fuel, catering, technical maintenance, aircraft defects, or crew, among other reasons [16].

Passenger and baggage handling are a common source of airline delay, which include disruptions or delays in check-in procedures, incorrect baggage routing, extended boarding time due to the type of passengers (reduced mobility, a large group of old people, etc.), or having to unload a baggage from a passenger that is denied boarding due to disruptive behavior, late arrival to gate, etc.

Ground operations are also another source of airline delays due to their importance in the turnaround process. If any part of this process is done inefficiently, it can lead to large delays. These operations include fueling, catering, or cleaning services, loading and unloading an aircraft, pushback, and buses, etc. Although these types of services are usually provided by external companies, the responsibility for any resulting delay lies within the airline [7,17].

To prevent fatigue-related risks, a flight crew has a maximum working time regulated by legislation [18,19]. If a crew exceeds the maximum working hours established due to previous flight delays or extended hours, the airline is responsible for arranging replacements and activating standbys. This replacement can take time, which can cause delays on the affected flights and the following flights.

Among the most critical airline-related delays are those associated with technical maintenance and aircraft defects [18]. Any unexpected technical failures, such as engine issues, hydraulic systems malfunctions, or avionics defects, usually need immediate action, repair, and safety inspections before departure, since it can affect the aircraft's airworthiness and operational safety. Aviation regulations state the strict necessity to comply with safety protocols [20], and any identified issue requires evaluation and immediate action. When this type of problem occurs, the airline maintenance departments have to perform a detailed diagnostic to determine the extent of the issue and the possible repair. Depending on the issue, repairs can go from simple actions that require less time, to more complex actions that require additional engineers or mechanics, and additional repairing time. Once repairs are done, the aircraft has to undergo safety inspections to make sure all systems are working as expected.

3.1.1.2. ATFM En-Route

A delay due to air traffic congestion occurs when the number of scheduled flights exceeds the capacity of the various airspaces along the planned flight route. When the airspace is congested, flights are delayed by ATC to regulate the flow of aircraft and avoid overcrowding specific sectors, as well as making sure that all flights are keeping safe distances. However, from the passenger's perspective, this kind of delay can be confusing since the plane is at the gate, boarding is completed, and everything appears ready for departure, yet the flight is delayed. Not being able to see the coordination happening between ATC and the aircraft in the airspace can make the delay seem unjustified. According to Eurocontrol reports, the ATFM En-Route category represents an average delay of 2.3 minutes per flight in Europe throughout 2024 [15]. As shown in Figure 12, this category is divided into four subcategories: capacity/staffing, weather, disruptions, and others.

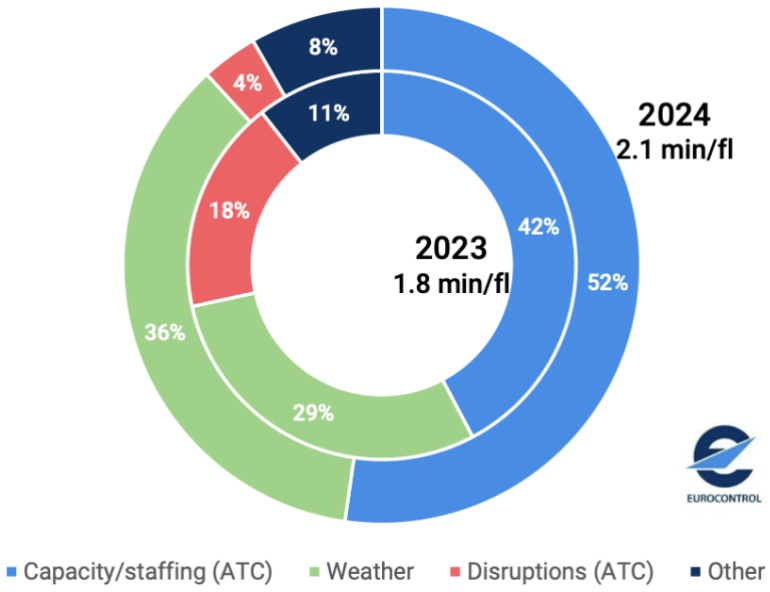


Figure 3: Share of En-Route delays (% of minutes) [15]

Capacity/staffing: Refers to delays caused by airspace or airport restrictions and staffing shortages. An example would be when there are not enough air traffic controllers to manage the flow of aircraft, or if an airport reaches its maximum operational capacity. It can also be due to the capacity difference between airspaces. This type of delay tends to be due to infrastructure constraints or temporary staffing issues [21]

Weather: Refers when adverse weather conditions, like thunderstorms, fog, or strong winds, impact flight operations within controlled airspace sectors. These weather conditions can cause poor visibility, turbulence, or rerouting of aircraft to avoid the most affected areas, which causes a reduction of airspace capacity. During these adverse

weather conditions, air traffic controllers reroute flights or decrease the number of aircraft in impacted sectors for safety purposes [20].

Disruptions: Refers to unexpected events that affect flight operations and cause significant delays. This subcategory can be a result of various causes, such as air traffic controllers' strikes or technical failures in air traffic management systems. A strike affects flight operations because there are fewer controllers available, and that can result in a reduction in airspace capacity. Technical failures in air traffic management systems affect flight operations since, if there's a failure in radars or in communication, it can disrupt coordination between flights.

3.1.1.1. Weather

Weather-related delays occur when there are adverse meteorological conditions that have an impact on flight operations and safety. This type of delay can affect either airports or, as mentioned in the ATFM En-route section, controlled airspaces sectors. These weather conditions include thunderstorms and lightning, winds, heavy snow and ice, fog, and low visibility. There are other weather conditions that are less common but are more severe, which include volcanic ash clouds and hurricanes, and tropical storms.

Thunderstorms and lightning can create wind shear and high turbulence, which can lead to pilots taking alternative routes to avoid the areas affected [22]. Wind shear, crosswinds, and tailwinds can affect the departure or arrival of an aircraft at an airport since they affect the ability to land or take off. It can also shift the aircraft's intended path and trajectory [23].

Fog and low visibility can affect aircraft performance during the cruise and approach phases. Low visibility can lead to an increase in the separation requirements between aircraft, which can lead to a decrease in the number of flights allowed in congested airspace sectors. Airports use Runway Visual Range to measure the level of visibility. If the visibility is too low, ATC can activate LVPS, which are procedures activated to ensure safety during LVOs [24]. These procedures include decreasing the number of aircraft allowed to take off and land. It can also affect the landing or takeoff itself. Additionally, heavy snow and ice can lead to the accumulation of ice on critical flight surfaces, which is why aircraft and airports are equipped with anti-icing and de-icing systems. These procedures can lead to delays, since they take time.

3.2. Introduction to Synthesia

The visual representation part of this project will be carried out using an AI video generator platform: Synthesia.

Figure 4: Synthesia Logo

3.2.1. What is Synthesia?

Synthesia is a tool that uses AI to enable users to create videos using their virtual avatars and AI-generated voiceovers. Instead of relying on real actors, it uses AI technology and real people's images to build a human-like avatar [25].

This tool provides a variety of realistic avatars that can be used as video presenters. These avatars are developed using advanced AI modeling methods [26] that replicate human facial expressions, body language, and speech. It also offers personalized voiceovers with a range of voices and languages, which ensures accessibility to a global audience. Synthesia uses text-to-speech with the help of NLP (Natural Language Processing) and TTS (AI text-to-speech) [27], which generates speech that sounds very similar to a human, making it difficult to differentiate it from a real voice.
The website has been designed in a way that doesn't require any prior video editing experience. Users type a script, choose an avatar, and the AI generates the video with those inputs.

3.2.2. Why use Synthesia?

Synthesia has several advantages over traditional video productions. One of the reasons for opting to use AI-generated videos is the ability to produce high-quality visual representations that are less expensive. This is because conventional video production involves hiring actors, renting locations, filming equipment, as well as an extensive post-production editing effort, which can be expensive. AI-generated video platforms eliminate most of these logistical challenges while maintaining a professional appearance and minimizing resources [28,29]. Moreover, producing a traditional video not only has an elevated cost but can also be time-consuming; it can take weeks or months, from scripting and filming to editing the video to finish it [30]. AI-generated videos, like Synthesia, simplify the entire process and allow users to create a video by simply writing a script and selecting an avatar. With these two inputs, the software can generate a complete video in a matter of minutes.

In this project, the aim of the videos that are going to be created is to help passengers understand the situation they find themselves in. The number of possible scenarios that can happen is endless and often unpredictable, but they all result from a delay. Since the reason for these delays can vary widely, from weather disruptions to technical issues, it

is important to use a platform that allows users to create videos with a consistent look and tone while also making it easy to apply changes to adjust to the specific details of each delay. Synthesia allows this by simply changing the script written, unlike traditional filming, where changing a video is far more complex and time-consuming.

But besides the need for flexibility, the platform used needs to allow users to create videos that can reach the passenger in a language that is easy to understand. Given how global air travel is, the passengers affected by these delays come from different linguistic backgrounds. Synthesia has over 140 languages [31] available, which enables the airline to create a voiceover in multiple languages and accents without the need for multilingual speakers. This not only improves clarity but also reinforces customer trust in stressful situations such as flight delays.

3.2.3. How does Synthesia work?

Creating a video with Synthesia is a simple process, designed to be accessible to users of any skill level:

1. Log in: The very first step to be able to create a video with Synthesia is to access the website of the platform: https://www.synthesia.io/. Once on the website, the user can either register for the first time or log in using their account.

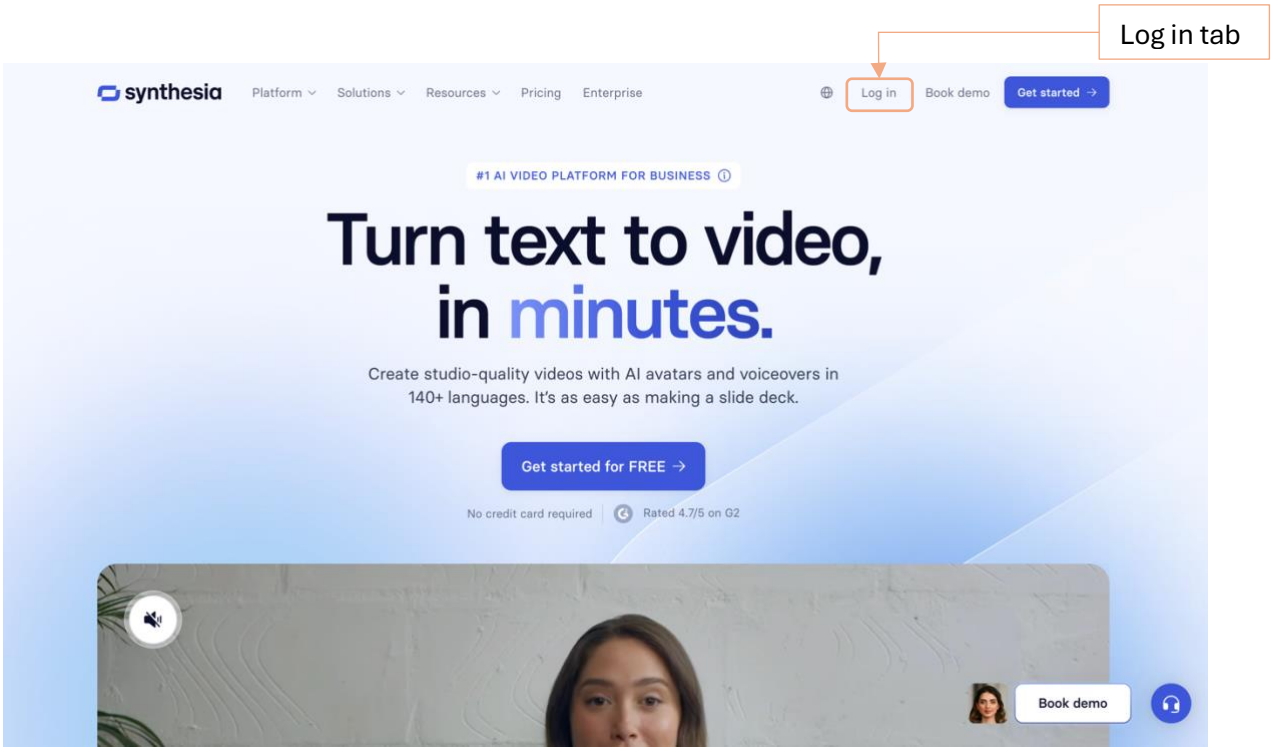


Figure 5: Screenshot of Synthesia main page [25]

2. Starting a new video: Once logged in or registered, the website will redirect the user to their account dashboard. From this dashboard, the option “New video” will have to be selected. The user can choose between starting from scratch or using a template.

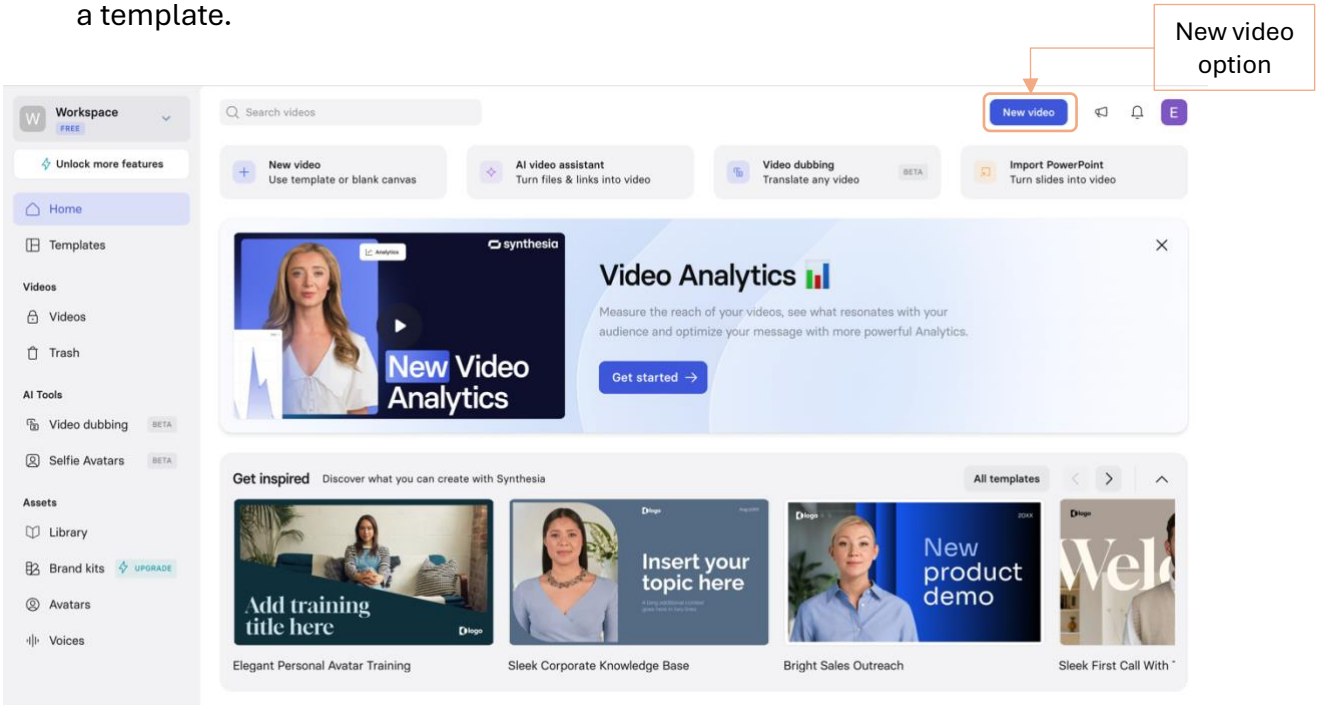


Figure 6: Screenshot of Synthesia dashboard

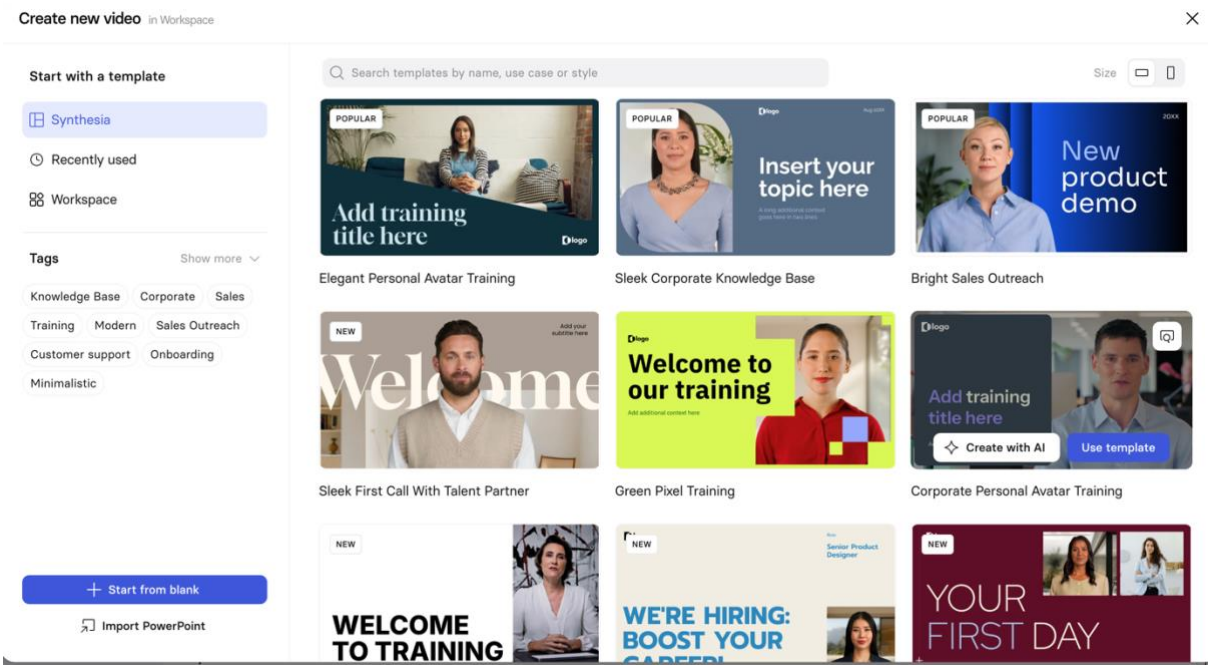


Figure 7: Screenshot of Template options

3. Writing a script and adjusting the tone: The user will have to input the script, which will be converted into an AI-generated speech. In this setting, the user will be able to choose from multiple languages and adjust the tone and pronunciation of the speech.

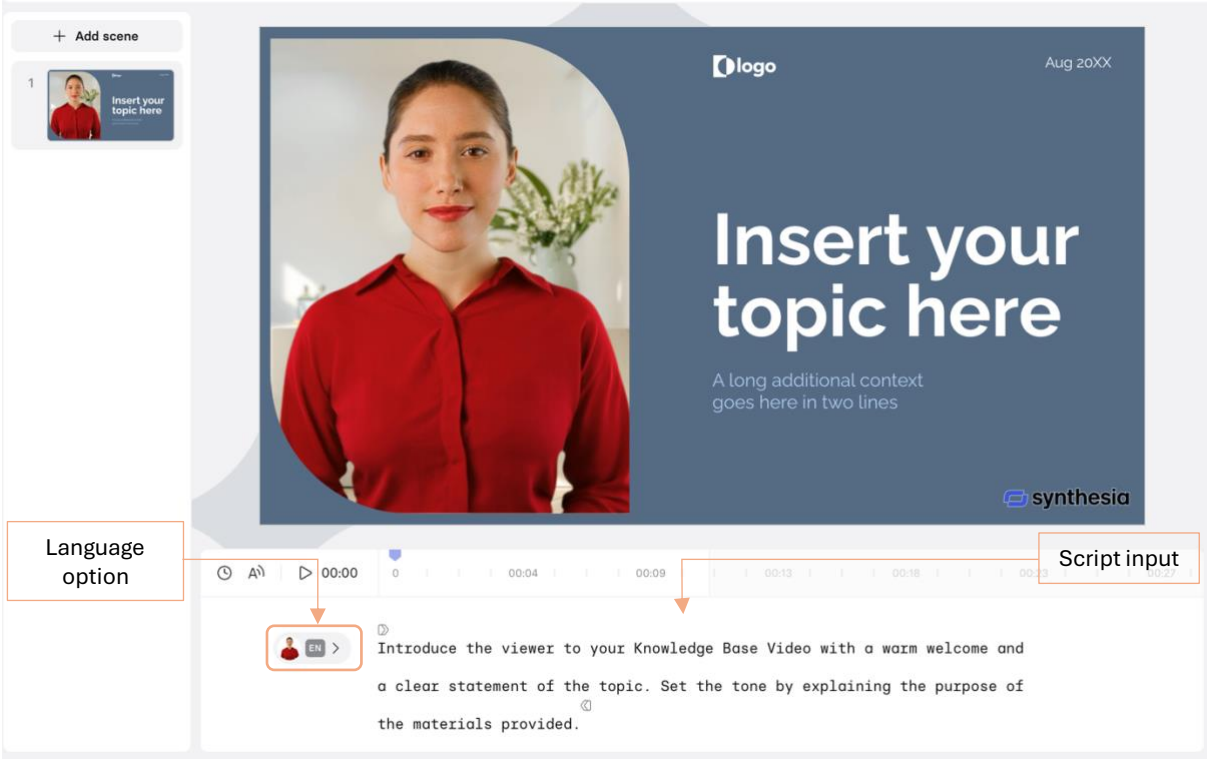


Figure 8: Screenshot of the video editor screen

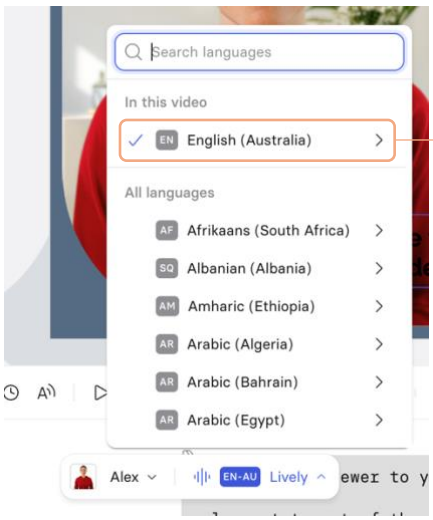


Figure 9: Screenshot of the languages available

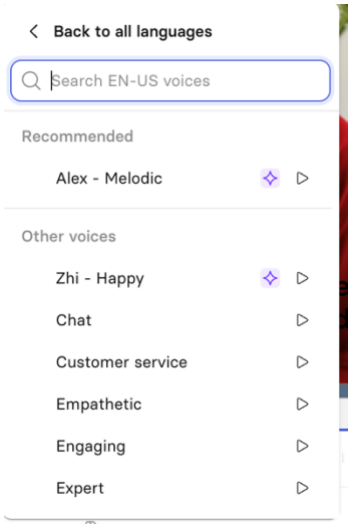


Figure 10: Screenshot of the tones available in that language

4. Select an avatar: Once the script is written, the user will be able to choose an avatar from the extended library to serve as a video speaker as well as make adjustments to the positioning and expressions.

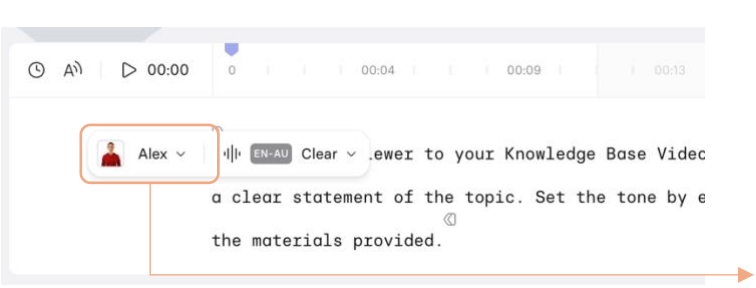


Figure 11: Screenshot of the library of available avatars

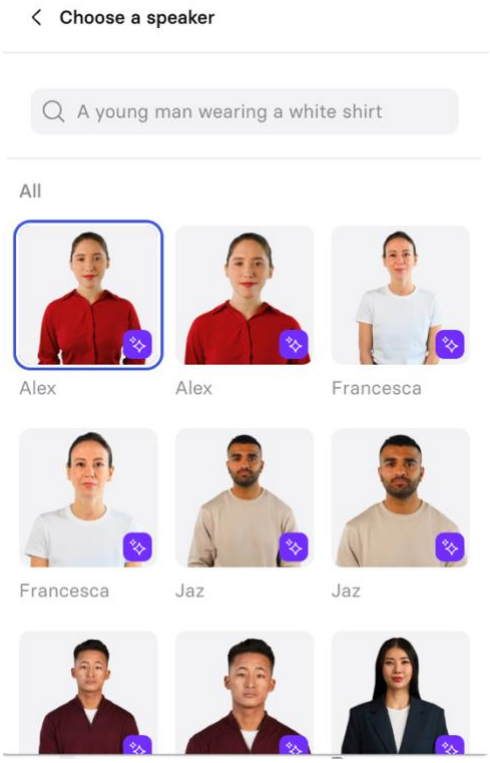


Figure 12: Screenshot of the available avatars

5. Customize the video: The user can add background, images, animations, captions, and music, as well as the company logo, to reinforce the message.

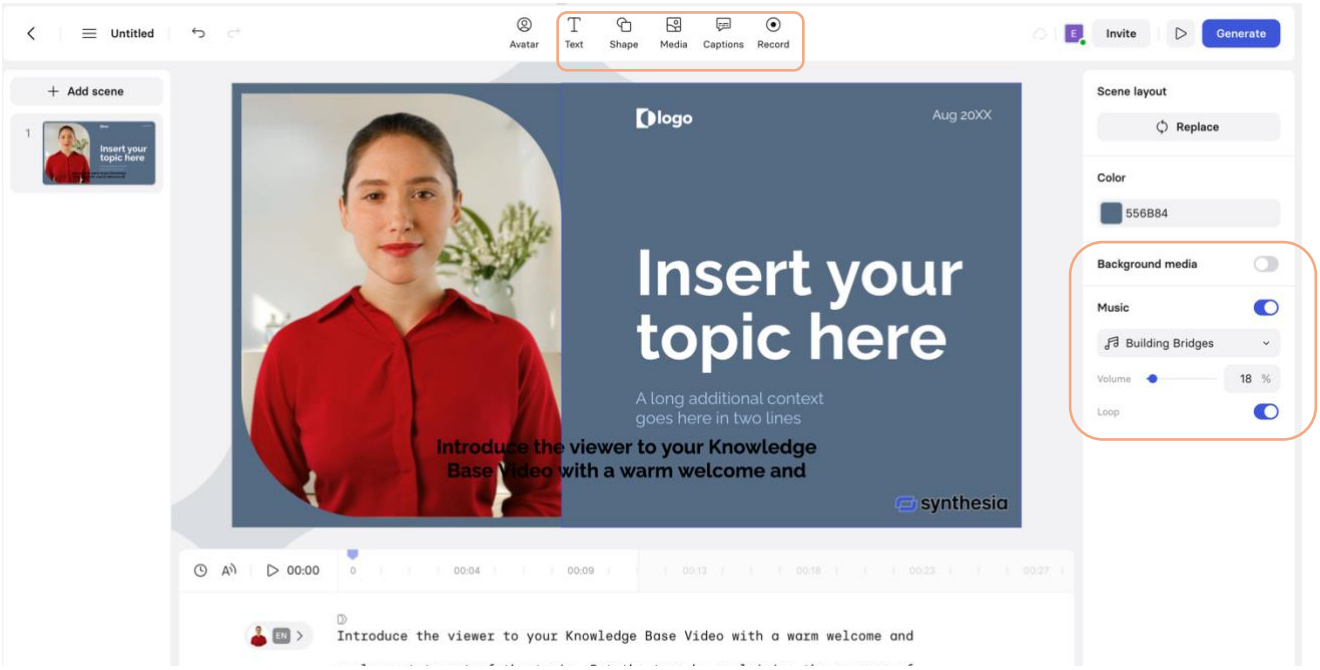


Figure 13: Screenshot of the customizing options

3.3. Video creation

Flight delays can be frustrating, especially when passengers feel they haven't received enough information and don't fully understand the situation. The videos aim to visually represent to passengers, through animated video, what is causing the delay and provide some understanding of how it happens. Designed to bridge the gap between technical processes and passenger awareness, they enhance transparency and improve communication. By simplifying complex aviation concepts and representing them through spoken explanations and visual representations, the videos try to offer a more engaging way for passengers to understand why delays occur and how they unfold.

3.3.1. Airline delays

Airlines delays are one of the leading causes of delays in Europe [15], but inside of this category there are various reasons for delays. As mentioned before, the main airline-related delays are those caused by technical problems. These types of delays are difficult to explain due to the need to balance informing passengers about the situation and keeping a calm environment. It is important to keep transparency but explaining in great detail what is causing a technical delay to passengers right before they have to board that same aircraft might cause panic and lead to certain passengers feeling unsafe and deciding to not flight. For this reason, in this case, the video will be vaguer, giving enough information to the passengers to keep their frustration about the situation under control but without causing panic.

Link to video: https://share.synthesia.io/70704bb0-6bf9-4d2b-9487-665604a8f448

The first thing this video mentions is how safety checks, which are generally where technical problems are found, are a regular occurrence that happens on every flight; it's important to emphasize that it's a procedure that is not specific to this flight. Once the safety checks are introduced, the maintenance team is mentioned, who are responsible for making sure that every technical problem found is resolved. However, the video avoids going into detail about the responsibilities of this team and the nature of the maintenance activity. This was a deliberate choice to prevent any unnecessary concerns.

Rather than focusing on the technical problem itself, the entire video focuses on the airline's commitment to safety and preparation before departure to ensure a smooth and safe flight. This way it helps the passengers feel like every step is being taken care of, without overwhelming them with technical details right before boarding.

In this case, the role of visuals is minimal since the video focuses on delivering a calm message about technical delays rather than the step-by-step process of fixing technical problems.

3.3.2. ATFM en route video

Link to video: https://share.synthesia.io/5ea2d131-2f44-4d83-b7b5-a7af387407d1

As mentioned before, grasping the concept of air traffic congestion can be confusing, especially when that aircraft is already boarded. To help the passenger understand this concept, this video explains what ATFM stands for and what it is in simple terms: a system used to make sure the sky is safe and organized. Once the passengers know what ATFM stands for, the video explains how the sky is organized, how is a system of invisible highways inside airspaces and divided into sectors, and how these sectors are coordinated by ATC. To try and make this concept more approachable, there's a photo, obtained from ENAIRE, where these highways are represented.

Figure 14: Highways represented by ENAIRE [33].

In this case, the video focuses on when the delay happens due to not having enough operational capacity. To try and make understand the passenger the actual number of flights that are currently flying at the same time in the same sector and what this capacity looks like, a screenshot of flight radar on a random day, showing all the active flights in the sky at that time, is used.

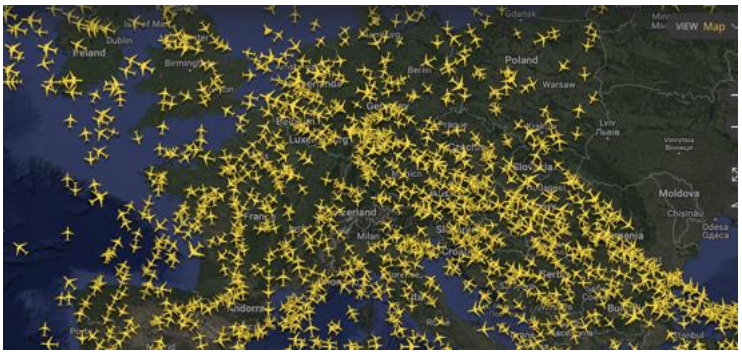


Figure 15: Screenshot of Flight Radar [34].

Once the passenger has knowledge of these concepts and how this problem has been created, the video explains how it's resolved and why it's affecting the flight. It mentions how to make sure that all flights maintain a safe distance from each other, ATC might ask some flight that are ready for departure to wait before taking off. It explains how it is required to reduce the risk of congestion and ensure that all flights are operated safely.

By explaining this delay with a representation of the airspace as if it were invisible highways and showing images, it helps ensure that passengers not only receive information about the delay, but also understand why it was necessary, which may result in feeling more informed and reassured.

3.3.3. Weather-related delays

Delays caused by weather are a big category, since there are a lot of conditions that can affect an aircraft, an airport, or an airspace. In this particular video, the scenario chosen is weather-related delays caused by fog and low visibility at the arrival airport. This type of condition is quite common yet typically misunderstood, especially when the weather conditions at the departure airport are clear.

Since fog and low visibility affect an airport's ability to manage landing safely and the pilot's ability to have a clear view of the runway to land safely, the aim of the video of is to help passengers understand how the conditions at the arrival airport play an important role in determining whether a flight can safely take off or not.

Link to video: https://share.synthesia.io/b024e851-ad2f-4303-abb5-b3f001dcd8d9

The first thing that the video mentions is how frustrating it can be to be delayed due to weather when the conditions at the departure airport seem normal and under control. It explains how important visibility is to be able to land an aircraft and how pilots rely on instruments as well as visual confirmations during the final approach to the runway. To make sure that the passengers fully grasp the concept, it includes a situation that can happen to them in real-life: having to park their car when there's fog.

Figure 17: Clear runway [35]

Figure 16: Foggy runway [36]

In this video, visuals of a runway in both situations, low visibility and clear conditions, are used to reinforce how important it is to be able to have visibility when landing. This way the passenger can see from a pilot's point of view how the runway looks and the difference

3.4. Analyzing survey results

3.4.1. Introduction

To measure the effects of this video, an online survey was created and shared to be able to analyze whether the video explanation effectively portrayed the causes of flight delay. The aim of the survey was to find out if the video helped passengers improve their understanding of delays.

3.4.1.1. Purpose

The main purpose of this survey was to evaluate how passengers from different backgrounds conceived the video as a delay communication. The survey sought to evaluate whether the video explanation was simplified and clear for all passengers, regardless of their flight frequency and age. It also evaluated if the visuals added to the video helped with understanding the delay better, what the overall thoughts and reactions to the video and approach it took compared to the usual delay explanation were, and if this would improve their experience as an affected passenger.

3.4.1.2. Methodology

The survey was conducted among passengers who had different flight habits and age ranges, and the responses were collected through an online survey made with Google Forms. It focused on getting information about the age range, flight frequency, and the main purpose of their flights to be able to identify if the information was comprehensible for any type of passenger. It was distributed through a Google Forms Link and shared through personal contacts, including friends, family members, and acquaintances. Due to the sharing method, this type of sample is a convenience sample [37] and therefore, dependent on access and willingness to participate. To be able to analyze the understanding of passengers and the effectiveness of the visual elements, there were three questions:

1. Did you understand the main reason for the delay explained in the video?
    a. Participants could answer “Yes,” “No,” or “More or less” to indicate their level of understanding.
2. How clear did you find the explanation?
    a. Responses were rated on a scale from 1 to 5, where 1 represented not clear at all, and 5 represented very clear.
3. Did the visuals in the video help you understand better the reason for delay?
    a. Participants could answer “Yes” or “No” to express whether the visual elements contributed to the understanding of the video.

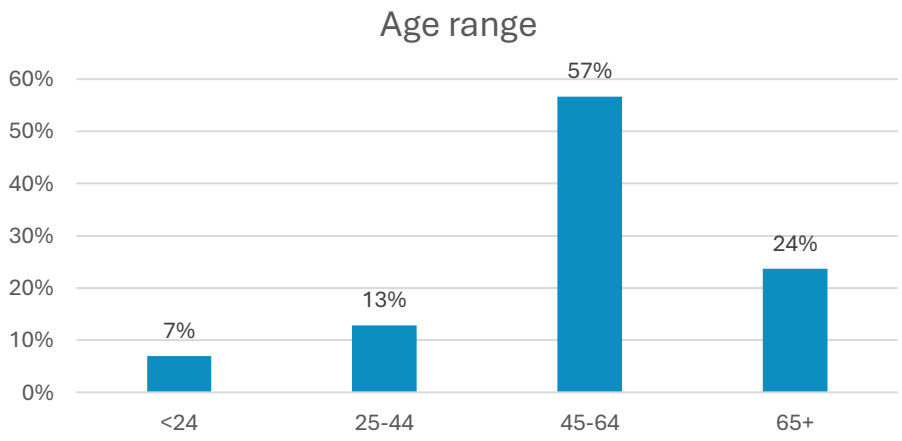
After assessing comprehension, the survey included an additional two questions to assess the effectiveness of video communication and obtain feedback from passengers:

1. Do you feel that using videos like this to explain delays would improve your experience as a passenger?
    a. Participants could answer “Yes” or “No” to express whether this method would be useful in a case of a flight delay
2. Do you think there is something that could make this video more helpful? If so, what would it be?
    a. Participants could select from four options:
        i. More visuals
        ii. Additional examples
        iii. Nothing, it was clear
        iv. Other: an open-ended option for passengers to provide additional suggestions

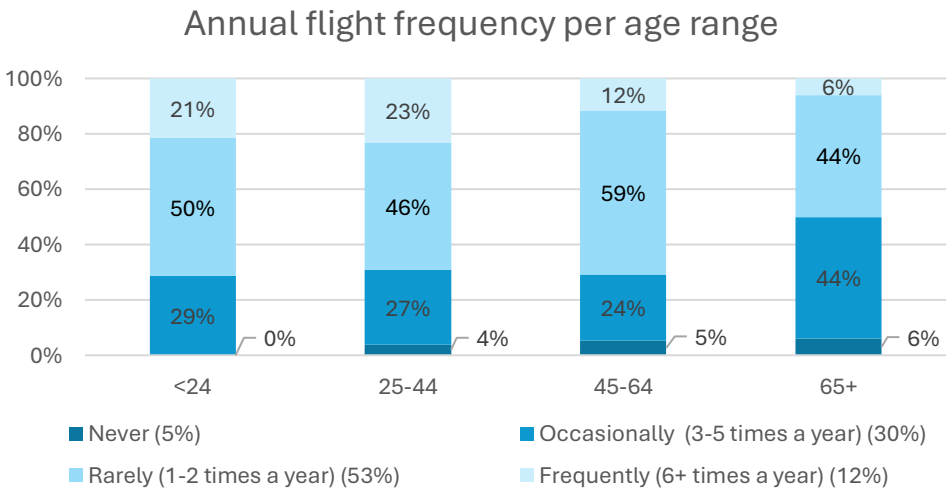
3.4.2. Results analysis

A total of **203** participants answered the survey. These responses offered a range of opinions about the effectiveness of the video and its perceived impact on the passenger's experience.

3.4.2.1. Flying habits



Graphic 1: Percentage of Participants in Each Age Group.



Graphic 2: Flight habits per age range.

Graphics 1 and 2provide an insight into the demographics and the flight habits of the answers provided. Graphic 1 displays the percentage of responses per age range and which groups participated the most. In this case, the age range with the significantly higher participation rate is between 45 and 64, representing 57% of all the answers.

Graphic 2 compares the annual frequency with the age range, providing a clearer way to see how often different age groups travel. In all age ranges, almost 50% of responders travel only once or twice a year, which is significant since infrequent passengers are likely to be less familiar with concepts related to aviation and airlines. As a result, they may be more dependent on clear and easy-to-understand explanations in the event of a delay or a disruption.

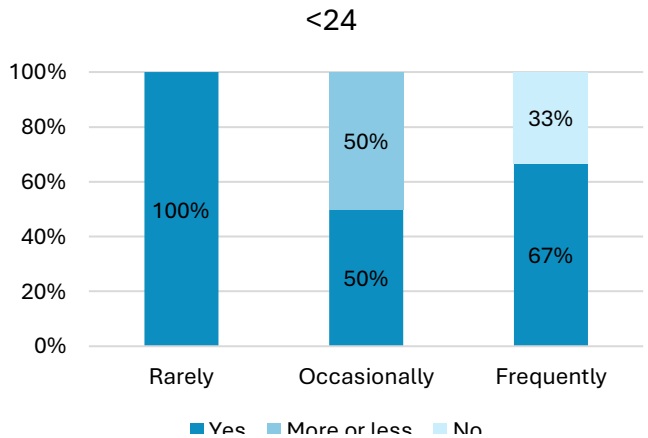
3.4.2.2. Understanding the explanation

The understanding rate is 92.6% across all age ranges and flight frequencies, which suggests that the delay explanation is clear and easy enough. However, 6.9% and 0.5% answered “More or less” and “No”, which suggests that while the explanations were generally effective, there may still be some aspects that were not fully clear and would not help every passenger. These aspects will be analyzed in the following sections.

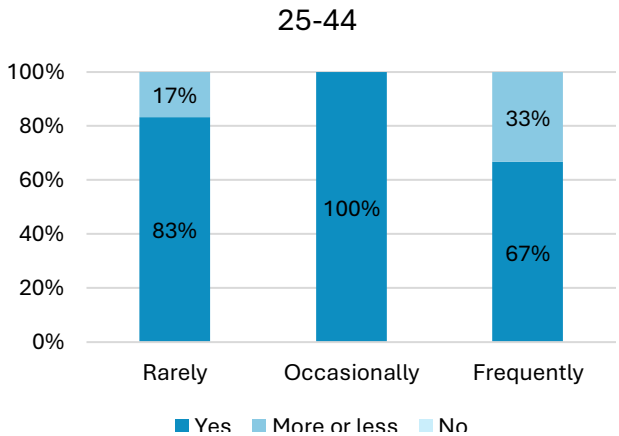
Graphics 3-6 represent the answer to the question mentioned before: Did you understand the main reason for the delay explained in the video?

The data obtained from the answers is segmented based on age range and flight frequency.

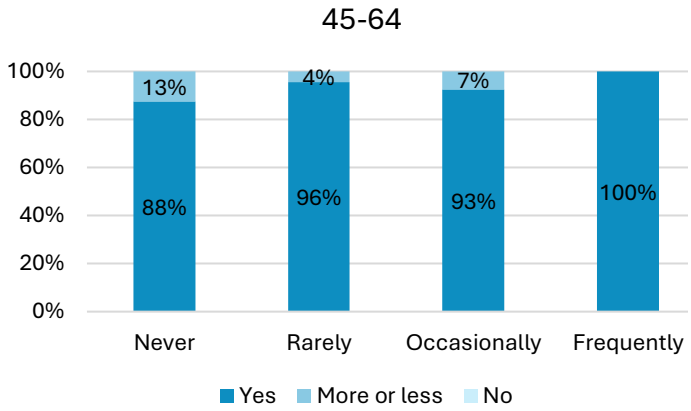
Those participants who are 45 or over showed the same level of comprehension regardless of how often they travelled. In contrast, younger participants showed a slightly lower level of comprehension, with only one person under the age of 24 who answered that they did not understand the explanation, and two others in the same age group who indicated “More or less”. Across all ranges, those participants who travel rarely tended to understand the explanation, suggesting that it was simple enough even for those travelers who might not be familiar with aviation concepts.



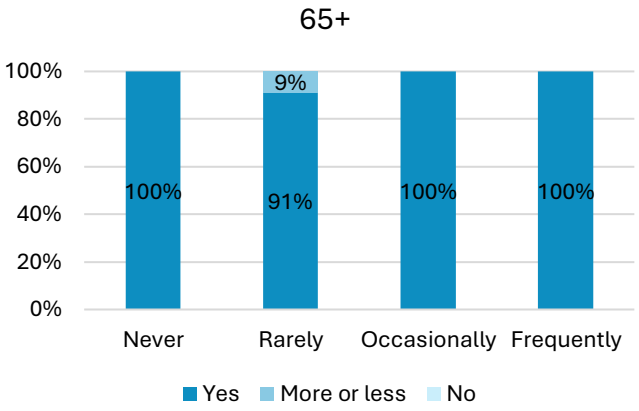
Graphic 3: Impact of Flight Frequency on Understanding for Respondents Aged Under 24.



Graphic 4: Impact of Flight Frequency on Understanding for Respondents Aged 25-44.

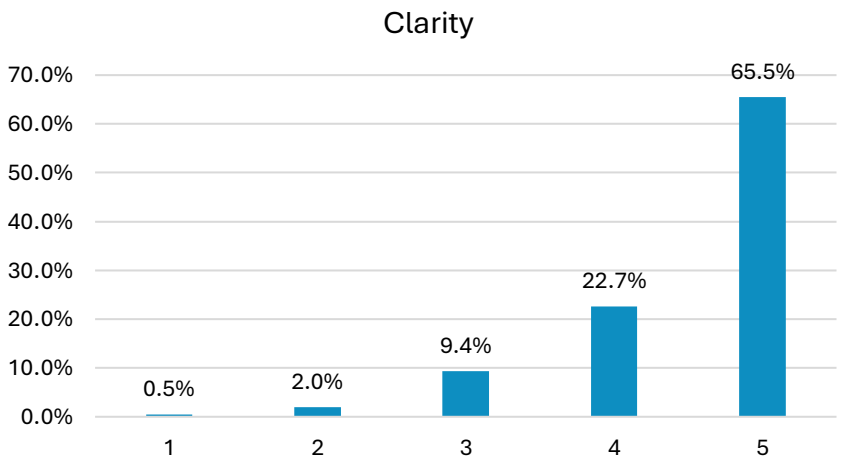


Graphic 5: Impact of Flight Frequency on Understanding for Respondents Aged 45-64.



Graphic 6: Impact of Flight Frequency on Understanding for Respondents Aged 65+.

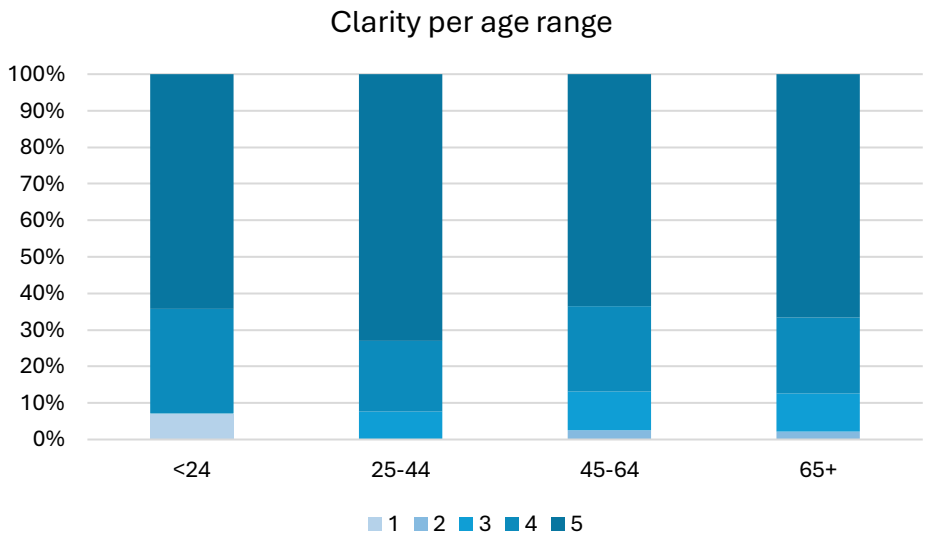
In the survey, participants were also asked to rate the clarity of the explanation in the video. The results show that 65.5% of participants rated the explanation as 5 (very clear), and 22.7% rated it as 4, indicating that nearly 90% of participants found it very clear or clear. This reinforces that the majority of the viewers not only understood the primary reason for the delay but also perceived it as effective and clear. However, a small percentage of responders did not find the explanation clear enough, with 9.4%, 2.0%, and 0.5% rating the explanation with a score of 3, 2, or 1, respectively. This is somehow consistent with the previous data, where 6.9% and 0.5% showed either no or minor understanding of the video. It also shows that while some participants understood the situation and the delay, they found that the explanation was not clear enough.



Graphic 7: The next graph shows the clarity segmented by age range.

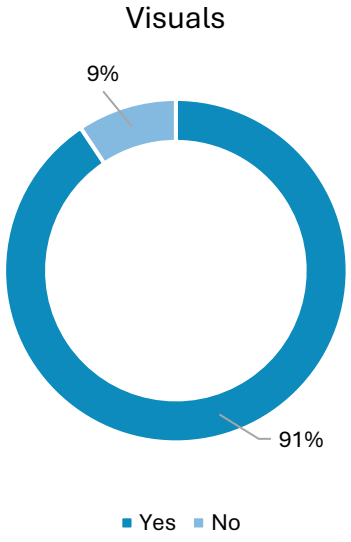
Graphic 8 shows the clarity segmented by age range. It shows that while those participants who were 45 or older had the highest understanding rate, which means that they understood the situation, over 10% of both age groups (45-64 and 65+) did not find the explanation clear enough (1,2,3). On the other hand, while the participants younger

than 24 had the lowest understanding rate, over 95% answered that they found the explanation very clear (5) or clear (4).



Graphic 8: The next graph shows the clarity segmented by age range.

This clarity and understanding of the explanation can be attributed, in part, to the visual elements that are in the video. This can be proven with graphic 9, where 91% of participants answered "Yes" to the question of whether the visuals helped them understand the delay.

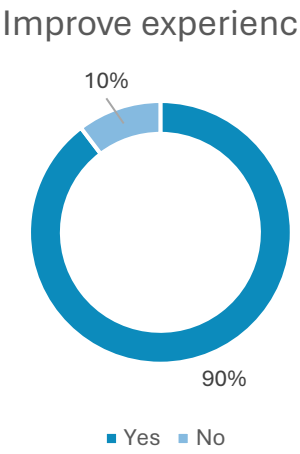


Graphic 9: Effectiveness of Visual Elements.

3.4.2.3. Feedback and improvements

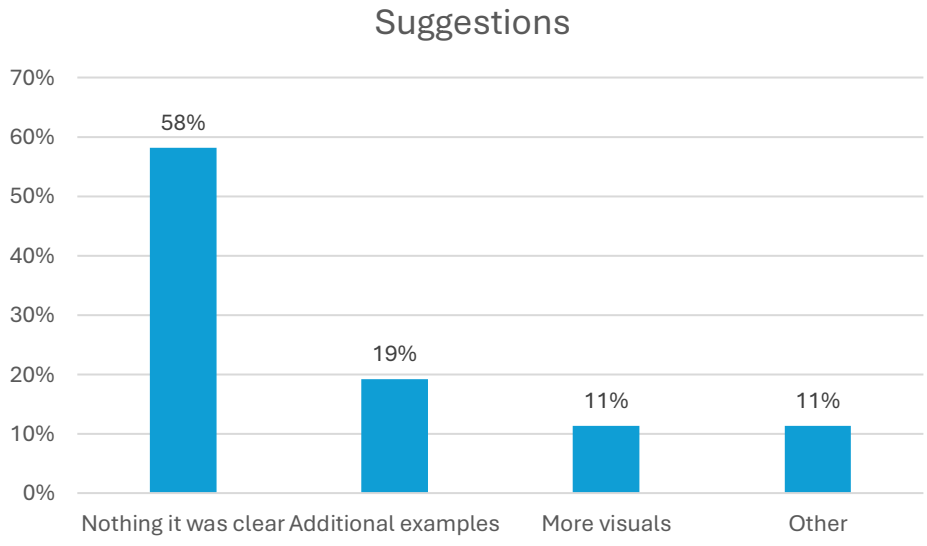
To be able to assess how this method would affect the experience as a passenger, the question asked was: Do you feel that using videos like this to explain delays would improve your experience as a passenger?

The response to this question indicates a strong positive reception to using these videos to communicate delays. Graphic 10 shows how 90% of the participants think that videos like the one shown would improve their experience as passengers. It reflects the effect of the way the delay is explained and delivered, and how it simplifies the complex concepts behind the delays.



Graphic 10: Perceived Impact of Video Explanations on Passenger Experience.

While 58% also stated that they wouldn't make any changes to improve the video, 42% did suggest possible improvements and enhancements. Of these, 19% suggested including more examples to reinforce the explanation, 11% suggested including additional visual elements, like illustrations or animations, and the remaining 11% chose the "Other" option, which was open-ended. In this last option, the majority provided detailed explanations on what visuals they would use to illustrate the explanation better, while others requested more information about the flight itself, such as the delay time.



Graphic 11: Participant Suggestions for Improving the Video.

3.4.3. Conclusions

The data gathered from the survey responses provide an overview of how passengers from different age ranges and flight habits perceived the delay explanation. The overall understanding rate is 92,6%, which suggests that the video conveyed the main message to participants who had different backgrounds and different knowledge. The level of comprehension was consistent across all age and flight frequency segments, even those infrequent passengers who are less likely to be familiar with the concepts and situation.

The very few cases in which participants indicated partial or no understanding suggest that there might be some components of the video, such as visual aids or pace, that could be improved in order to be able to achieve a higher understanding rate. This is also shown in the responses to the question on perceived clarity, because although 88.2% of the participants rated the explanation between a 4 and a 5 (clear and very clear, respectively), the remaining percentage of participants rated the clarity lower, between 1 and 3. This indicates that the delay was understood, but the explanation could have been clearer. Inside this percentage of participants (11.9%), the majority were over 45 years old, yet it was this same age range that had the highest understanding rate. In contrast, the situation with younger participants was the opposite; their understanding rate was the lowest, but the vast majority rated the explanation clear or very clear. This shows that while the content of the video was understood, the form or delivery may affect the clarity differently across various age groups. Another insight gathered in this survey was how helpful the visuals were, with 91% of participants indicating that it helped them understand the delay and make it clearer.

Finally, the survey also showed how useful this way of explaining and presenting delays is; 90% of participants stated that these types of videos would improve their passenger experience, and it would help them understand the situation better. Moreover, while over half of the participants felt like there were changes necessary, 42% provided suggestions to improve this method.

3.5. Real-life mockup

This mockup has been created to visualize how these delay-explanation videos would be shared with passengers, both as an email viewed on a computer and an SMS viewed on a phone.

To make the example as realistic a fictional passenger, airline, and flight scenario have been created with the following details:

- Passenger: Jane Doe
- Airline: EMM Airlines
- Flight number: EM1234
- Departure airport: Barcelona (BCN)
- Arrival airport: Los Angeles (LAX)
- Scheduled time of departure: 12:00 PM

It should be taken into consideration that the email and SMS would be sent in the language that the passenger has selected as preferred.

3.5.1. Email view

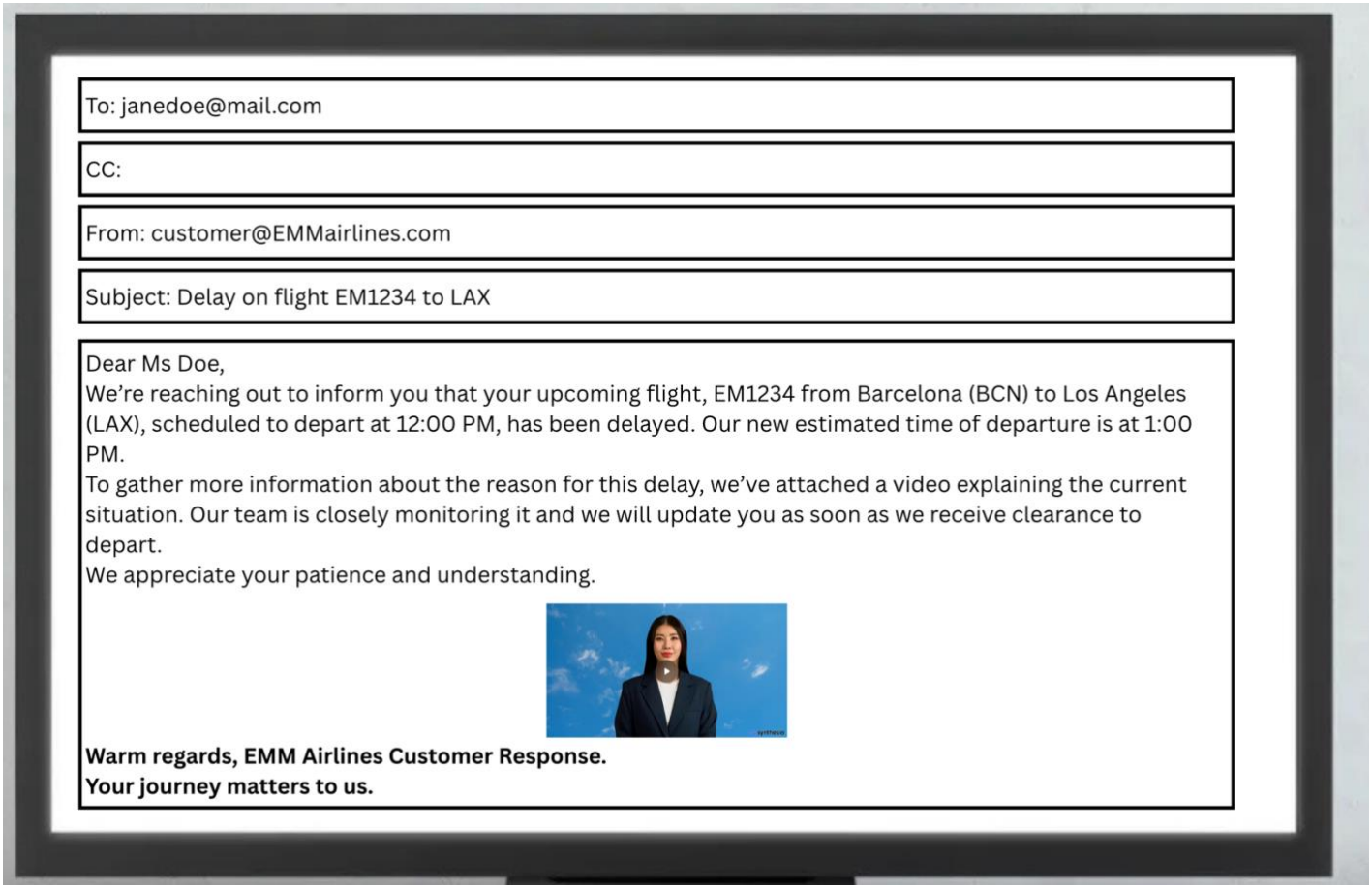


Figure 18: Email mockup

3.5.2. SMS view

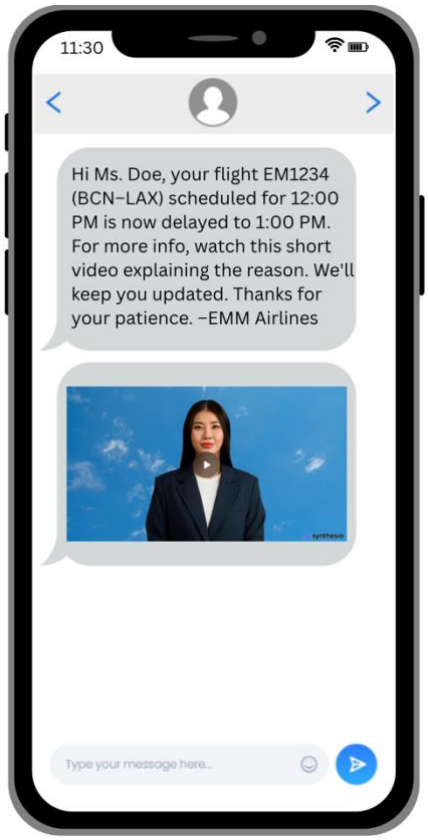


Figure 19: SMS mockup

4. Final conclusions

This project aimed to find a way to bridge a gap between the general public and aviation, and one of these gaps is the delays and how they are communicated. It aimed to try and find a way to make this communication more transparent, informative, and empathetic to the passenger while keeping a calm environment. It's an analysis of how modern tools, in this case, AI-based video technologies like Synthesia, can change the current methods into something more accessible and feasible.

Since all causes of delay, internal and external, can have an impact on both passenger and airline operations, it was important to find a way to be able to communicate and announce these delays that was transparent but also efficient for the airline. Efficiency in this industry is key, since the situation can change at any point in time. The use of Synthesia's video creation platform to generate clear, realistic, and human-centered messages is a fast but easy way for airlines to deliver this announcement. It should be taken into consideration that this project has used the free version of this platform, which has limited avatars and voice options. The premium version enables the user to instantly translate videos to a wide variety of languages, which can be useful in flight, where there are passengers from all over the world. It also has more realistic avatars, voices, and a large media library, which would allow airlines to adapt messages fast in real-time to adhere to the situation happening. Using AI-based tools to create these announcements is much more cost-effective than producing traditional live-action videos, as well as more scalable.

The survey and its results helped validate the tone, clarity, and impact of the video. It was important to get a real-life opinion about the usefulness of these videos to prove their effectiveness. The general conclusion of the survey is that the majority of participants who watched the video felt more informed and reassured after viewing it, and it would improve their experience as a passenger. It was simplified enough so that it could reach a general public who may not have the knowledge or experience, but not to create alarm.

As a result of this project, the next steps can include implementing this type of video explanation in certain real-world systems to evaluate the impact of these video explanations on passenger satisfaction and understanding of the issue. Over time, depending on the results of this evaluation, this method could become a new approach to explain delays in a more empathetic and clear way across the aviation industry.

In conclusion, this project shows that by using AI-powered tools, airlines have the possibility to redefine and improve the way they manage and communicate delays to passengers, by using technology and a human-centered approach.

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Annexes

Interview with Customer Operation Planning in Vueling S.A.

1. Com reaccionen habitualment els passatgers davant dels retards en els vols i quines són les preocupacions o queixes més comunes que rebeu en aquestes situacions?

Els passatgers acostumen a mostrar frustració o preocupació, especialment quan el retard impacta connexions, compromisos personals o laborals. Les queixes més comunes giren entorn de la manca d'informació actualitzada, la incertesa sobre els horaris i, en alguns casos, la percepció de manca d'assistència durant l'espera.

2. Quin tipus de suport ofereix Vueling als passatgers durant els retards, com ara allotjament, vals, etc?

Oferim assistència als clients seguint les directrius del Reglament (CE) 261/2004, que estableix el dret dels passatgers a menjar, begudes, allotjament o transport alternatiu en funció de la durada del retard i la distància del vol. Aquest suport pot incloure vals per a consumicions, allotjament si cal pernoctar, i atenció especial a passatgers vulnerables.

3. Quin és el procediment estàndard per comunicar els retards als passatgers i quins canals s'utilitzen?

La comunicació es fa de manera proactiva a través de diversos canals:, correus electrònics, notificacions a l'app oficial. El nostre objectiu és garantir que el passatger rebi la informació tan aviat com sigui possible i per vies múltiples.

4. Quins desafiaments enfronteu a l'hora de fer anuncis de retard i com assegureu que la informació proporcionada sigui precisa?

El principal repte és la variabilitat de la situació: les causes poden canviar ràpidament i, de vegades, hi ha incertesa operativa. Ens assegurem de contrastar la informació amb les àrees operatives, com el centre de control, abans de comunicar-la, i mantenim un equilibri entre la rapidesa i la fiabilitat de la informació.

5. Com gestiona el vostre equip les situacions en què la causa d'un retard no està clara o quan cal canviar ràpidament el missatge?

En aquests casos, prioritzem informar de manera transparent però prudent, indicant que actualitzarem tan aviat com tinguem més dades. Quan hi ha un canvi sobtat, s'activen protocols interns per actualitzar immediatament tots els canals de comunicació.

6. Qui és el responsable de prendre la decisió final sobre quina informació es comparteix amb els passatgers durant un retard?

La decisió és de l'equip de Customer service 24x7 amb coordinació amb el centre de control operatiu (OCC). Sempre busquem consensuar el missatge amb les àrees implicades per garantir coherència, precisió i alineament amb la normativa.

7. Quin és l'equilibri entre la transparència i el manteniment d'un ambient de calma en els missatges? Quins detalls es proporcionen habitualment sobre la causa d'un retard?

Busquem ser clars i respectuosos amb el dret a la informació del passatger, però també prudents per evitar crear alarma. Normalment es comunica la causa general —per exemple, "condicions meteorològiques adverses", "restriccions de trànsit aeri" o "manteniment tècnic"— sense entrar en detalls tècnics innecessaris Si hi ha alguna situació notable que està afectant la operativa (caiguda de Microsoft, Dana...) ens inclinem a donar un missatge que indiqui que la afectació del seu vol es per aquest motiu.

8. Amb quina freqüència s'actualitza la informació als passatgers durant un retard i què desencadena una actualització?

La informació s'actualitza sempre que hi ha una nova estimació d'hora de sortida o qualsevol novetat rellevant. No hi ha una freqüència fixa, però intentem mantenir els passatgers informats de forma regular i especialment si es produeix algun canvi operatiu.

9. Quines estratègies s'utilitzen quan la informació canvia ràpidament, com per exemple quan un vol està sobtadament llest per sortir després d'un retard?

En aquests casos, es reactiven immediatament tots els canals de notificació i es coordina amb el personal de terra per agilitzar l'embarcament. Són situacions en què la rapidesa és clau, i per això tenim missatges predefinits que podem adaptar i enviar en pocs minuts. També treballem coordinats amb la tripulació del vol perquè, en cas que el vol estigui embarcat (embarcant) els clients tinguin una informació homogènia.

10. Com gestioneu la comunicació durant grans interrupcions, com ara condicions meteorològiques extremes o fallades tècniques dels sistemes?

En grans interrupcions, es treballa de forma coordinada entre diversos equips: Disruptions, Operacions, Comunicació i Atenció al Client. Es fan actualitzacions regulars a través de tots els canals i, si cal, s'estableixen línies d'informació directa amb els aeroports afectats. També reforcem els equips d'atenció per respondre dubtes i gestionar reclamacions.