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Achieving Harmonization of a Biometric ID Management Framework across APEC Economies: Global Benchmarking Study

APEC Digital Economy Steering Group

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Contents

1. Introduction

1.1 What are biometrics?

In the context of the present study, biometrics refer to the measuring of a wide range of physical or behavioral characteristics that are unique to every individual (such as fingerprints, the iris of the eyes, scent, gait, or even muscle memory recall) to positively ascertain that individual's identity. Biometrics are indissociable from technology, which includes hardware sensors and related software to parse and match the captured characteristics. Biometrics constitute one of the three common factors of authentication: what a person is, in contrast to what a person knows (e.g., the combination to a safe) or has (e.g., a key to a safe). Among those factors, biometrics stand out for being unique to their owner, impractical to fake, and not relying on the individual's fallible memory and preparedness.

1.2 Why do biometrics matter in air transport?

The commercial air transport industry contributes USD 3.5 trillion (4.1%) in direct, indirect, and induced value to the world's gross domestic product (GDP). It also supports 87.7 million direct and indirect jobs worldwide, most of which skilled. It enables adjacent industries, such as tourism and hospitality, given that 58% of all international tourists travel by air. Lastly, it provides a vital socioeconomic lifeline to remote and insular communities.

However, the continuous delivery of these benefits hinges on the safe, secure, economical, efficient, and sustainable processing of air travelers. Pre-COVID-19, as many as 12.5 million passengers flew daily on 128,000 flights serving 48,000 unique city-pair routes, operated by nearly 1,500 commercial airlines at almost 3,800 airports. In the wake of the pandemic, the historical growth rate in traffic –which saw a doubling in traffic every fifteen or so years– has been set back several years but is eventually expected to resume after the global passenger traffic returns to pre-COVID-19 levels (i.e., 4.5 billion passengers per annum) around the year 2025.

It is in this context that biometric technology can help the commercial air transport industry in several ways.

1.3 Benefits of biometrics to air transport

One of the key benefits of biometric technology is that it can alleviate the growing capacity shortage at airports through more efficient passenger processing. Just before the onset of the COVID-19 pandemic, all but four of the top 100 busiest airports worldwide had insufficient terminal and runway capacity to handle ten more years of traffic growth. While the pandemic has delayed congestion at those airports by a few years, it was estimated back then that around two trillion U.S. dollars in fresh capital would require investing into airports globally by the year 2040. Should the industry become capacity-constrained once again, fewer economic benefits of aviation would materialize; one pessimistic scenario examined by the Air Transport Action Group (ATAG) of only 2.7% in revenue-passenger-kilometer annual growth by the year 2038 would lead to a global GDP opportunity cost of USD 293 billion, inclusive of direct, indirect, and induced impacts. The use of biometrics in airport terminals carries the potential to speed up passenger processing, and therefore unlock latent capacity with cheaper capital investments than traditional infrastructure expansions. Likewise, the use of self-service technology secured by biometrics decreases the reliance of airport operators on manual labor, which is a significant benefit in the face of widespread staff shortages. In that sense, biometric technology represents a capital expenditure investment that pays off in the form of reduced operating expenditure.

Second, biometric technology has the potential to increase the degree of confidence in the positive identification of travelers. In principle at least, biometrics reduce the likelihood of human error or fraudulent impersonation thanks to the unique, non-transferable, and difficult-to-spoof nature of the biological features involved. In doing so, biometric technology can enhance security outcomes from airside threats and illegal border crossing.

For air travelers, biometric technology makes proving their identity faster, easier, and more convenient, as it decreases the reliance on legacy tokens such as passports and boarding passes. It provides for a more seamless and personalized user experience, especially in parts of the air travel journey that are status-based (such as lounge access and priority boarding). By processing passengers more efficiently at checkpoints, it can also increase the dwell time in retail and food & beverage (F&B) areas, which benefits not only travelers, but also most leading airports worldwide that now derive most of their operating income from non-aeronautical activities. Lastly, touchless technologies serve to reassure travelers that are worried about the epidemiological risk of disease spread through contact surfaces.

1.4 Limitations of biometrics in air transport

Conversely, biometric technology brings disadvantages either by design or through ill-conceived implementations. First, implementations can be costly – they require not only biometric sensors, but also middleware integration with airline, airport, or authority systems. In economies with a low labor cost base, the return on capital investment in sensors and automated gates, which have the potential to reduce the need for staff, can be uncertain or unreasonably long.

The design and calibration of the biometric technology are also a source of operational risk for operators. First, there is often a discrepancy between the design accuracy of a system -as measured in an R&D lab or a pilot project with ideal operating conditions- and its effective accuracy. In turn, this discrepancy can lead to false negatives (i.e., the wrong rejection of a valid traveler) that cause manual rework, loss of confidence in the technology, decreased throughput at the facility, and frustration for travelers. False positives are far less likely, but their consequences are much more severe if individuals were allowed to go where they should not. For mission-critical applications, such as border control or boarding gates, the accuracy of biometric checkpoints cannot be less than that of manual screening. Second, systems designed in one environment may simply not work in another. There have been examples of biometric sensors trained on one particular demographic, for instance, which then performed poorly well installed in an environment where the facial features and skin tone differ greatly.

Post-implementation, tail risks include mishandling of biometric data, whether it is accidental or fraudulent. Because biometric features cannot be reset, unlike a password for example, the consequences of data breaches to privacy and identity fraud are potentially greater.

1.5 The adoption of biometrics in air transport

Biometric technology in air transport has seen significant adoption in the past twenty years. A strong impetus for it was the need for enhanced security in passenger screening following the terrorist attacks on September 11, 2001. More recently, the urgency to remove physical touchpoints at airports and increase traveler confidence related to the COVID-19 transmission risk has also sped up adoption. In 2019, only 7% of airlines worldwide had invested in biometric solutions, such as self-boarding gates. By 2021, this figure had increased to 20% and is expected to accelerate further (SITA, 2021). Airports are also seen to be increasing their investments in biometric technology for economic reasons, to aid in the recovery from the COVID-19 pandemic (Airports Council International (ACI), 2021).

Since the first visions for the use of biometrics in air travel formulated in the 1990s, of which the biometric passport and its embedded chip were an early embodiment, several initiatives have aimed at guiding and harmonizing industry adoption. Among them was the “Simplifying Passenger Travel” multi-agency interest group in the 2000s; the International Civil Aviation Organization (ICAO)’s Digital Travel Credential (DTC), that aims to standardize the issuance of travel credentials in a digital format; IATA’s One ID working group, reporting to the IATA Travel Standards Board, focusing on digitalization of admissibility and contactless travel; and, the “New Experience Travel Technologies” (NEXTT) by IATA and ACI, which aims to extend the biometric vision to baggage handling and artificial intelligence.

1.6 Biometric implementations around the world

In this study, we have examined cases of biometric technology implementation by airlines, airports, and governments around the world. We found that most involved facial recognition, which users of consumer technology such as mobile devices would be familiar with; and most were led by public agencies and airport operators. Table 1 summarizes some of those cases.

Table 1: Examples of biometric implementations at airports around the world

Economy	Airport(s)	Touchpoints	Biometric technology	Stakeholder(s) leading the project	Project
Aruba*	Aruba International Airport	Check-in, bag drop, security access, border control, boarding	Facial recognition	Governments, airport operator and airline	Aruba Happy Flow & CBP Entry/Exit
France*	Lyon-Saint Exupéry airport	Check-in, bag drop, security access, boarding	Facial recognition	Airport operator	MONA Biometric
Germany*	Frankfurt Airport	Bag drop, security access, boarding	Facial recognition	Airport operator and airline group	Star Alliance Biometrics
Hong Kong, China*	Hong Kong International Airport	Check-in, bag drop, security access, border control, boarding	Facial recognition	Airport operator	Flight Token
India	Varanasi and Bengaluru airports, and subsequently 5 other airports by 2023	Check-in (planned), bag drop (planned), airport entrance, security access, boarding	Facial recognition	Government, in collaboration with partnership airports	Digi Yatra

Japan*	Narita International Airport, Haneda Airport	Check-in, bag dop, security access, boarding	Facial recognition	Government-led, in collaboration with airport operators	Face Express
Korea*	Gimpo Airport	Security access, boarding (testing)	Palm vein recognition	Airport operator	N.A.
Malaysia*	Kuala Lumpur International Airport	Check-in, security access, boarding	Facial recognition	Airline-led (AirAsia), in collaboration with airport operator	FACES
Qatar*	Hamad International Airport (trial)	Check-in, bag drop, security access, border control, boarding	Facial recognition (under trial) and iris/fingerprint (for border control)	Airline and government	Smart Airport
Singapore*	Singapore Changi Airport	Security access, boarding, border control	Facial recognition	Government and airport operator	FAST Program
Spain*	Menorca Airport, Madrid–Barajas Airport	Check-in, security access, boarding	Facial recognition	Airport operator	Aeropuerto Aena 4.0
United Arab Emirates*	Dubai International Airport	Check-in, bag drop, border control, lounge, boarding	Facial and iris recognition	Government and airline	Emirates' Biometric Path, Smart Tunnel (border control)
United Kingdom*	London Gatwick Airport (trial)	Bag drop, boarding	Facial recognition	Airport operator	N.A.
	London Heathrow Airport (trial)	Check-in, bag drop, security access,	Facial recognition	Airport operator	N.A.

		security screening, boarding			
United States of America*	Hartsfield-Jackson Atlanta International Airport	Check-in; bag drop; security access; border control; boarding	Facial recognition	Airline in collaboration with the government	CBP Entry/Exit
	All U.S. international airports (entry border) and 32 airports (exit border)	Boarding and border control	Facial recognition	Government	CBP Entry/Exit

* Economies that have automated biometric identification gates at border control, separate from the listed biometric projects.

1.7 Biometric implementations among APEC economies

Members of the Asia-Pacific Economic Cooperation forum (APEC), which comprise 21 economies in the Asia-Pacific region and are the focus of this study, have also embarked on biometric adoption initiatives. Within APEC economies, individual stakeholders, such as airlines, airports, border control, customs, and related authorities, have designed their biometric-enabled processes to suit their own operational and statutory requirements. However, challenges related to the coordination of initiatives both within and across the APEC economies have resulted in an imperfect harmonization and interoperability of the processes and systems. As a result, passengers may be required to enroll their biometric features multiple times, or alternate between presenting their travel documents, such as boarding passes and passports, and verifying themselves biometrically across different touchpoints throughout the cross-border journey.

1.8 Objective of this research

To assist APEC economies in improving cooperation and achieving a shared biometric vision and roadmap for air travel, the APEC has commissioned a study with an aim to:

i. Raise awareness and increase support for the biometric identity process and technology harmonization among APEC economies;

ii. Learn from global biometric implementations in air travel and identify lessons learned suitable for APEC economies; and,

iii. Provide practical guidelines and recommendations on biometric identity adoption across all APEC economies.

1.9 Scope of the research

The present study includes a proposed tool to assess the current-state maturity of APEC economies in biometric implementations. IATA Consulting, the advisor appointed to conduct this study, prepared the maturity assessment framework, and designed and conducted an online survey and interviews with both private and public value chain participants that included airports, airlines, and civil aviation authorities to collect the primary inputs. This report summarizes the findings and observations that were collected.

1.10 Data collection for the project

Primary and secondary data collection was conducted using the following instruments:

- An online survey designed and administered by IATA Consulting from August 2022 to October 2022.
    - Inputs were received from 44 stakeholders from 22 different APEC economies and non-APEC economies, including airport operators, associations, civil aviation authorities, border control/ immigration, airlines, and other relevant authorities;
- Ten live interviews conducted remotely with airport operators, authorities, and solution providers;
- Discussions with IATA experts working on passenger facilitation and biometric-assisted passenger facilitation; and,
- A review of the extant literature and case studies on biometric processes and technologies in general and in the context of commercial air transport.

1.11 Validity of the findings

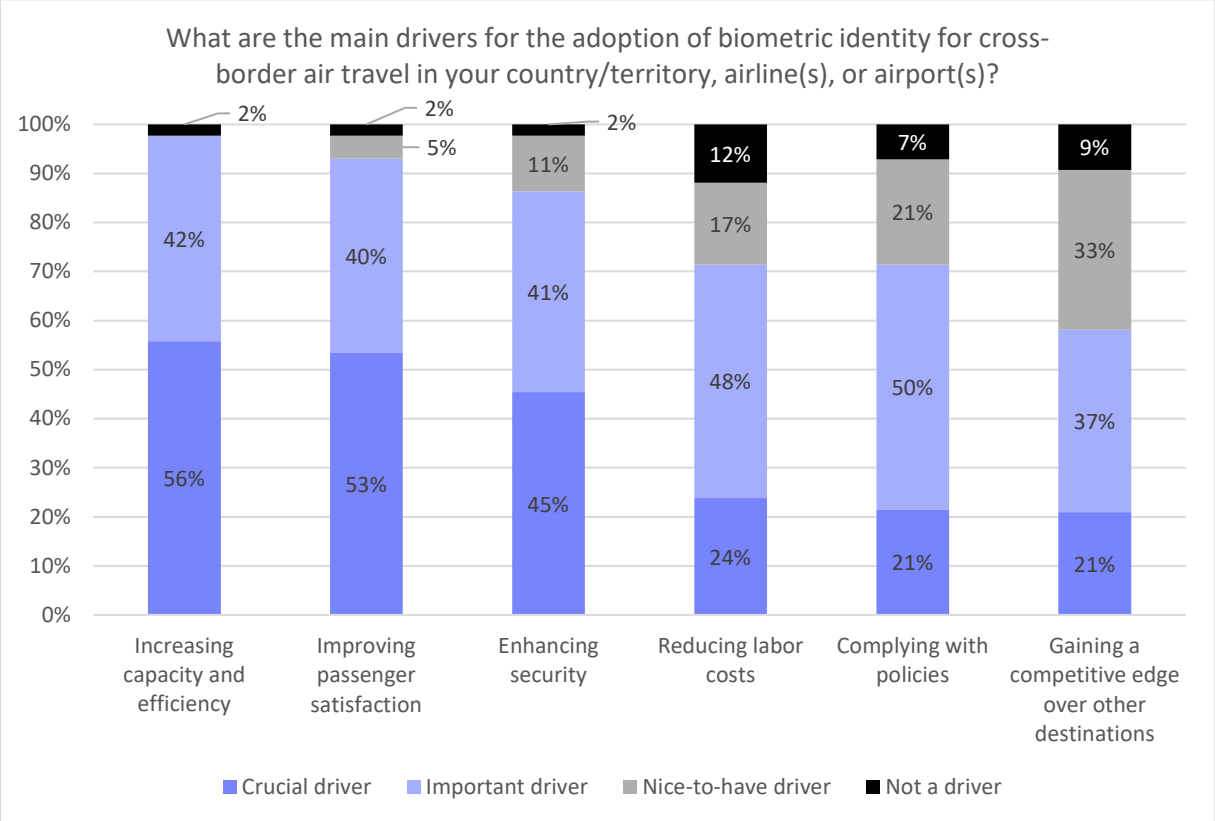
The assessment presented in this report reflects the collected survey and interview responses against the maturity framework and criteria set out in Section 3. IATA Consulting recognizes that the maturity of an APEC economy is a function of the set of criteria used and the definition chosen for each maturity level. The maturity assessment framework in this report is only intended as a practical tool for economies to measure their present and future progress in biometric identity implementations in cross-border air travel against a common taxonomy. It is not meant to pass judgment on the success of their initiatives nor to compare economies against one another.

It should also be acknowledged that the survey findings are based on a limited sample that is not necessarily representative of the entire industry, nor the entire group of APEC economies.

2. Key drivers of adopting biometric identity in APEC economies

The online survey asked respondents to rank their key drivers for biometric adoption. As shown in Figure 1, most respondents deemed increases in capacity/efficiency and passenger satisfaction, respectively, as crucial, and policy compliance as important. Notably, those respondents that did not deem the capacity benefit to be a driver come from the smallest air travel markets in the sample (fewer than 25 million passengers in 2019) and had no active biometric technology implementation at the time of the survey. Enhancing security outcomes and reducing labor costs were the next most important drivers across the board. Gaining a competitive edge was ranked last, with one third of respondents considering it a nice-to-have benefit.

Figure 1: Main drivers for the adoption of biometric ID for cross-border air travel



The rest of the present section introduces these key drivers in further detail.

2.1 Increase capacity and efficiency

The COVID-19 pandemic caused the loss of 2.3 million jobs across airlines, airports, and civil aviation groups, representing a 21% reduction in staffing levels compared to pre-pandemic levels (Oxford Economics, 2022). Some industry stakeholders lost as much as half of their workforce, as was the case of Sydney Airport.

However, a significant manpower reduction in air transport sector can result in operational issues. For example, at Frankfurt International Airport, which experienced a workforce reduction of about 18% since the pandemic, saw cancellation of 7.8% of the flights and delays in 68% of others (Bloomberg, 2022). Biometric solutions have the potential to automate manual processes and enable operational efficiencies. For example, Istanbul Airport recorded a 30% reduction in boarding times during its six-month trial period in 2021.

In the online survey conducted for this study, increasing capacity and efficiency was the most important driver for stakeholders (including regulatory authorities and airline/ airport operators) to adopt biometric identification solutions at airports. 98% of the respondents indicated it as an important or crucial driver.

2.2 Improve passenger satisfaction

In the online survey conducted for this study, passenger satisfaction was one of the main adoption incentives for the stakeholders to adopt biometric identification solutions at airports. 93% of respondents considered it a crucial or important driver. important or crucial driver for adopting biometric identity for cross-border air travel, and only 2% did not see it as a driver. This finding is consistent with the travelers' preoccupation for an enhanced experience. In 2021, IATA conducted a global passenger survey, which found that 73% of air travelers declared they preferred using biometrics instead of a passport or boarding pass if it helps expedite the process. 86% of those passengers who had experienced the biometric identification process further expressed satisfaction with how it works. In the same survey, one-fourth of all respondents mentioned the use of automated solutions as a key improvement to the border control process on arrival – which is perhaps no surprise considering that almost two-thirds of respondents were dissatisfied with service levels at border control.

2.3 Enhance security

The use of biometric identity throughout the journey carries the potential to decrease the risk for individuals to cross borders under a false identity, and to further mitigate human trafficking and other cross-border criminal activities. However, that is only true if biometrics are at least equally reliable as manual processes. Past research indicates that biometric processing of passengers brings a degree of consistency in the identity verification of travelers that is difficult to achieve manually. The most prevalent biometric identification method, facial recognition, was tested to be at least 99.5% accurate (National Institute of Standards and Technology, 2021), compared to a 86% accuracy achieved through the manual matching of travel documents and faces (National Library of Medicine, 2014). In the online survey, enhancing security is the third most important driver for justifying biometric implementations, with 86% of the respondents identifying it as crucial or important.

2.4 Reducing labor costs

Airlines and airports lost around USD 324 and USD 83 billion, respectively, in operating income in 2021 relative to 2019 from the effects of the COVID-19 pandemic. Asia-Pacific was one of the most affected regions, with a 57.5% decline in revenues compared to 2019 (Airports Council International, 2022). One of the key actions taken by aviation players to manage their losses was to cut labor costs by reducing manpower or wages. Labor costs were the largest expenses for airports and airlines at the onset of COVID-19, just ahead of fuel, and account for about 24% of total costs at airlines (IATA, 2021) and 34% at airports (ACI, 2020) respectively.

The layoffs have had devastating impacts on the workers themselves and on the operational capacity of their employers. As air travel recovers from the pandemic, staff shortages are being felt worldwide, to the point that airports have requested for airlines to reduce their schedule in the second half of 2022 due to limited passenger handling capacity in the terminals. Wage reduction has also had effects on both workers and their employers. For example, nearly 700 British Airways staff working in Heathrow, mostly at ticket checkpoints, went on a strike at the beginning of summer 2022 due to the 10% salary cut introduced during the pandemic.

In the context of staff shortages, automated biometric identification and verification can complement the existing workforce, allowing them to process more travelers per staff. Going forward, biometrics can be an increasing source of productivity and decreased reliance on labor in passenger processing. Our online survey identified this benefit as the fourth most important driver for adoption, with 71% of respondents deeming it an important or crucial driver, and only 17% indicating it as a nice-to-have.

2.5 Comply with policies and international recommendations

ICAO's Annex 9 to the Convention on International Civil Aviation provides standards and recommended practices (SARPs) related to the facilitation of landside formalities for clearance of aircraft and passengers inclusive of customs, immigration, public health, and agriculture authorities. In it, ICAO recommends that states "*consider the introduction of Automated Border Control (ABC) systems*" and, once introduced, "*use the information available from the PKD to validate eMRTDs* [e-Machine Readable Travel Documents]*, perform biometric matching to establish that the passenger is the rightful holder of the document, and query INTERPOL's Stolen and Lost Travel Documents (SLTD) database, as well as other border control records, to determine eligibility for border crossing*." Annex 9 also establishes a goal of "*60 minutes in aggregate for the completion of all required departure/ arrival formalities*".

In addition to supranational SARPs, some countries also have national policies in place that motivate and drive the adoption of biometric identification technologies in cross-border air travel. For example, India's Ministry of Civil Aviation published the Digi Yatra Policy in 2018 to enable biometric boarding processes at all airports across India. The policy document outlined the vision, standard operating processes for domestic and international departures, guidelines, and required controls (Ministry of Civil Aviation, India, 2018).

Yet, our survey found that compliance to SARPs and policies ranked only fourth out of the five drivers for adoption, with only 21% of respondents considering it as critical. Said differently, while biometric systems must comply with national and supranational policies (such as those that govern data protection), policies are not yet a key motivation for the adoption of biometrics in air travel.

2.6 Gain a competitive edge over other destinations

The least important driver for biometric adoption identified by the survey was the benefit of differentiating an airport or airline from the competition using biometrics. The top ten airports (based on SKYTRAX 2022 ranking) adopt biometric technologies, as identified in Appendix C. For about one third of responses, this driver was neither crucial nor important, but rather a nice-to-have. We expect that the indirect benefits of a highly-integrated biometric-enabled traveler journey will grow in importance as the technology becomes more ubiquitous and commercial offerings start developing around the use of biometrics at airports.

3. Regional biometric maturity assessment among APEC economies

The Asia-Pacific Economic Cooperation (APEC) is a regional economic forum that was established back in 1989 to leverage the growing interdependence of its 21 Asia-Pacific member economies (Australia, Brunei Darussalam, Canada, Chile, the People's Republic of China, Hong Kong, China, Indonesia, Japan, the Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, the Republic of the Philippines, the Russian Federation, Singapore, Chinese Taipei, Thailand, the United States of America, and Viet Nam). The word "economies" is normally used to describe the APEC members due to APEC's focus on trade and economic issues. This chapter summarizes the findings from the biometric implementation maturity assessment conducted among APEC economies conducted in 2022 as part of the present research.

3.1 The maturity framework

The levels of maturity in terms of biometric identification implementations across the APEC economies vary from one airport to another due to differences in priorities, context, and awareness or acceptance towards the technology. The word "maturity" in this context refers to the awareness, understanding, integration of, and acceptance toward biometric identity solutions in cross-border travel.

To determine biometric implementation maturity levels in consistently across economies and time, a maturity assessment framework was designed as part of this research. The framework does not only guide this and future maturity assessments, but also allows economies to understand which gaps to focus on to continue improving in their biometric journey.

The maturity framework is based on four key dimensions:

a) Vision: the degree of roadmapping and intentionality with which economies embarked on their biometric identity implementation journey.
b) Adoption: how many and which of the possible airport touchpoints (such as check-in, baggage drop, security, boarding, border control) have undergone biometric implementation.

c) Coordination: how deliberate, effective, and efficient is the system that allows the different participants in the biometric implementation to coordinate with one another.
d) Organization: whether any forum exists to plan and monitor ongoing developments in biometrics, and to keep stakeholders apprised.

Each dimension was measured against five levels (undeveloped, planned, nascent, developing, and mature), as shown in Table 2.

Table 2: Overview of the maturity assessment framework

	Undeveloped	Planned	Nascent	Developing	Mature
Vision	No formal vision	Vision for domestic travel only	Vision for partial cross-border travel, this side of the border	Vision for full cross-border travel, this side of the border	Vision for full cross-border travel, both sides of the border
Adoption across touchpoints in the aviation context[1]	Not adopted/ planned adoption in any touchpoints of air travelers' journey	Completed/ under trials at any touchpoint(s) of air travelers' journey: Either commercial touchpoints (e.g., check-in/ boarding) **OR** statutory (e.g., customs immigration)	Adoption at any touchpoint(s) of air travelers' journey: Either commercial touchpoints (e.g., check-in/ boarding) **OR** statutory (e.g., customs immigration)	Completed/ under trials at both commercial (e.g., check-in/ boarding) **AND** statutory (e.g., customs immigration) touchpoints of air travelers' journey	Adoption at both commercial (e.g., check-in/ boarding) **AND** statutory (e.g., customs immigration) touchpoints of air travelers' journey
Coordination between stakeholders in the biometric implementation	No biometric ID solution adopted by any stakeholder	Biometric ID solution adopted by one stakeholder (e.g., airline, airport, or border control) in trial or implementation	Biometric ID solution integrated/ coordinated/ shared with/ between two stakeholders (e.g., airport and airline, or airport and immigration) in trial or implementation	Biometric ID solution integrated/ coordinated/ shared with/ between two or more stakeholders (e.g., airport, airline, and immigration) **such that the passport is only required at no more than one touchpoint at the airport** for the departure process in trial or implementation	Biometric ID solution integrated/ coordinated/ shared with/ between two or more stakeholders (e.g., airport, airline, and immigration) from two different economies/ territories/ countries, **such that the passport is only required at no more than one touchpoint at the airport** for the departure AND arrival process (in another economy) in trial or implementation
Organization	No working group was established for the purpose of biometric ID implementation	Working group was established within the single organization for the purpose of biometric ID implementation	Working group established with more than one organization (commercial **OR** statutory) within the country for the purpose of biometric ID implementation	Working group established with more than one organization (commercial **AND** statutory) within the country for the purpose of biometric ID implementation	Working group established with more than one organization (commercial **AND** statutory) within **AND** outside of the country/ territory for the purpose of biometric ID implementation

[1] Touchpoints in the air travel context: air ticket booking, terminal entry, check-in, baggage drop-off, airside access, security checkpoint, outbound customs, emigration, boarding, immigration, baggage reclaim, inbound customs.

3.2 Maturity assessment case studies

To provide a representative overview of the level of maturity in biometrics in cross-border air travel among APEC economies, four implementation case studies were selected: Australia; Hong Kong, China; Chinese Taipei; and Thailand. Each of these APEC economies was evaluated according to the maturity assessment framework described earlier, using declarative inputs from the stakeholders that IATA Consulting received from both online interviews and surveys.

3.2.1 Case study #1: Australia

Australia was an early adopter of biometric identification solutions in cross-border air travel. Biometrics were first used at the arrival border control in 2008, followed by departure border control in 2015. Three years later, in 2018, Sydney Airport conducted the trial for the FAST passenger facilitation project with Qantas. However, the project was discontinued after the trial and never implemented on a full scale or permanent basis. During the trial, passengers could enroll their biometrics at check-in kiosks for biometric processing at bag drop, lounge entry, and boarding.

Vision

The economy articulated a detailed vision for full cross-border travel on both sides of the border (arrival and departure). Therefore, for the "Vision" dimension, Australia was assessed to be at the **Mature** stage.

Adoption across touchpoints in the aviation context

Australia utilizes biometric identification solutions at arrival and departure border control, despite trials having concluded and not yet implemented on a full-scale, or permanent basis for biometric processing at commercial touchpoints (e.g., bag drop, lounge entry, boarding). Therefore, for the "Adoption across touchpoints in the aviation context" dimension, Australia was assessed to be at the **Developing** stage.

Coordination between stakeholders in the biometric implementation

During the Qantas-Sydney Airport biometric trial, the Australian Border Force checked the quality of the facial images captured to discuss the possibility of the airport capturing the images instead of the border control for a more coordinated biometric system between

border control and the private sector (airport and airlines). However, this concept is in its early discussions and has not materialized yet as of October 2022.

Trials involved coordination between only the airline (Qantas) and the airport (Sydney Airport) for biometric-enabled processing at the commercial touchpoints. Therefore, for the "Coordination between stakeholders in the biometric implementation" dimension, Australia was assessed to be at the **Nascent** stage.

Organization

Although Australia has a National Passenger Facilitation Committee chaired by the Australian Border Force where the government and other industry stakeholders can discuss these types of initiatives, a working group for the purpose of the biometric identification implementation was established only within the Australian border force and no other governmental nor commercial entity. As such, for the "Organization" dimension, Australia was assessed to be at the **Nascent** stage.

3.2.2 Case study #2: Hong Kong, China

In Hong Kong, China, biometric identification implementation at the airport was first planned in 2016-2017 and rolled out at security e-gates in 2018. The airport operator, Airport Authority of Hong Kong's (AAHK), started with the airside entry security checkpoint as a first choice because it is a processor over which they had the most control.

Vision

The economy has a detailed vision for full cross-border travel, on both sides of the border. Therefore, for the "Vision" Dimension, Hong Kong, China, was assessed to be at the **Mature** stage.

Adoption across touchpoints in the aviation context

Hong Kong International Airport began biometric processing of passengers in May 2022 where passengers can check in and enroll at the check-in kiosk for certain airlines and flights (specifically, those that do not require health checks). They can then proceed with bag drop, enter e-security gates, and board with their facial biometrics. The local residents can also use their facial biometrics at immigration without the need to show their passports.

AAHK is discussing with immigration to extend the biometric processing service to foreign travelers.

	Check-in	Bag drop	Security (airside entry)	Immigration/ border control	Boarding
Enrolment	Possible	Possible	Possible	-	-
Biometric	Face	Face	Face	Face	Face
Documents	Passport, boarding pass[2]	-	-	-	-

As of October 2022, certain home-based airlines have adopted end-to-end biometric processing at the airport and most operating airlines have joined the self-boarding process. With the lift of travel restrictions in Hong Kong, China and the resumption of traffic, more airlines are joining the biometric identification implementation. AAHK is eventually expecting 100% adoption from airlines to provide a unified and seamless experience at Hong Kong International Airport.

Therefore, for the "Adoption across touchpoints in the aviation context" dimension, Hong Kong, China was assessed to be at the **Mature** stage.

Coordination between stakeholders in the biometric implementation

Through the coordination and collaboration between the airport and the immigration, facial recognition can be used to identify and verify the passenger at immigration, boarding gates, and security gates without the need for the passengers to show their passport. The passport will only be needed for enrolment, and not for the rest of the passenger journey (for eligible flights and passengers). However, this solution has yet to be coordinated with foreign economies to enable seamless biometric processing from departure (at Hong Kong International Airport) to arrival (in the destination country).

Therefore, for the "Coordination between stakeholders in the biometric implementation" dimension, Hong Kong, China, was assessed to be at the **Developing** stage.

[2] These documents are required at the touchpoint where the traveler enrolls at, e.g., at check-in kiosk.

Organization

AAHK engaged different stakeholders including Civil Aviation Departments, airlines, handling agents, and Immigration Departments through different taskforces and working group meetings to collaborate and develop a biometric solution that fits different security and business needs. AAHK is also in discussions with different business partners including other airport services and SkyCity (the latest airport development projects that comprising of office, hotel, retail, dining, and entertainment facilities) to explore more collaboration opportunities. Moreover, they are also part of the IATA One ID working group (involving foreign stakeholders) to seek opportunities for cross-country biometric trials.

Therefore, for the "Organization" dimension, Hong Kong, China was assessed to be at the **Mature** stage.

3.2.3 Case study #3: Chinese Taipei

Biometrics was first introduced at immigration e-gates for its local citizens, then for economy's frequent travelers, whereby facial image and fingerprint are captured to match the biometrics in the passport. The facilities were later upgraded to allow foreigners who travel in and out of Chinese Taipei frequently or foreigners with residential permits to use it – the so-called "f-gates".

Vision

The economy has a vision for partial cross-border travel on this side of the border. Therefore, for the "Vision" dimension, Chinese Taipei was assessed to be at the **Nascent** stage.

Adoption across touchpoints in the aviation context

	Check-in (trial)	**Bag drop**	**Security (airside entry) (trial)**	**Immigration/ border control**	**Boarding (trial)**
Enrolment	Possible	-	Possible	-	-

Biometric	Face	Passport, boarding pass	Face	Face and fingerprint[3]	Face
Documents	Passport, boarding pass	-	-	Passport	-

Biometrics was first introduced at immigration e-gates for the citizens of Chinese Taipei, followed by the economy's frequent travelers. At the end of 2021, Taoyuan International Airport also began a trial for biometric processing at check-in, airside access (security), and boarding for a few flights and airlines. Enrolment can be done at the check-in counter, the common-use self-service (CUSS) kiosks, or the security checkpoint (airside entry).

The trial continued for eight months until August 2022, after which a review of the trial and results was conducted (and in progress as of October 2022). The biometric identification solution was adopted permanently at immigration, and its trial at the commercial touchpoints has just been completed.

Therefore, for the "Adoption across touchpoints in the aviation context" dimension, Chinese Taipei was assessed to be at the **Developing** stage.

Coordination between stakeholders in the biometric implementation

In the trial at Taoyuan International Airport, facial image and fingerprint are captured for verification against the registered biometric information, which is still required at immigration touchpoints. This information used and verified at immigration is not used at other touchpoints (e.g., boarding or check-in). As a result, while biometric identification solutions are used at both commercial (e.g., check-in, boarding) and regulatory (e.g., immigration) touchpoints, the separate systems result in the passport being required more than once at the airport.

For the "Coordination between stakeholders in the biometric implementation " dimension, Chinese Taipei was assessed to be at the **Nascent** stage.

[3] Only for local citizens or frequent travellers of Chinese Taipei. The system is separate from the commercial touchpoints.

Organization

Taoyuan International Airport first approached the Ministry of Transport to obtain its support for this implementation. After receiving the green light from the Ministry of Transport, the airport had further discussions with the airlines and Customs, Immigration, Quarantine and Security (CIQS). A working group was established, with more than one organization (commercial and statutory) within the economy for the purpose of biometric identification implementation. During these discussions, the required actions by each stakeholder were communicated (e.g., the enrolment at the check-in counter to be processed by airlines), and there was a timeline established for each major action that the respectively responsible stakeholder should take. However, the working group was comprised of the economy's stakeholders and did not include stakeholders outside the economy.

Therefore, for the "Organization" dimension, Chinese Taipei was assessed to be at the **Developing** stage.

3.2.4 Case study # 4: Thailand

In Thailand, the airports have varying levels of maturity and readiness, with the Suvarnabhumi and Don Mueang airports, both operated by Airports of Thailand (AOT), leading the way.

The first and only touchpoint that utilizes biometric identification solutions is border control (as of October 2022). However, the terminal infrastructure at the airport (CUSS/CUTE) allows for biometric identification solutions to be adopted at Suvarnabhumi Airport in the future. While facial recognition is planned to be deployed at some point, the exact date of trial/rollout is unconfirmed as of October 2022.

Vision

The economy has a vision for full cross-border travel on both sides of the border (arrival and departure). Therefore, for the "Vision" dimension, Thailand was assessed to be at the **Mature** stage.

Adoption across touchpoints in the aviation context

Thailand utilizes biometric identification solutions at border control but has yet to implement/ conduct trials for other touchpoints at the airport. Therefore, for the "Adoption across touchpoints in the aviation context" dimension, Thailand was assessed to be at the **Nascent** stage.

Coordination between stakeholders in the biometric implementation

Biometric identification is only adopted at the border control as of October 2022, and no other touchpoint adopts the technology for potential coordination/ integration. Therefore, for the "Coordination between stakeholders in the biometric implementation" dimension, Thailand was assessed to be at the **Planned** stage.

Organization

No working group was established specifically for the purpose of biometric identification implementations, although regular industry meetings are held between the Civil Aviation Authority of Thailand (CAAT), airport operators, and airlines to discuss matters that include plans for biometric identification implementations. Any plans, updates, issues, and

feedback can be raised during these meetings. Therefore, for the "Organization" dimension, Thailand was assessed to be at the **Undeveloped** stage.

3.3 Findings from the maturity assessment framework

Based on the online survey carried out by IATA Consulting with stakeholders covering 22 economies (of which 14 are APEC economies), the result for each of the key dimensions can be summarized as follows.

3.3.1 Vision

For the "Vision" dimension, it was found that only less than a third of stakeholders (30%) had a vision for biometric identification implementations in full cross-border travel on both sides of the border for commercial and regulatory touchpoints. A lower proportion was observed for stakeholders from APEC economies. The result is illustrated in Table 3 below.

Table 3: "Vision" for the stakeholders from APEC and non-APEC economies

	Commercial touchpoints		Regulatory touchpoints	
	All economies	APEC economies	All economies	APEC economies
Unsure	2%	0%	2%	0%
No formal vision	9%	9%	14%	15%
Vision for domestic travel only	7%	9%	2%	3%
Vision for partial cross-border travel, this side of the border	16%	21%	20%	21%
Vision for full cross-border travel, this side of the border	36%	44%	32%	38%
Vision for full cross-border travel, both sides of the border	30%	18%	30%	21%

3.3.2 Adoption across touchpoints in the aviation context

Based on IATA Consulting survey results, the touchpoints that indicated the highest biometric use (including under trials) were the departure (47%) and arrival border control (50%). This is aligned with the IATA's 2021 passenger survey, which indicated that most travelers would use biometric identification at the entry immigration (51%) or exit immigration (47%), while a minority of them would use biometric identification at the lounge (5%) or during the baggage drop (7%) (International Air Transport Association, 2021).

Figure 2: Usage of biometric identification within the passenger journey (International Air Transport Association, 2021)

3.3.3 Coordination between stakeholders in the biometric implementation

One of biometrics implementations' greatest success factors, but also challenge, is the inter-stakeholder coordination required to ensure that processes are aligned and systems interoperable. For example, the passport details of travelers who have enrolled in a biometric program are used at multiple touchpoints. Some of these touchpoints are under the purview of commercial entities (such as the airline's check-in and baggage drop), serve an operational purpose (to fulfill the travel contract), and connect to ad-hoc systems (such as a departure control system, or DCS). Other touchpoints are under the purview of public agencies (such as border control), serve a statutory purpose (to maintain the integrity and security of air transport and borders), and connect to entirely independent systems (a government database of individuals).

The realization of the end-to-end seamless travel journey introduced earlier requires coordination between those entities, and the alignment of their respective commercial and statutory objectives. Without it, travelers will experience a fragmented travel journey, possibly comprised of multiple biometric enrolments serving different purposes.

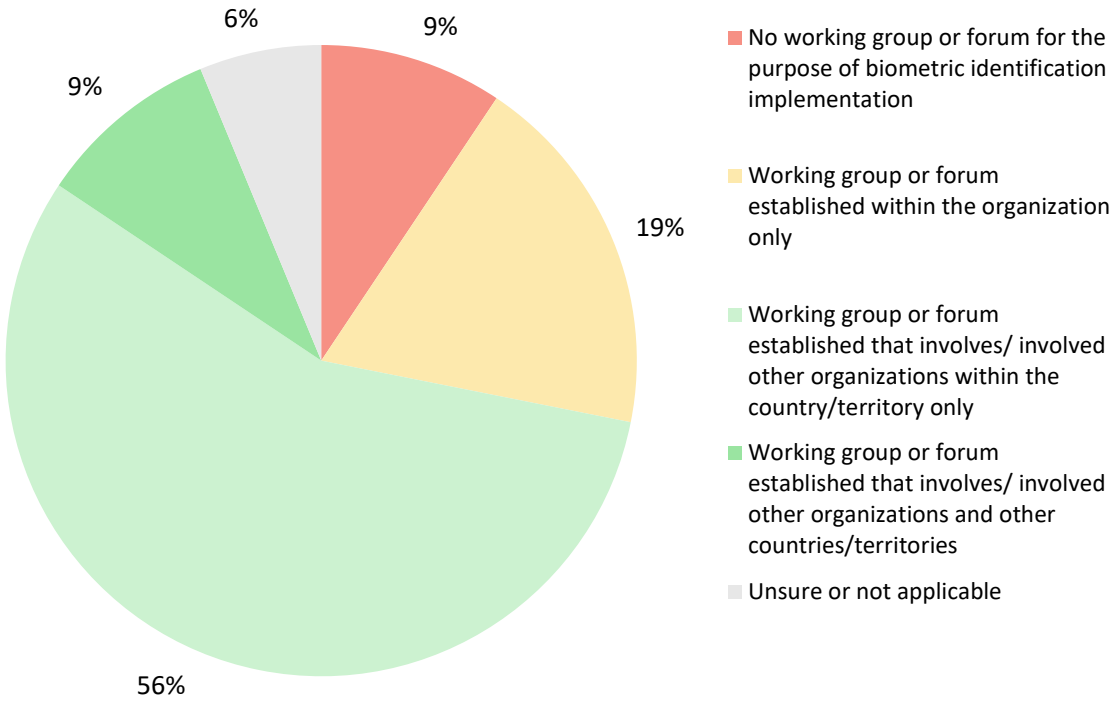
In the same fashion, coordination is required not only between stakeholders within one travel market, but across markets as well, if the single vision for cross-border seamless journeys is to be realized.

Such coordination, as this study found, is the single most difficult challenge for biometric implementation projects to overcome. While fragmented standards exist that each address one part of the biometric design, such as standards for 2D face recognition, there is no multiagency and international forum whose exclusive role it is to standardize biometric implementations in a cross-border context. Coordination tends to remain ad-hoc, best-effort, and based on bilateral initiatives.

3.3.4 Organization

Communication and effective collaboration are both key challenges and success factors for biometric ID implementations in cross-border air travel.

Figure 3: Working group or forum for the purpose of biometric identification implementation



As shown in Figure 3, the survey results indicated 65% of the stakeholders had working groups that involved stakeholders apart from themselves. However, only 9% had working groups or forums that involved foreign stakeholders. The vision for biometric

implementations in cross-border air travel requires the collaborative efforts across borders (i.e., coordination and collaboration with foreign stakeholders) to enable end-to-end seamless biometric processing from departure to arrival.

4. Biometric identification management applications in aviation

Airports handle complex traveler movements daily, with differing security and verification requirements (e.g., for domestic and international) and directionality (e.g., arrival, departure, transfer, and transit). Terminal crowding is a recurring problem at airports worldwide, especially due to the uneven and lumpy distribution of flights throughout the daily banks, which lead to either peak-hour congestion and underutilization of terminal assets. At the same time, airports must comply with stringent government regulations and deal with significant security threats, which make it impossible to relax processing standards based on traffic levels. Calibrating the manpower and physical resources needed to process travelers in a reasonable timeframe is, therefore, a difficult balancing act for airport planners. Both security and passenger efficiency related issues can be eased with the adoption of biometrics.

In this study, we took stock of the different types of biometric applications commonly in use around the world, both within and outside commercial air transport, to contextualize the study's findings.

4.1 Biometric technology in other industries

The past three decades have seen tremendous innovation in the development of biometric sensors. The most common types that we observed are fingerprint, face, hand geometry, iris, voice, gait, and palmprint. The advantages and disadvantages of using these biometric identifies is summarized in Table 4 below.

Table 4: Biometric systems' advantages and disadvantages (Belhadj, 2017)

Biometrics type	Advantages	Disadvantages
Fingerprint	• Most-used biometrics • Mature technology • Relatively high matching accuracy • High matching speed • Low cost • Able to use multiple fingers • Twins-discrimination power	• Dedicated sensor that requires to be touched and maintained • Sensors can be foiled by tricked fingerprints • Small but significant failure to enrolment rate • Accuracy is dependent of the sensor and the user

Face	• Can operate on simple 2D images or 3D in static or movies images • High user acceptability • Reasonable accuracy	• Accuracy dependent on controlled acquisition (e.g., background, light) • Sensitive to simple changes (e.g., glasses, face hair, emotions, age)
Hand geometry	• Ease of use • Small template size • High user acceptability	• Low accuracy • High cost compared to other modalities
Iris	• High accuracy • Difficult to be tricked (even using lens or dead iris) • Low sensitivity to outside influences	• Low user acceptability • Cost tends to be high
Voice	• Ease of use • Low cost • Easy interface with phrases and words • High user acceptance	• Low accuracy • Possible replay attack • Possibility of spoofing by persons skilled in mimicking • Can be affected by recording conditions • Sensitive to voice changes
Gait	• Distance-based identification • Independent of the acquisition conditions	• Low accuracy • Can be affected by footwear, nature of clothing, the affliction of the legs, walking surface • Affected by age
Palmprint	• Recognition area larger than fingerprint, i.e., more features • High accuracy • High user acceptability	• Scanners expensive with large surface • Accuracy is dependent of the sensor and the user

4.2 Biometric technology in commercial air transport

As a subset of the most common biometric identifiers across all industries shown in Table 4, those most typically seen at airports are:

a) Facial recognition
b) Iris recognition
c) Fingerprint recognition
d) Palm print or vein patterns recognition

The following sections elaborate on their current application, with examples of airports around the world that have adopted them.

4.2.1 Facial recognition

Facial recognition technology identifies a person from a still image or video recording of their face, using a cloud of points measured at significant markers of the face's shape. Facial recognition encompasses a wide range of methods, but the generalized principle is that they compare a digital template of the face with their numerical representation in a database of known travelers. Our review found that facial recognition is one of the most ubiquitous applications of biometrics in air travel. An example of an airport that adopted facial recognition is:

Aruba Airport

Launched in 2015, the Aruba Happy Flow is the first fully self-service passenger experience using biometric technology from curb to boarding, and one of the most advanced implementations worldwide. It was developed with the collaborative efforts of the Government of Aruba, Aruba Airport Authority, KLM, Schiphol Group, and Vision-Box. It allows passengers to check in, drop their bags, pass through immigration, and board the flight using facial recognition.

4.2.2 Iris recognition

The iris is the colored, donut-shaped portion of the eye behind the cornea that surrounds the pupil. It is unique to a person and does not change throughout life, as the iris is well protected from any damage by the cornea, making it suitable for biometric identity. As the iris information is captured by an infrared camera, it can be used even in low-light conditions.

Examples of airports that adopted iris recognition are:

Hamad International Airport, Doha Qatar

At Hamad International Airport, iris biometrics are used at border control gates to identify travelers. This has halved the passenger processing time at immigration in the past when processed by immigration officers (Iris ID, 2022).

Amsterdam Schiphol Airport

European, Liechtenstein, Switzerland, Norway, or Iceland I.D. card or passport holders can become registered travelers and move through security and passport control at Schiphol airport using iris recognition, as shown in Figure 4. The automated gates allow those travelers to pass the border clearance in just ten seconds (Schiphol Airport, n.d.).

Figure 4: Border control gates for Privium members at Schiphol Airport (Schiphol Airport, n.d.)

4.2.3 Fingerprint recognition

Fingerprint recognition is the oldest and the most well-known biometric authentication approach (Sabhanayagam, Senthamaraikannan, & Venkatesan, 2018). However, while fingerprints tend to coexist with biometric passports in economies that use them, their use is generally limited to government agencies (e.g., border control).

For example, both Singapore and Thailand use fingerprint identification at their border control. However, Singapore adopts fingerprint recognition as a secondary trait for biometric recognition, for passengers who are unwilling or unable to utilize facial or iris recognition, while Thailand adopts fingerprint as the sole biometric trait for border processing.

While ubiquitous pre-COVID-19, fingerprint sensors have lost in popularity as the traveling public became increasingly hesitant to touch high-traffic contact surfaces, and operators had to provide means of sanitizing those surfaces without damaging the sensors.

4.2.4 Palmprint or vein patterns recognition

Palmprint recognition uses unique features of the palm's surface, which contains ridges and valleys similar to fingerprints, to automatically recognize a person's identity (Zhang, Yue, & Zuo, 2011). On the other hand, palm vein recognition refers to the technology using the unique palm vein pattern captured under near-infrared light for personal authentication, focusing on the unique variations of each individual's vein thickness or shape. This biometric technology is less popular but found application at a few airports, such as Gimpo Airport in the Republic of Korea.

Korean Airports Corporation (KAC)

In 2022, KAC led a biometric identification implementation in partnership with Korean Air to enable biometric boarding for passengers flying on its domestic routes. Palm vein scanning is used to verify passengers' identities, and eligible passengers can register their biometric information at Korean Air kiosks in Gimpo International Airport's departure area. Korea Airports Corporation also signed an agreement with financial institutions and the Korea Financial Telecommunications & Clearings Institute to launch the "Bio-Authentication Airport Linkage Service". Through this service, customers who register their palm vein data and mobile phone numbers with the financial institutions and consent to the use of their information at the airport can use their pre-registered information at the airports in order to quickly complete the identification process at the designated gate and board the plane (Airports Council International, 2022).

5. Challenges and issues faced and the proposed solutions

The stakeholder interviews conducted as part of this study indicate that the benefits of using biometric technology to enhance air travel are well understood and not a matter of contention. Yet, several key challenges emerge clearly from the discussions.

The complete range of challenges and issues faced in biometric adoption by APEC economies as examined in this study include:

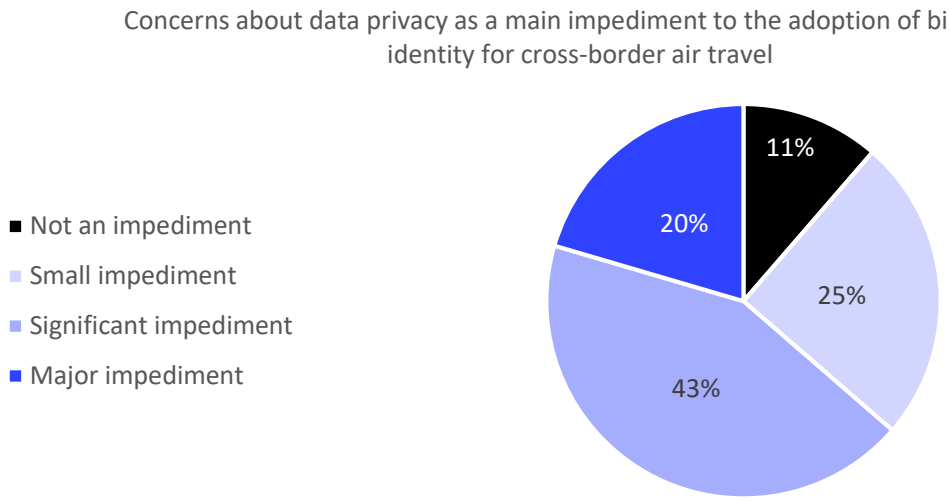
1. Concerns about data privacy and security;
2. Regulatory or legal concern;
3. Insufficient funding;
4. Stakeholders' interest and support;
5. Stakeholder collaboration;
6. Insufficient trust between stakeholders;
7. Technical hurdles; and
8. Uncertainties in requirements and expectations.

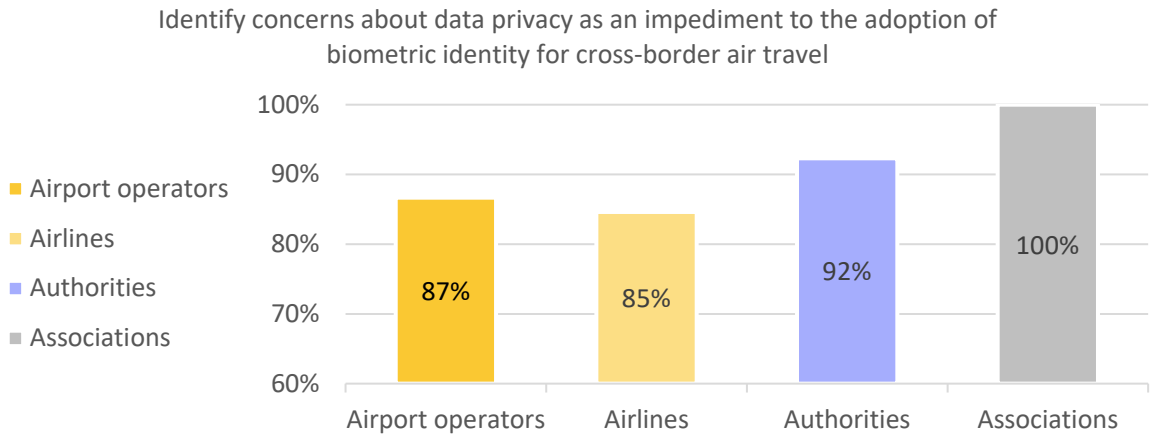
Each of the above will be further explained in the sections below, and subsequently, the proposed solutions for them.

5.1 Concerns about data privacy and security

Based on the online survey conducted by IATA Consulting, data privacy and security has risen to become a top issue faced by stakeholders (including both government and commercial entities) in implementing biometric identification solutions in cross-border air travel. 63% of respondents found data privacy to be a significant or major impediment to adopting biometric identity for cross-border air travel. It was also found that this was a bigger problem for authorities than for commercial entities, as shown in Figure 5.

Figure 5: Concerns about data privacy as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings





This result is consistent to the IATA's 2021 survey findings (International Air Transport Association, 2021), by which the top three concerns of passengers related to the use of biometric information are data breaches, data being shared with other organizations, and lack of information on how the data is handled or used.

5.2 Regulatory or legal concerns

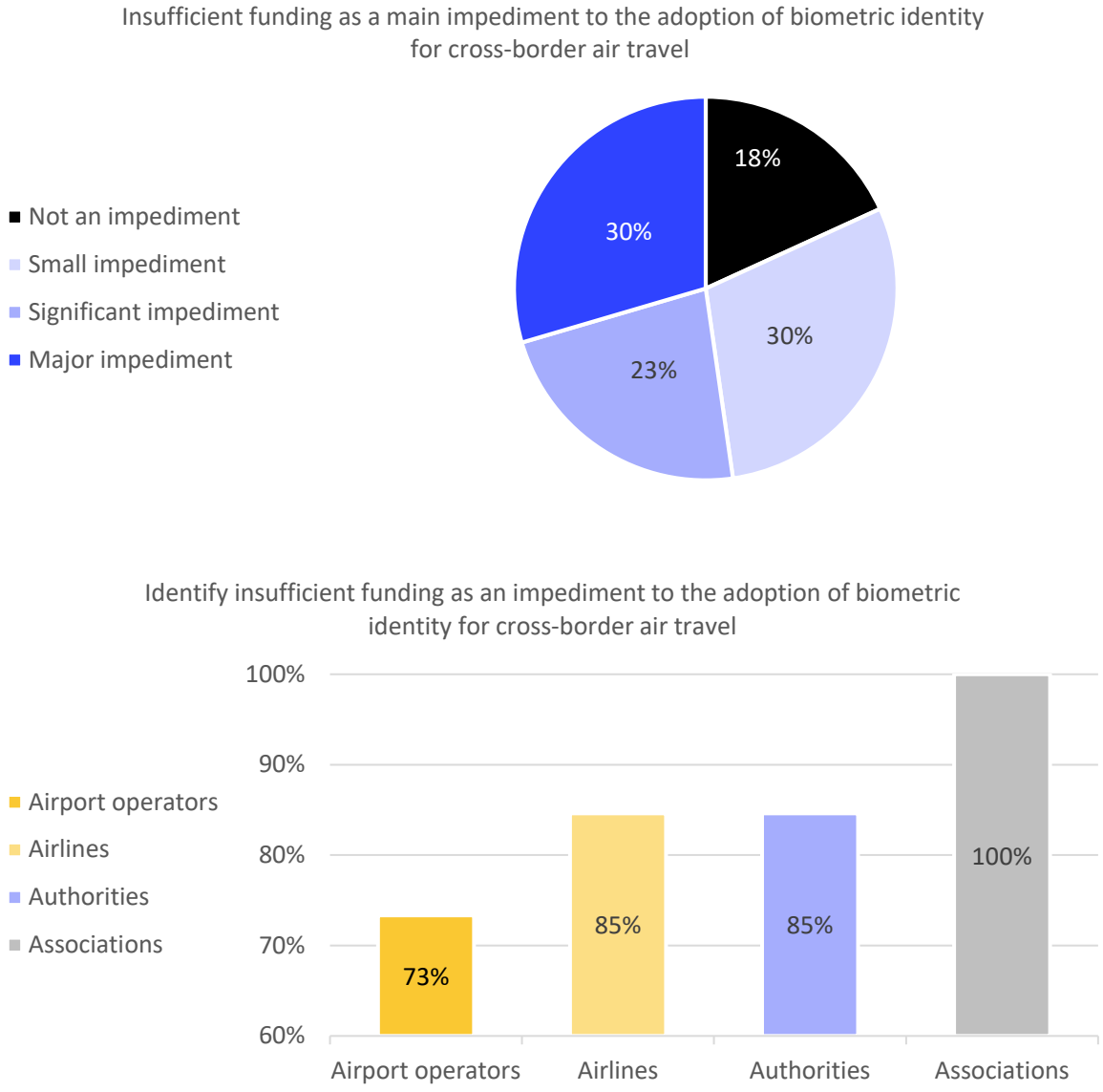
Economies each have their own set of regulations that they need to comply with. On top of national regulations, there are regional regulations and standards that economies may be required to comply with. Despite being a single set of standards, these regulations are also subjected to differing interpretations across economies.

One of the struggles raised during the stakeholder interviews was that a single approach to biometric deployment could not be applied uniquely across different countries, due to differing sets of (and occasionally contradicting) regulations and governing standards.

5.3 Insufficient funding

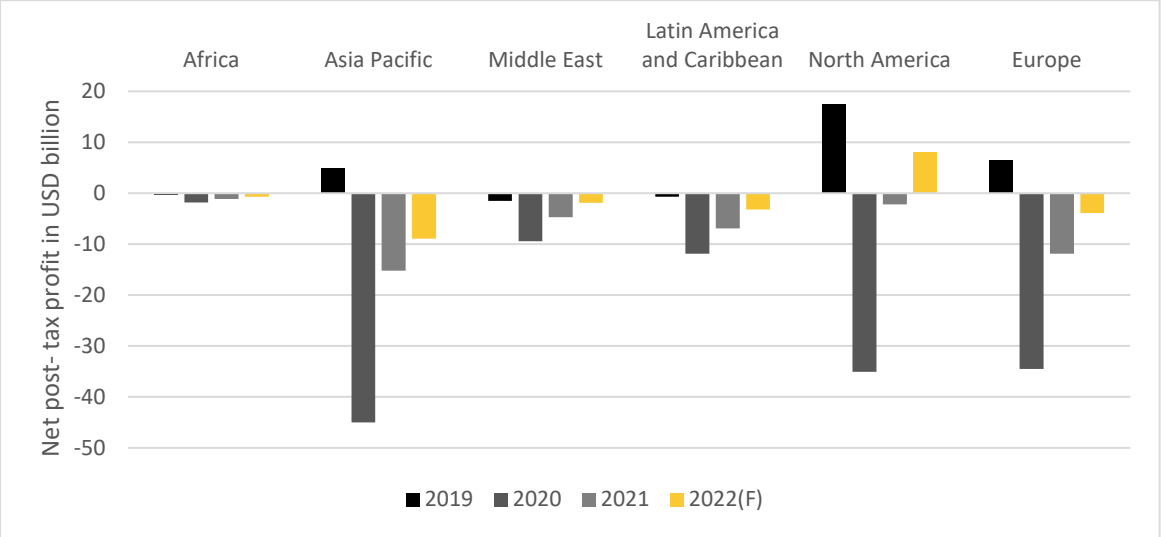
Based on our online survey, a majority (53%) of aviation stakeholders identified insufficient funding as a significant or major impediment to adopting biometric identification in cross-border air travel (Figure 6).

Figure 6: Insufficient funding as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings



Respondents found that biometric identification technologies are costly to implement, especially due to the high hardware infrastructure costs. Perhaps unsurprisingly, the financing issue is a larger hurdle for airlines, authorities, or airports that are operated by the government, compared to the private airport operators (Figure 6). This funding issue would also be more pronounced for airlines operating in the Asia Pacific region, which have experienced a greater financial hit from COVID-19 as illustrated in Figure 7.

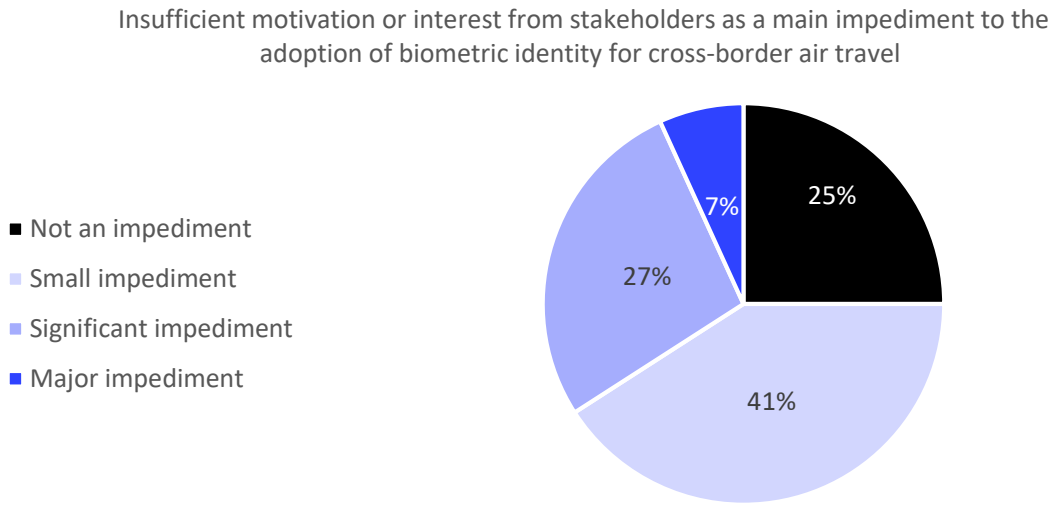
Figure 7: Net post-tax profit of airlines by region (International Air Transport Association, 2022)

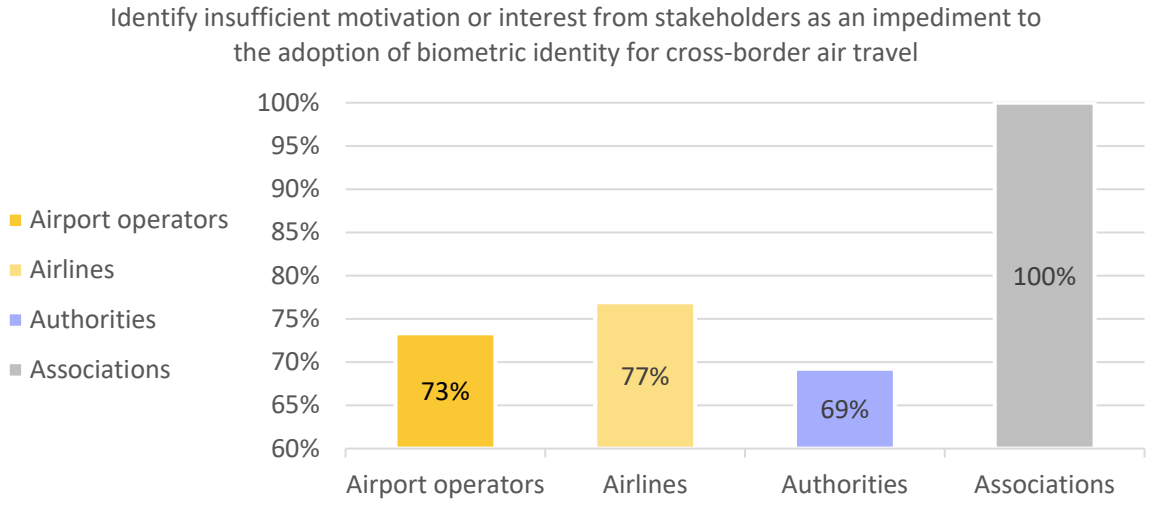


5.4 Stakeholders' interest and support

Biometric identification implementations in cross-border air travel require the involvement of multiple stakeholders. However, the stakeholders' willingness and interest to participate in such projects vary with differences in resource availability and receptiveness to changes (in business model, process, and environment). As shown in Figure 8, more than one third of all respondents identified insufficient motivation or interest from stakeholders as a significant or major impediment to biometric identification implementations in cross-border air travel. The challenge was found to be greater for the airport operators and airlines than for authorities.

Figure 8: Insufficient motivation or interest from stakeholders as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings.

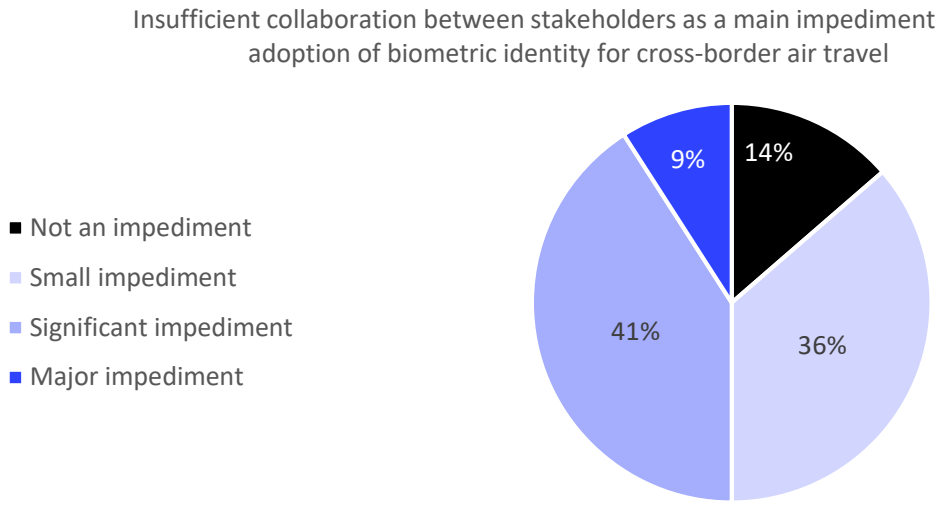


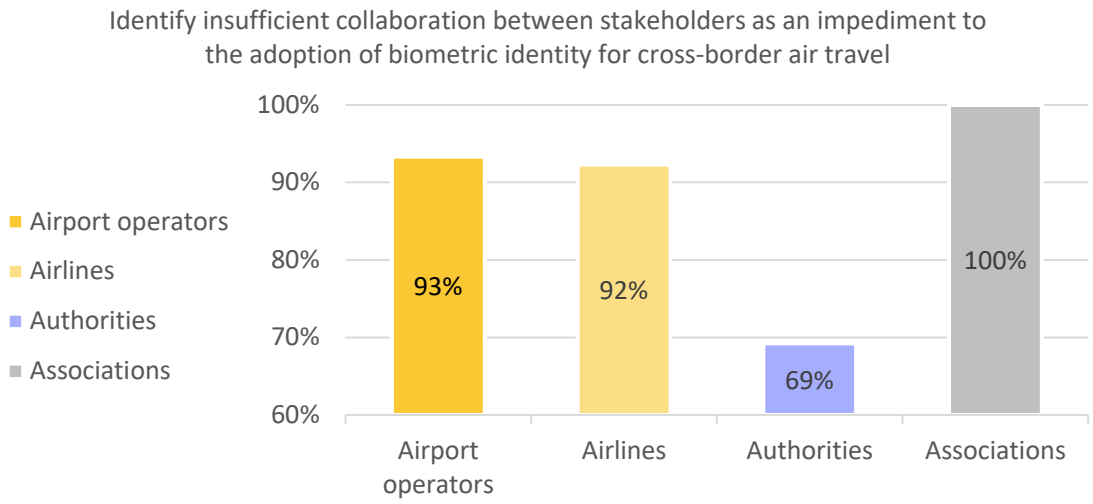


5.5 Stakeholder collaboration

As mentioned earlier, a key challenge stemming from the survey is the insufficient collaboration between stakeholders, especially for the private sector (both airport operators and airlines). From the results, half of the respondents indicated insufficient collaboration between stakeholders as a significant or major impediment to biometric identification implementations in cross-border air travel, while 14% did not see it as an impediment at all (Figure 9). Almost all surveyed airport operators (93%) and airlines (92%) found it to be one of the obstacles they faced in the biometric identification implementations (Figure 9).

Figure 9: Insufficient collaboration between stakeholders as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings

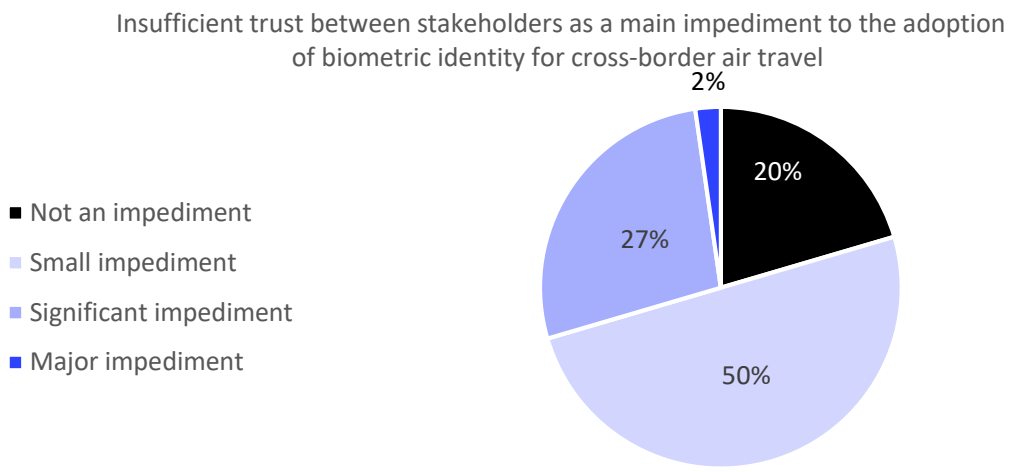


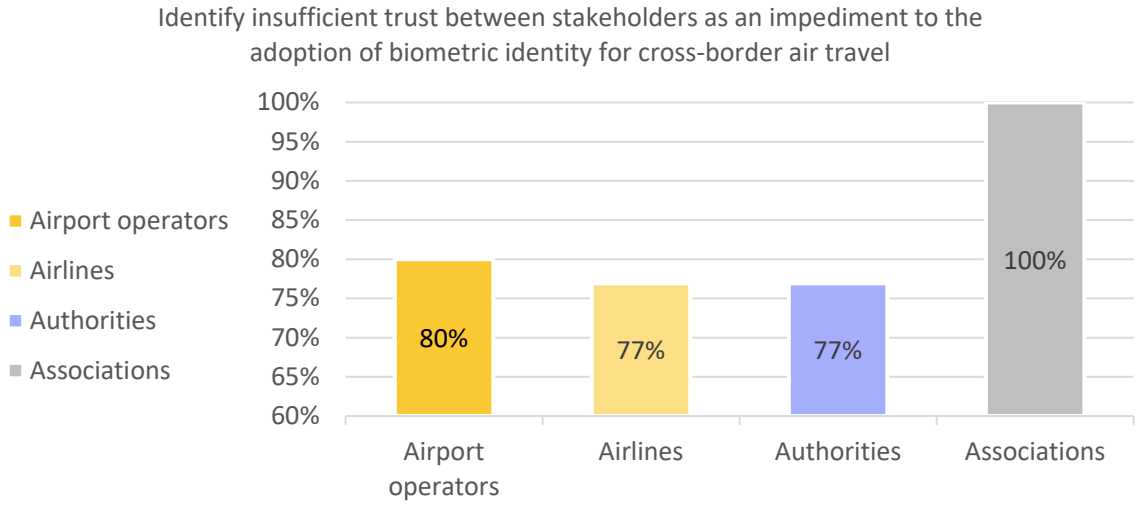


5.6 Insufficient trust between stakeholders

The difficulty of coordinating public and private stakeholders and building trust within an economy, or across more than one economy is a recurring theme. Figure 10 shows that almost one third of respondents consider the lack of trust to be a significant or major impediment to biometric adoption.

Figure 10: Insufficient trust between stakeholders as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings





5.7 Technical hurdles

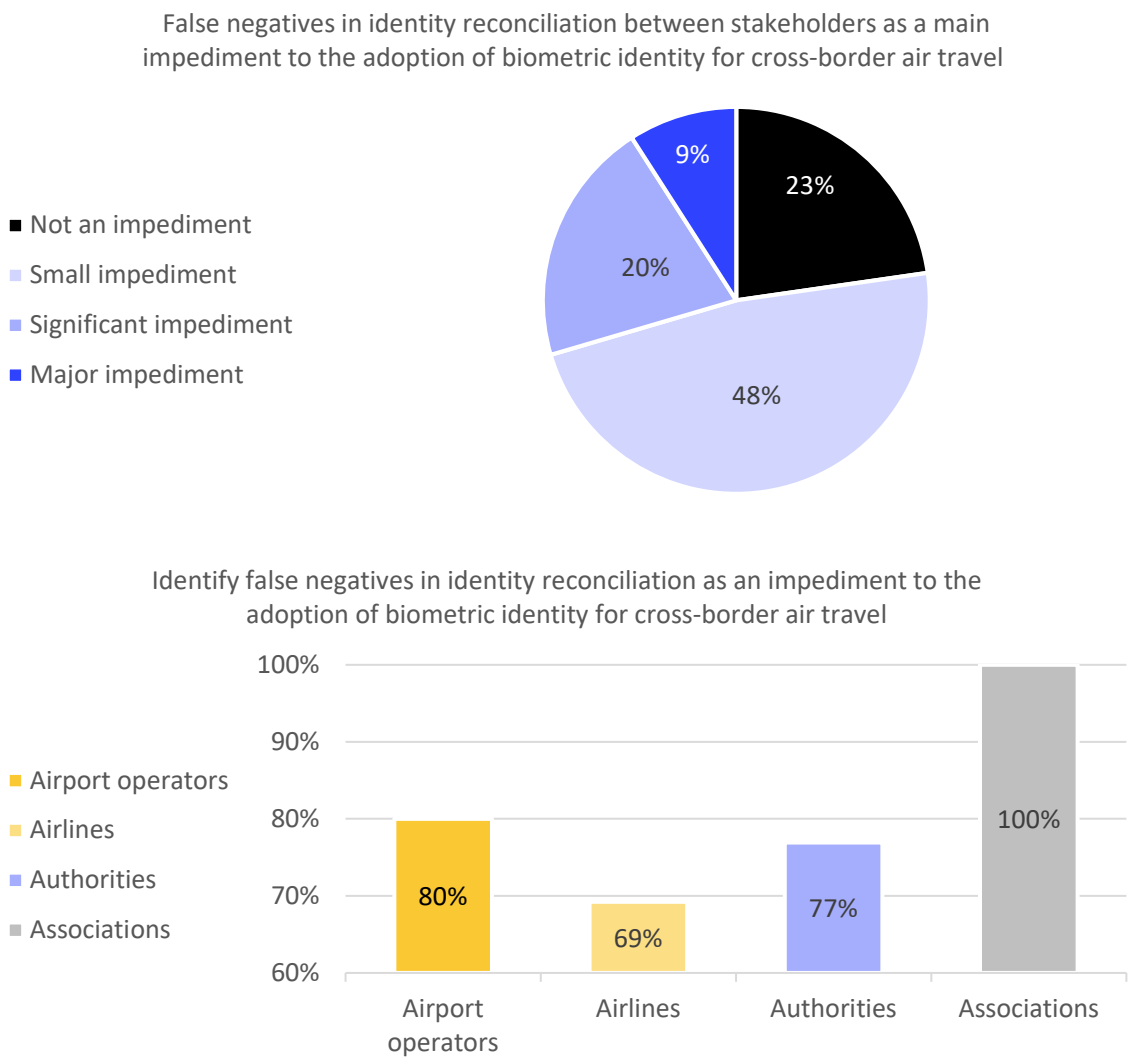
Data integration and coordination

Another challenge raised during interviews was the issue of data integration and coordination between participants. A particularly thorny issue is that of data exchange between the private sector (e.g., passenger data obtained at check-in) and authorities (e.g., personal data for border control identity verification). Questions of ownership and duty of care become problematic when the data gets transferred from one entity to another.

False negatives

While seen as an impediment, false negatives did not significantly impact most of the respondents' biometric identification implementations based on the survey results. Only 29% of respondents saw it as a significant or major impediment and is slightly less critical for airlines (Figure 11).

Figure 11: False negatives in identity reconciliation as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings



Point of capture

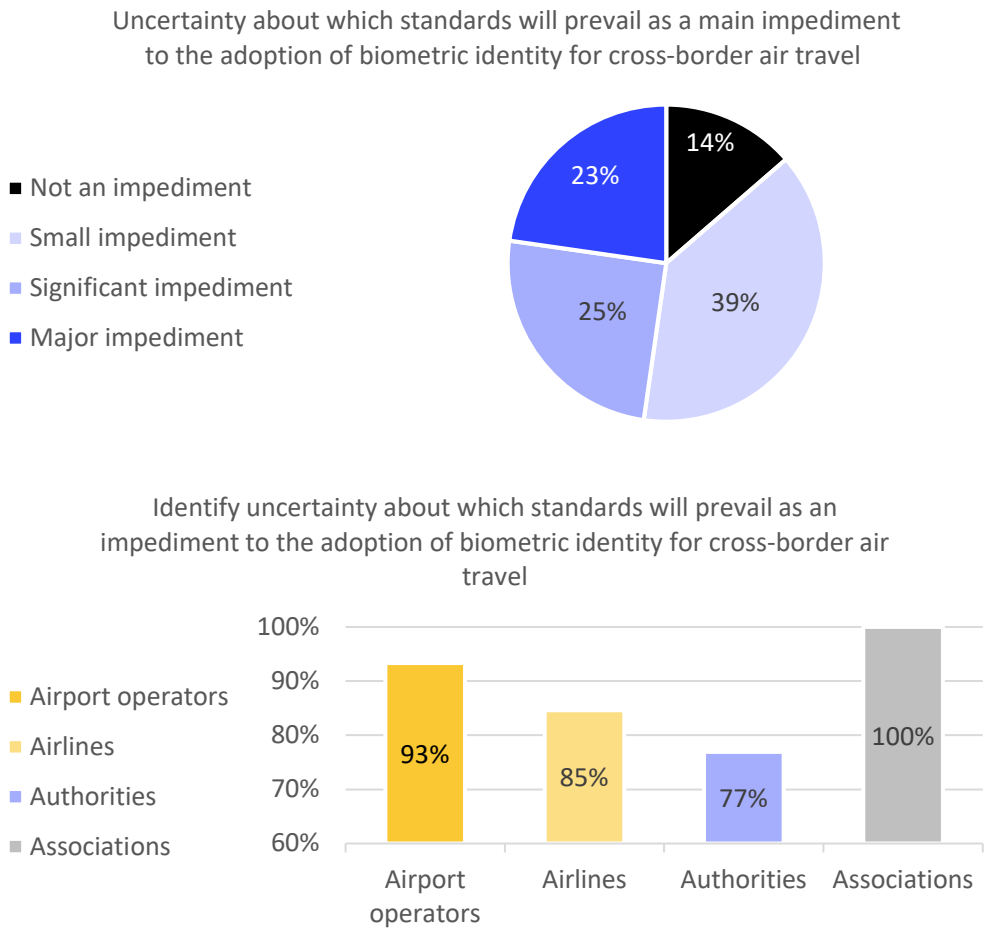
A third technical hurdle raised in interviews with stakeholders related to having the right environment for accurate biometric enrolment (e.g., capturing a facial image) and subsequent reading. The impact of lighting on facial image capture, for example, was a commonly-raised issue.

5.8 Uncertainties in requirements and expectations

Based on the online survey, almost half of the respondents (48%) found the uncertainty about evolving biometric and data regulation standards to be one of the challenges and issues slowing down adoption in cross-border air travel. However, a varying level of impact

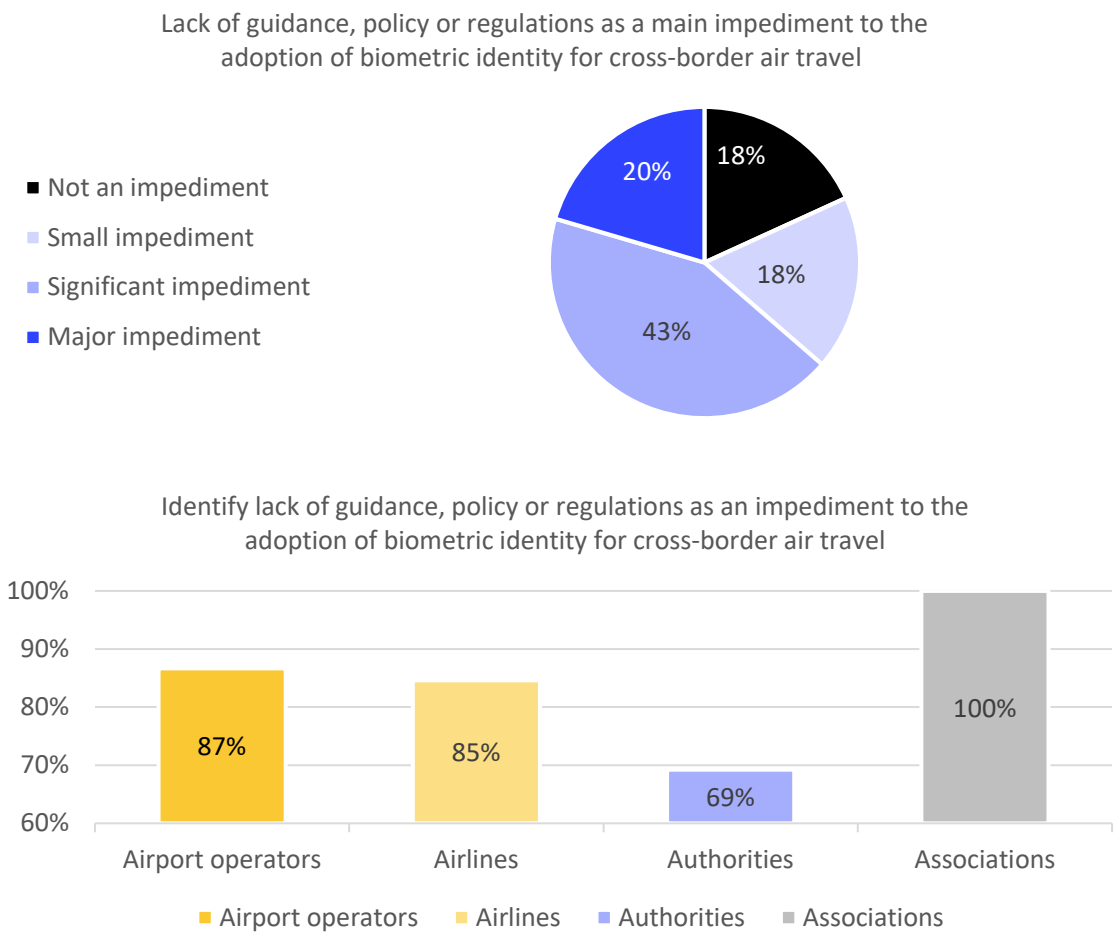
is observed across the stakeholders, with the private sector, especially the private airport operators, seeing a greater impact from that uncertainty (Figure 12).

Figure 12: Uncertainty about which standards will prevail as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings



A similar observation was made on the challenge of a lack of guidance, policy, or regulations. 63% of respondents identified this as a major or significant impediment to the adoption of biometric identification technologies in cross-border air travel. It was again seen as a greater challenge for the private sector (Figure 13).

Figure 13: Lack of guidance, policy, or regulations as an impediment to the adoption of biometric identity for cross-border air travel by degree of impact (top) and by type of stakeholder (bottom) based on survey findings



5.9 Proposed solutions to address the challenges and issues

Discussions were held with the interviewees on how to mitigate the challenges and issues faced by the air transport stakeholders in implementing biometric identification solutions in cross-border air travel. Several mitigation options emerged and are summarized in Table 5 for guidance purposes.

Table 5: Proposed solution to the challenges and issues faced in implementing biometric identification solutions in cross-border air travel

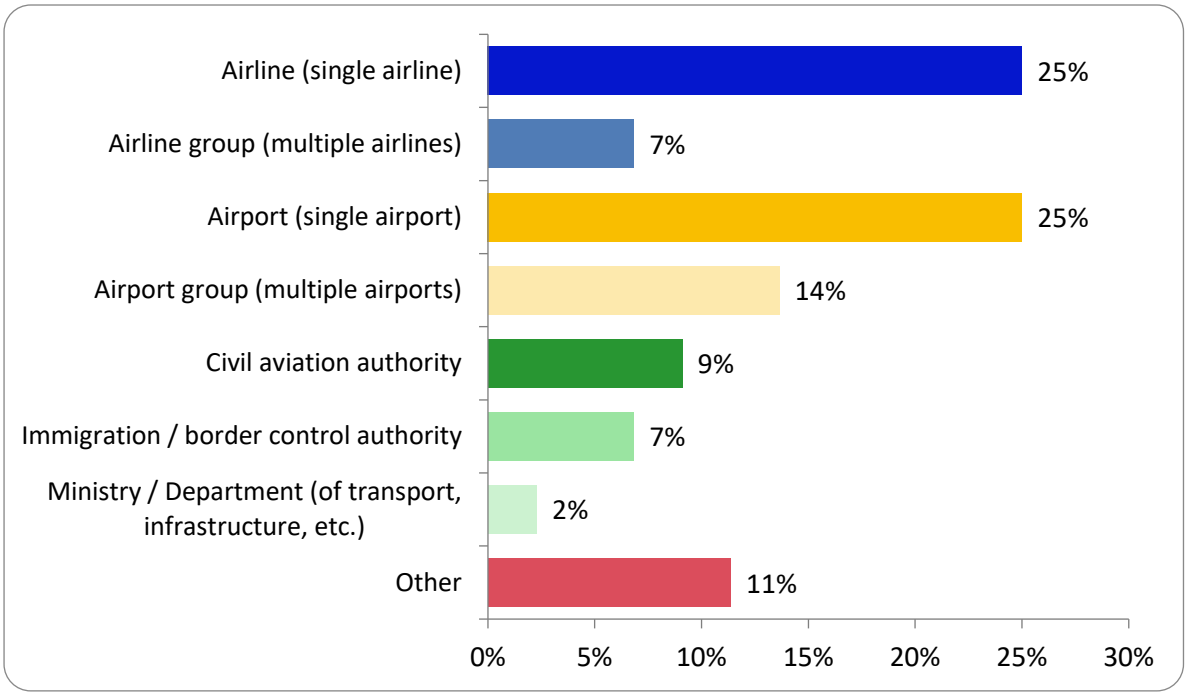
Challenges and issues	Proposed solutions
Concerns about data privacy and security	• Inform the travelers, in concise and simple language, about their rights in the collection, handling, storage, amendments, and deletion of their data, as well as the purpose of data usage and by whom

	• Seek informed consent from travelers
Regulatory or legal concern	• Hold discussions within and between countries/territories/economies to build a mutual understanding of how national regulations overlap and differ
Insufficient funding	• Prepare the case for public subsidies and private investment, by quantifying the tangible and indirect benefits of biometrics
Stakeholders' interest and support	• Increase awareness of the benefits of biometric adoption through regular communications • Consider incentives programs related to adoption
Stakeholder collaboration	• Encourage the involvement of government agencies to lead, promote, support or coordinate implementation programs as they have the "final say" on statutory requirements for security, border control, etc., and usually hold stronger influencing power
Technical hurdles	• Form technical groups to explore questions of data capture, ownership, and exchange • Be prepared for changes (e.g., infrastructural) to accommodate the implementation
Uncertainties in requirements and expectations	• Form a working group to agree on the policies, regulations, SARPs, and user requirements on biometric

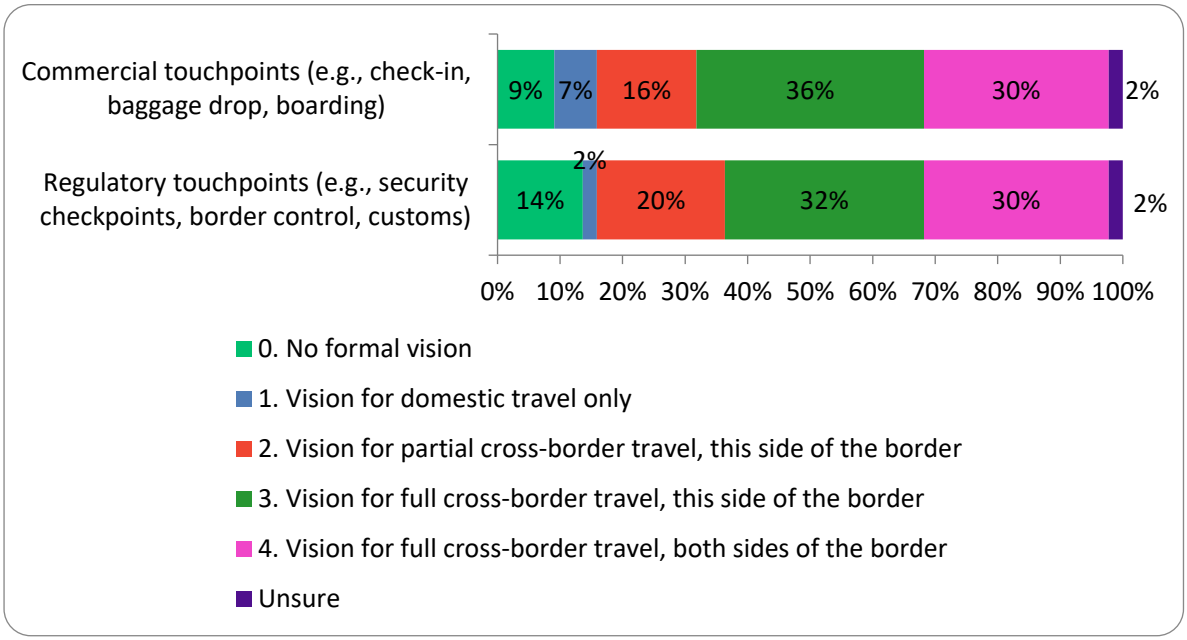
6. Appendix

Appendix A: Aggregated survey results

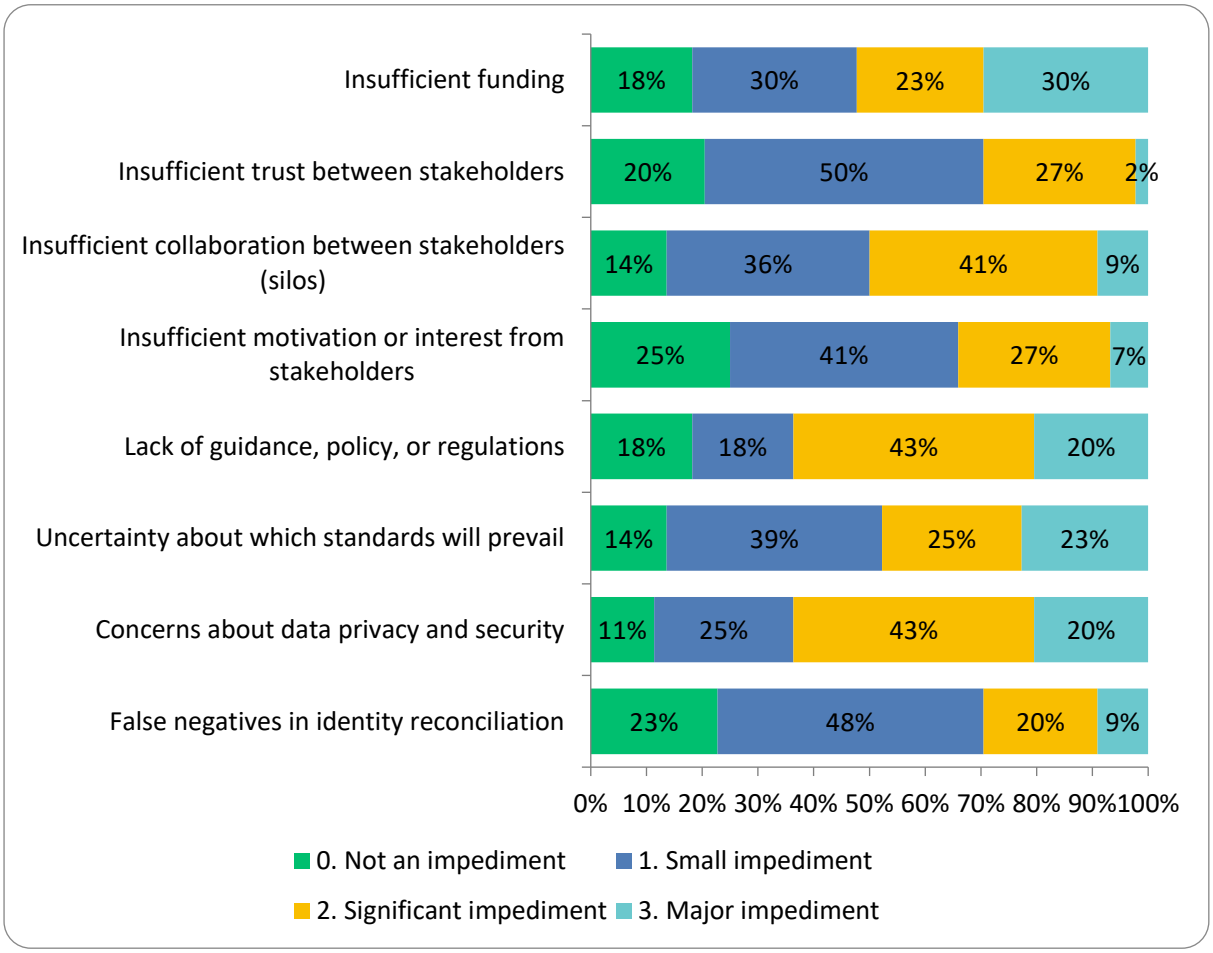
Q. What best describes your organization? [No. of responses: 44]



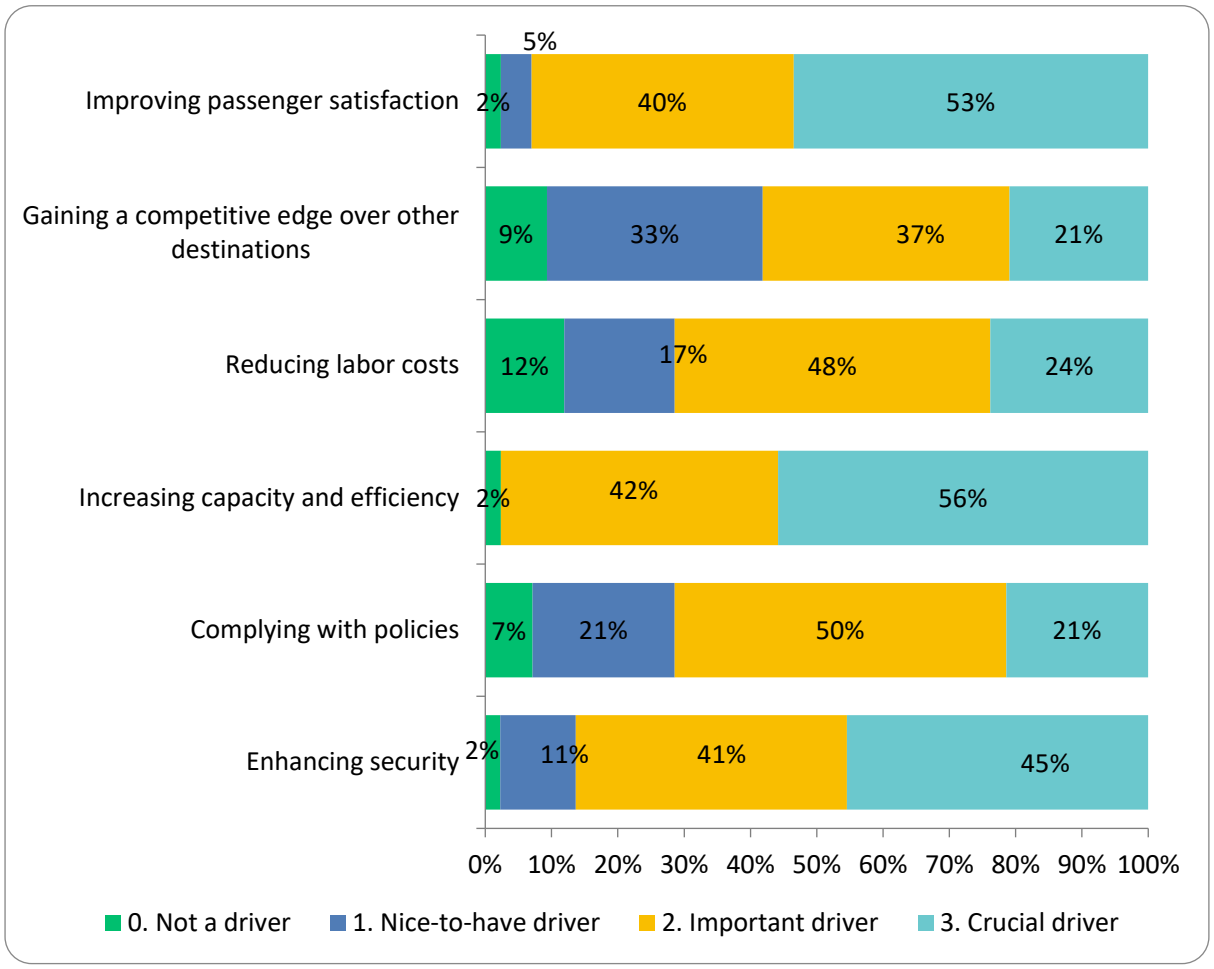
Q. Is there a clear vision or ambition for using biometric identity in air travel in your country/territory, airline(s), or airport(s), and how far does it extend? [No. of responses: 44]



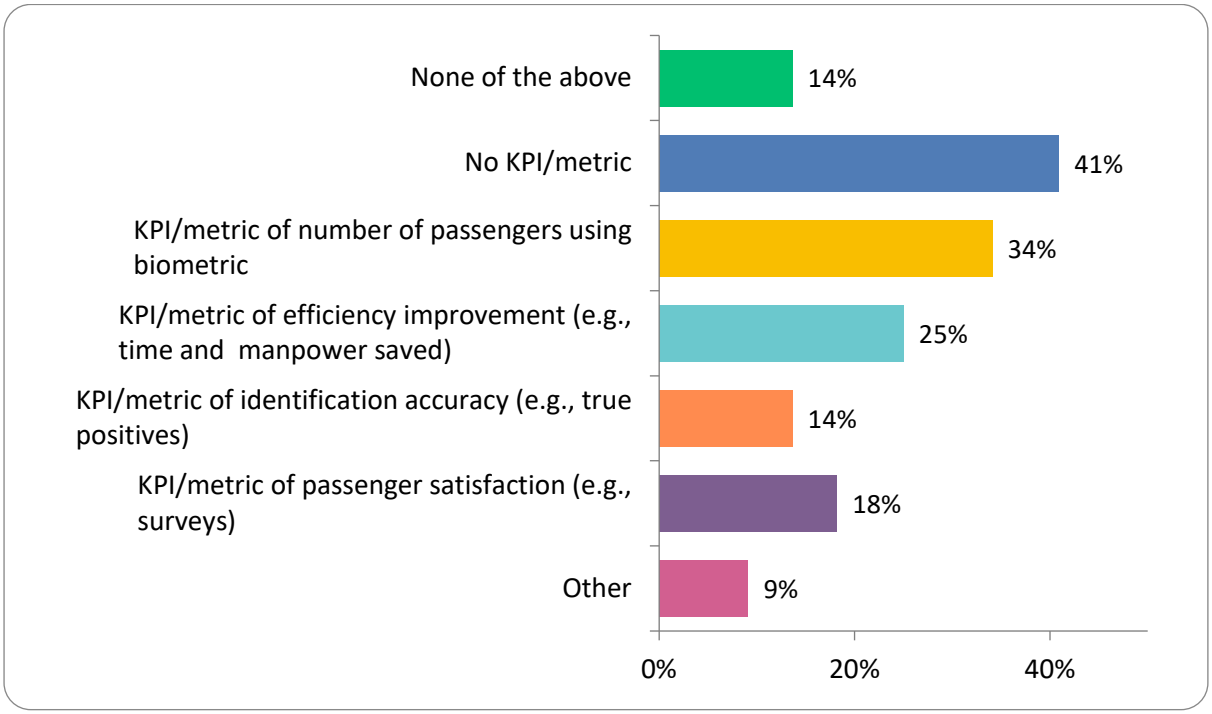
Q. What are the main impediments to the adoption of biometric identity for cross-border air travel in your country/territory, airline(s), or airport(s)? [No. of responses: 44]



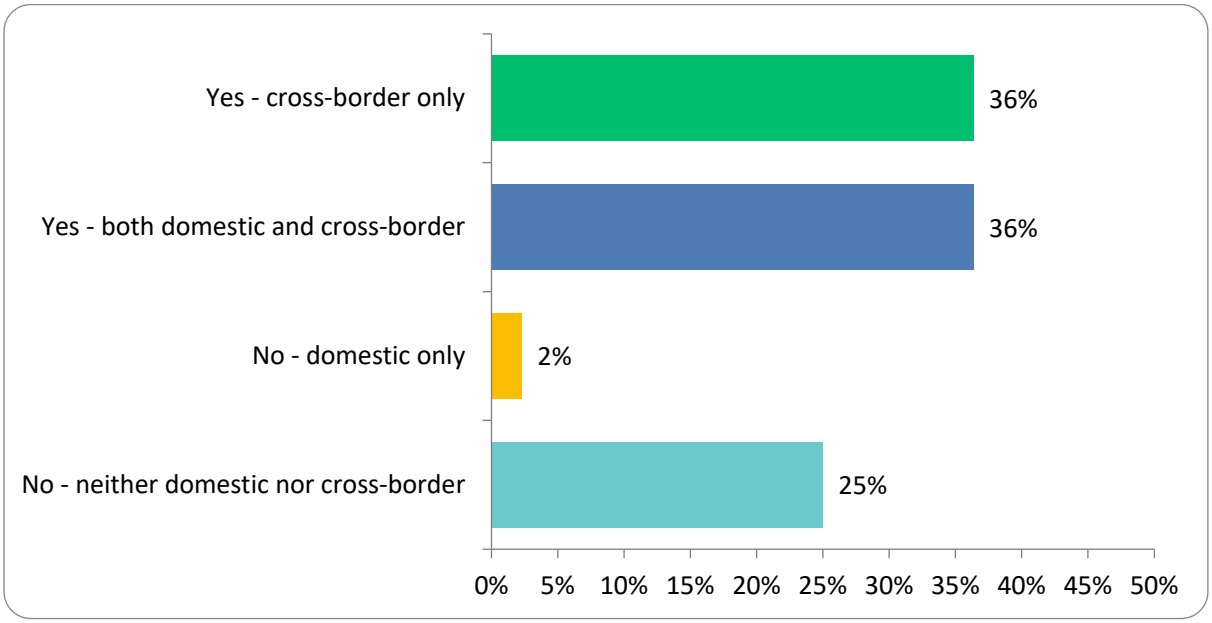
Q. What are the main drivers for the adoption of biometric identity for cross-border air travel in your country/territory, airline(s), or airport(s)? [No. of responses: 44]



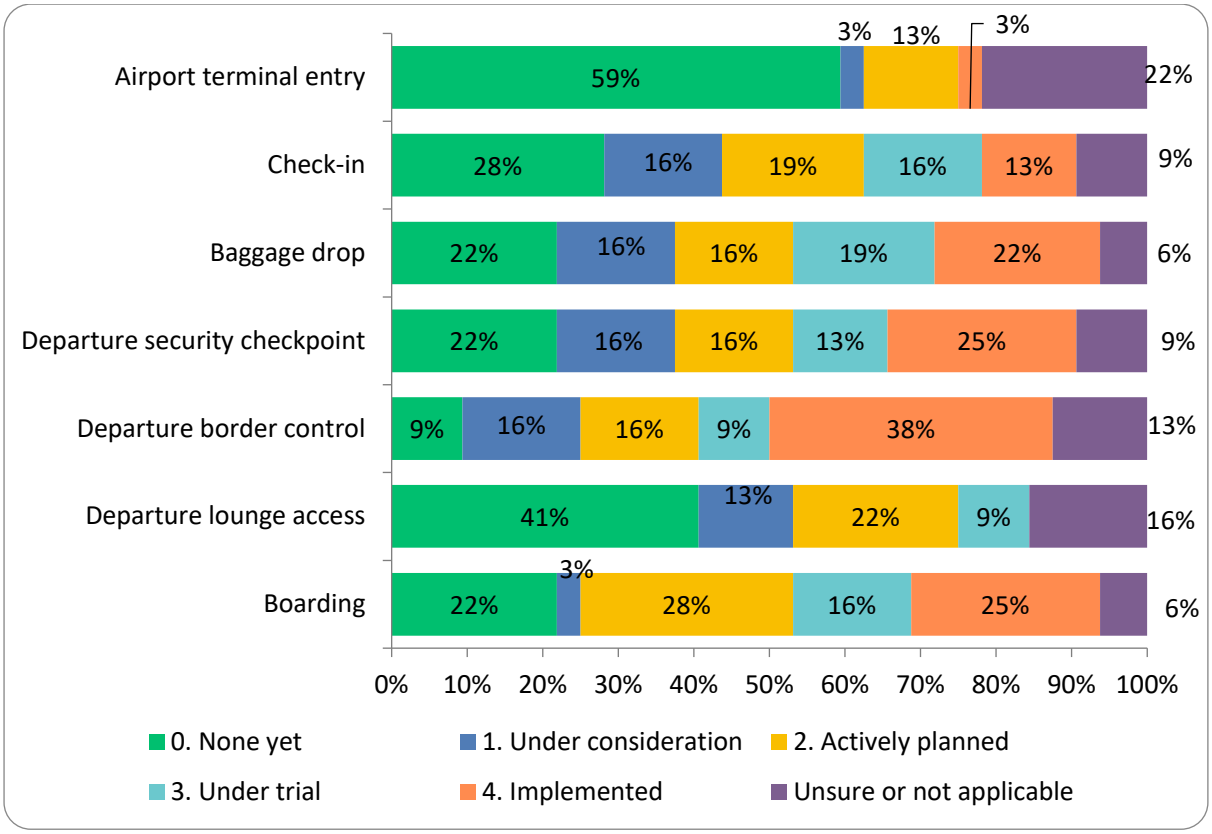
Q. Do you currently measure progress toward biometric adoption for cross-border air travel in your country/territory, airline(s), or airport(s) using KPIs/metrics? [No. of responses: 44]



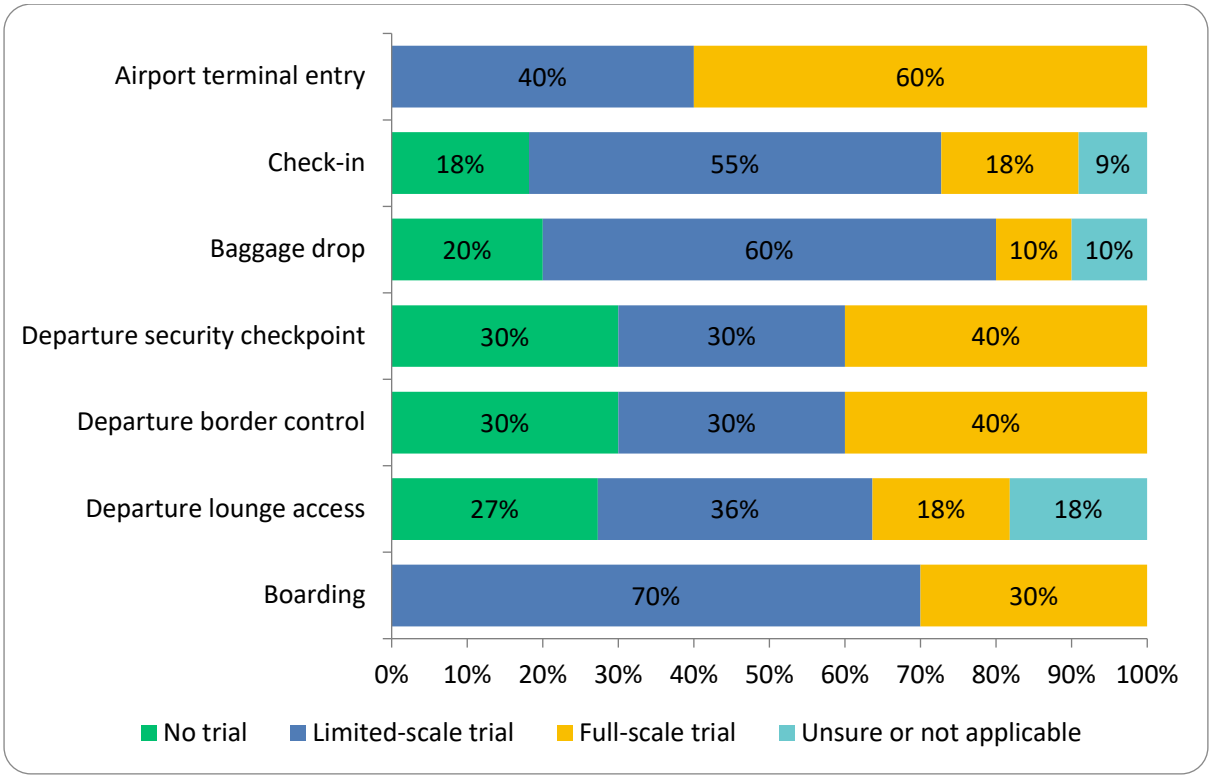
Q: Are you aware of any biometric implementation for cross-border air travel being considered, actively planned, under trial, or already implemented anywhere in your country/territory, airline(s), or airport(s)? [No. of responses: 44]



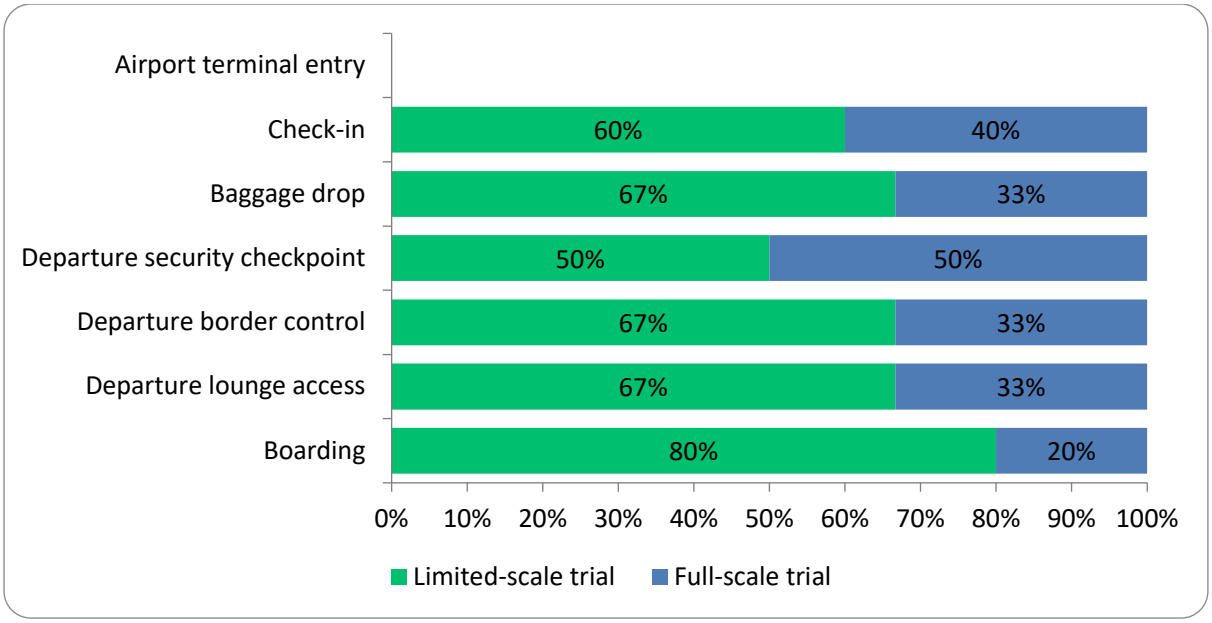
Q: What is the most advanced current state of adoption of biometric identity for outbound (departing) cross-border air travel in your country/territory, airline(s), or airport(s)? [No. of responses: 32]



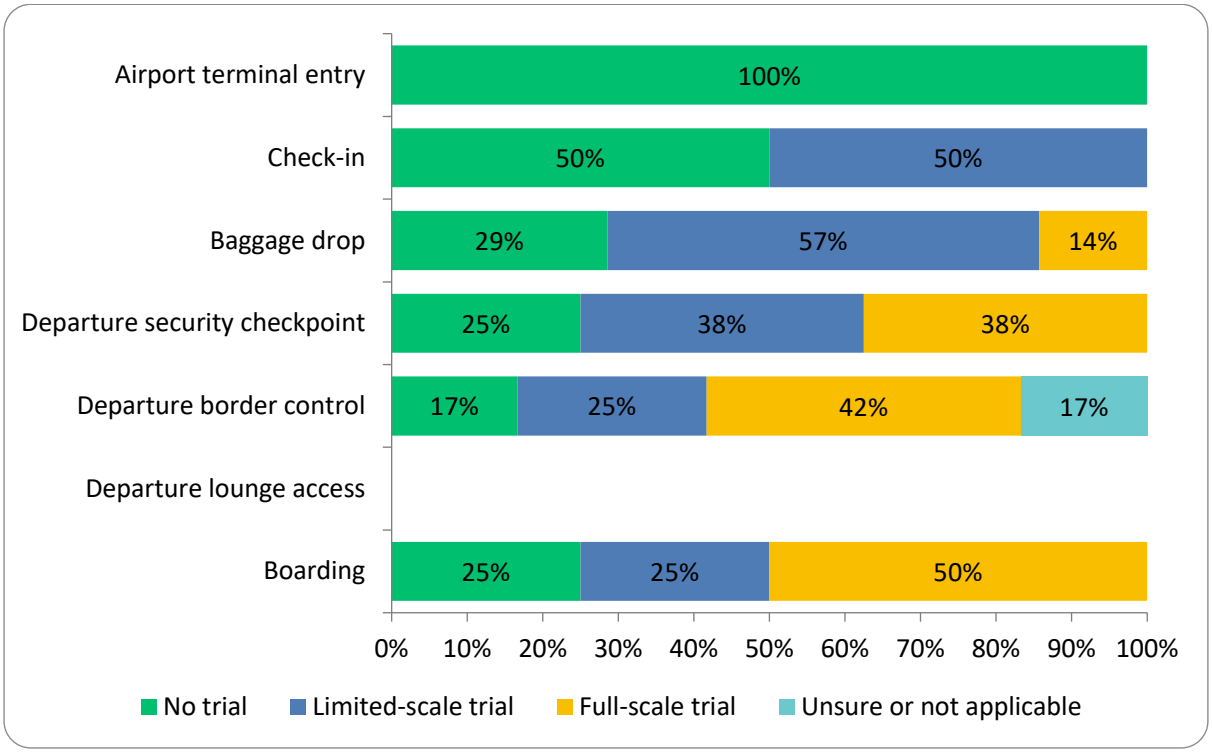
Q: For the following outbound touchpoints you selected earlier (i.e., indicated "Under consideration" or "Actively planned"), is a trial being considered prior to implementation? [No. of responses: 24]



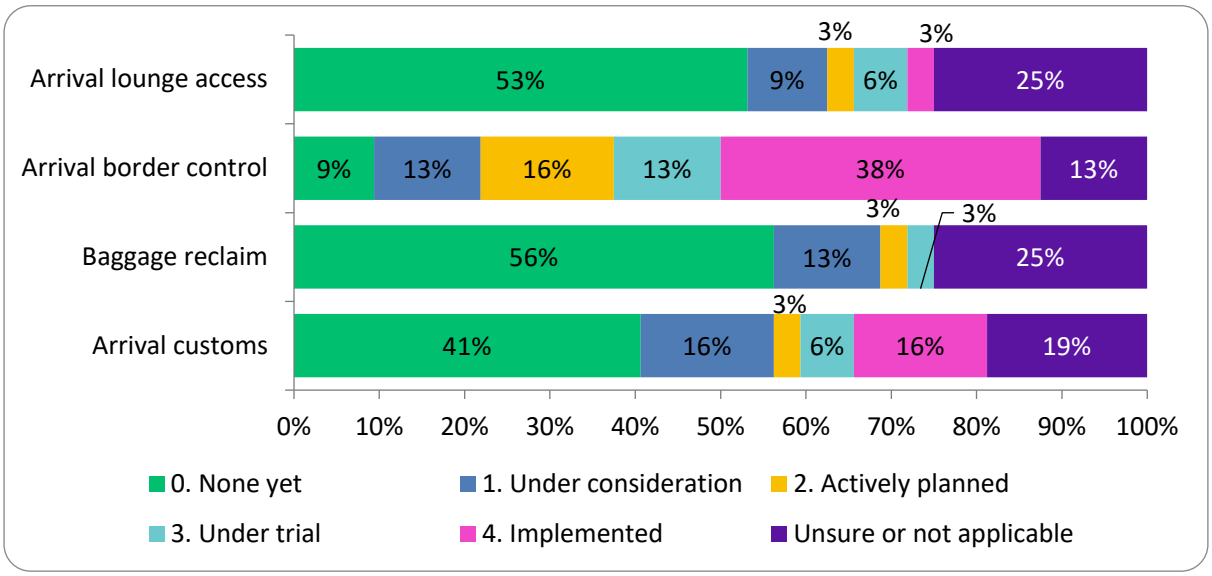
Q: For the following outbound touchpoints you selected earlier (i.e., indicated "Under trial"), what is the nature of the trial that is underway? [No. of responses: 11]



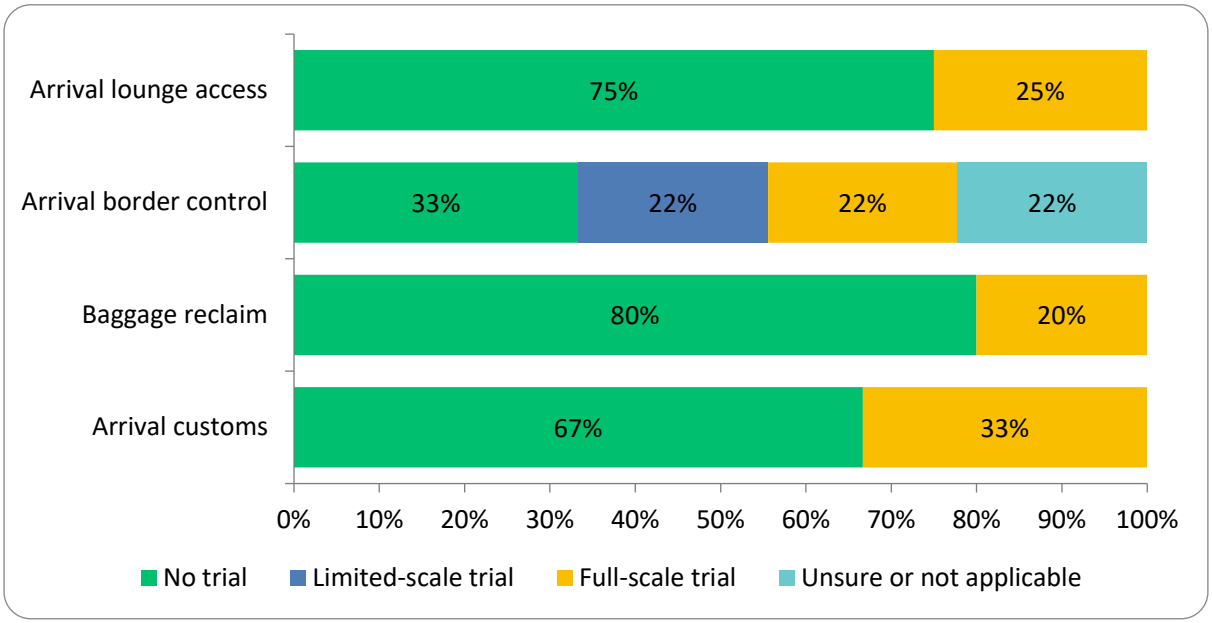
Q: For the following outbound touchpoints you selected earlier (i.e., indicated "Implemented"), was a trial conducted prior to implementation? [No. of responses: 17]



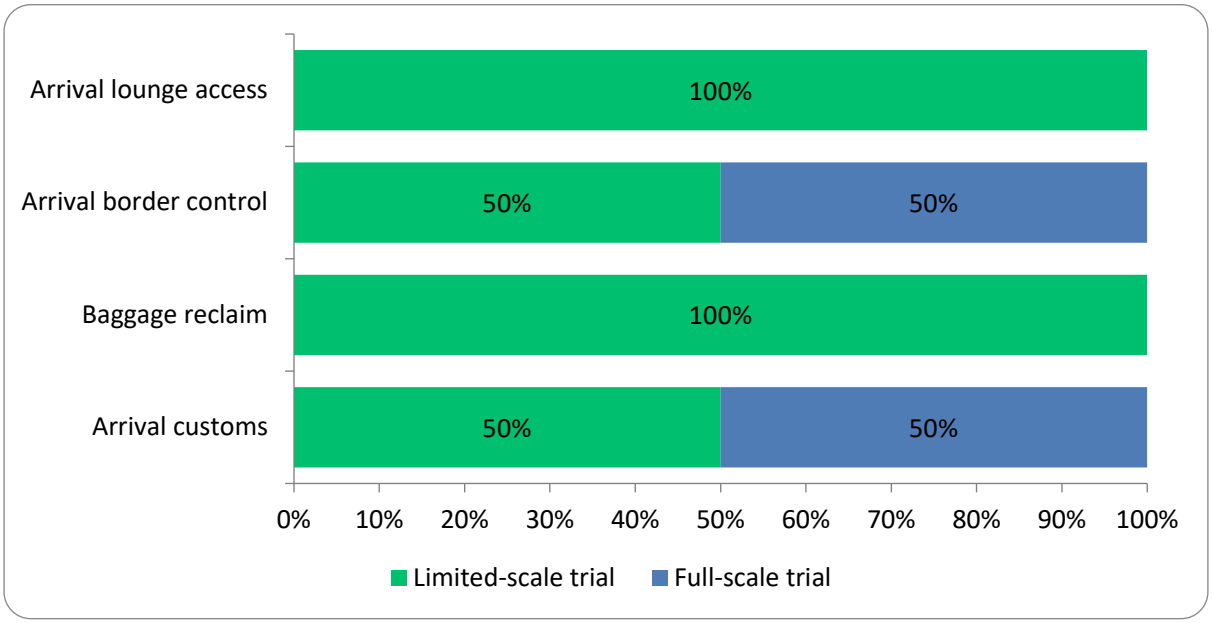
Q: What is the most advanced current state of adoption of biometric identity for inbound (arriving) cross-border air travel in your country/territory, airline(s), or airport(s)? [No. of responses: 32]



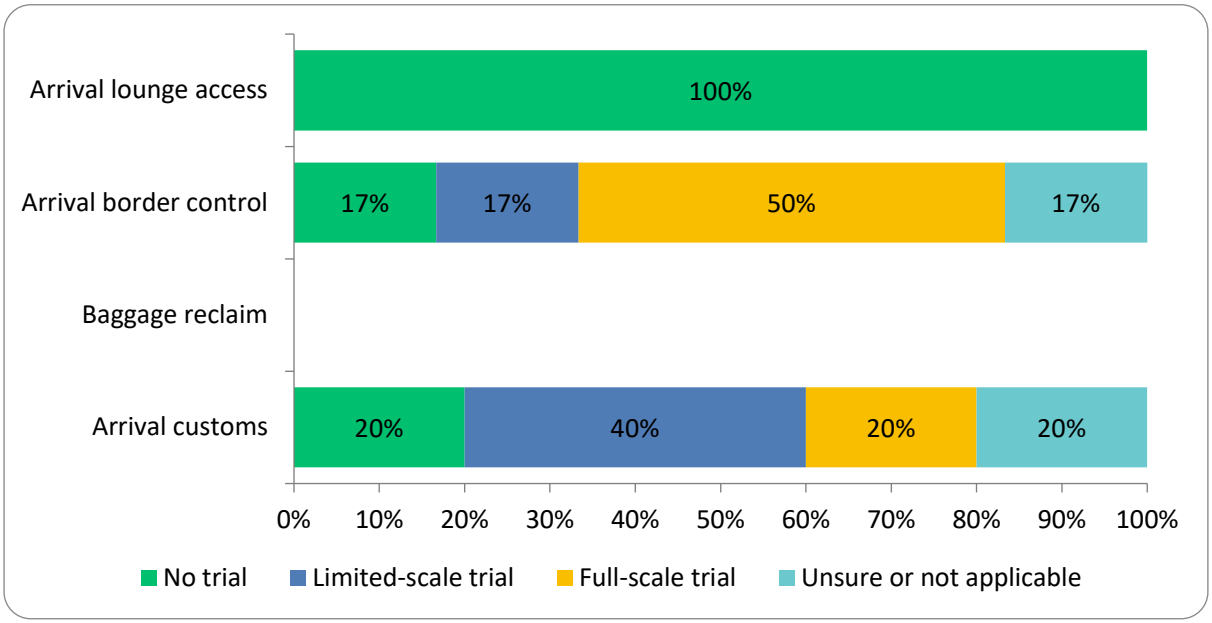
Q: For the following inbound touchpoints you selected earlier (i.e., indicated "Under consideration" or "Actively planned"), was a trial being considered prior to implementation? [No. of responses: 11]



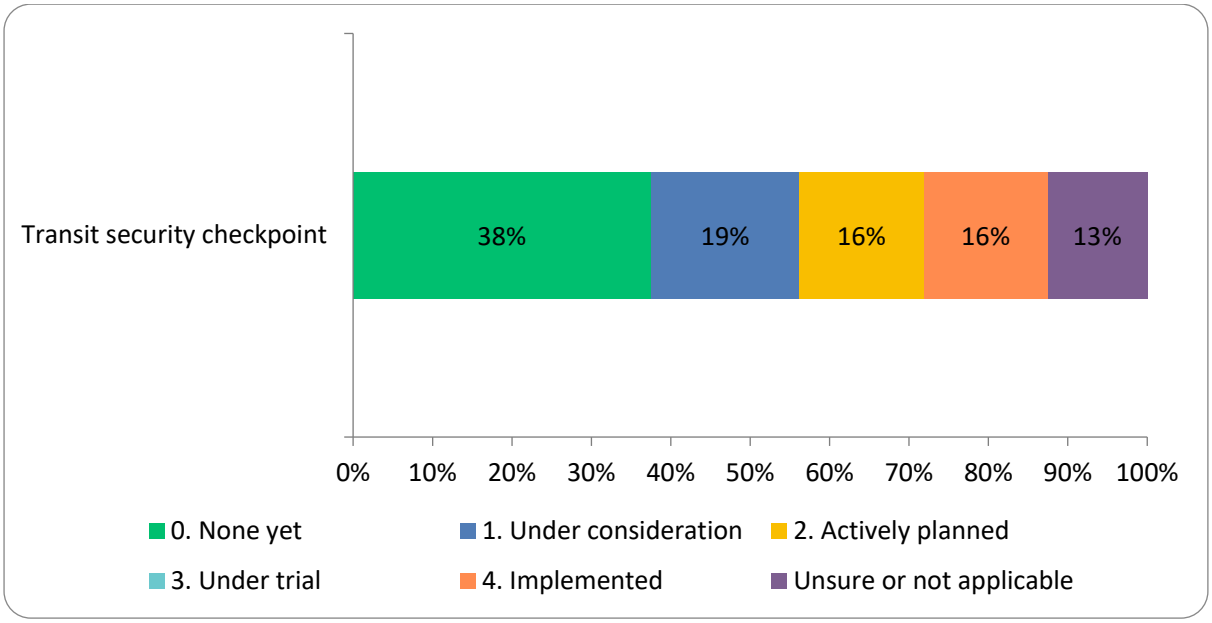
Q: For the following inbound touchpoints you selected earlier (i.e., indicated "Under trial"), what is the nature of the trial that is underway? [No. of responses: 5]



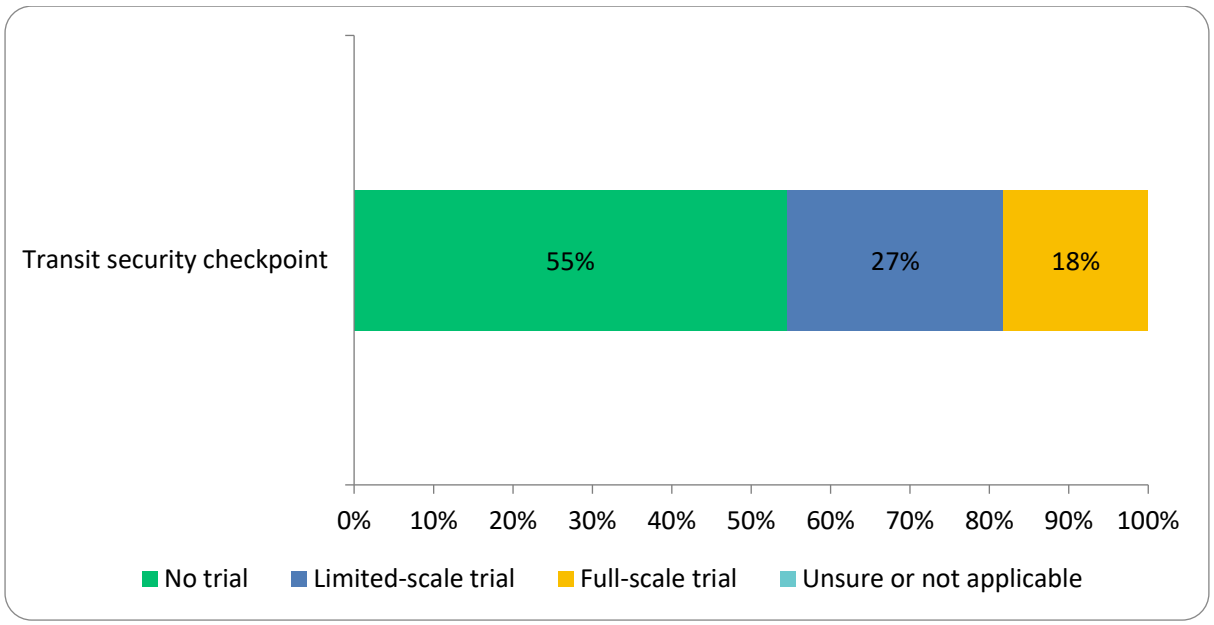
Q: For the following inbound touchpoints you selected earlier (i.e., indicated "Implemented"), was a trial conducted prior to implementation? [No. of responses: 14]



Q: What is the most advanced current state of adoption of biometric identity for transit cross-border air travel in your country/territory, airline(s), or airport(s)? [No. of responses: 32]



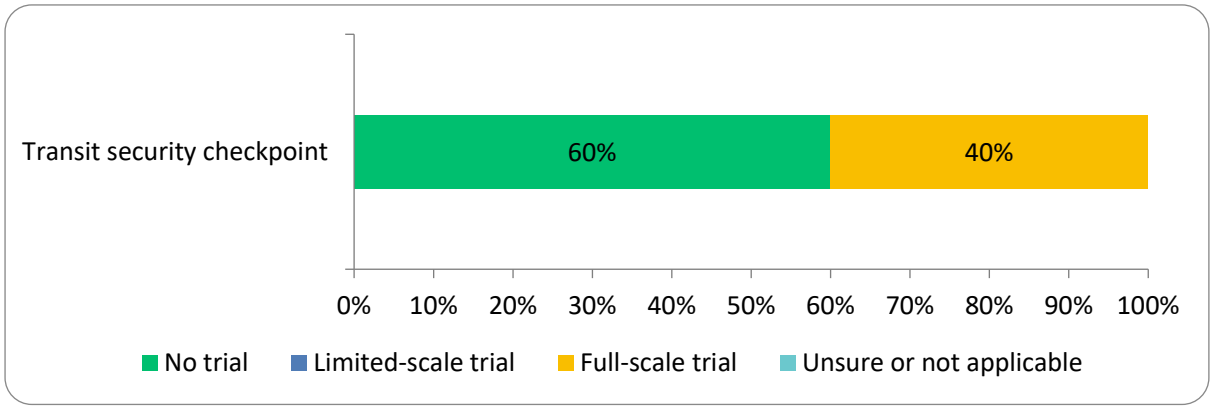
Q: For the following transit touchpoints you selected earlier (i.e., indicated "Under consideration" or "Actively planned"), is a trial being considered prior to implementation? [No. of responses: 11]



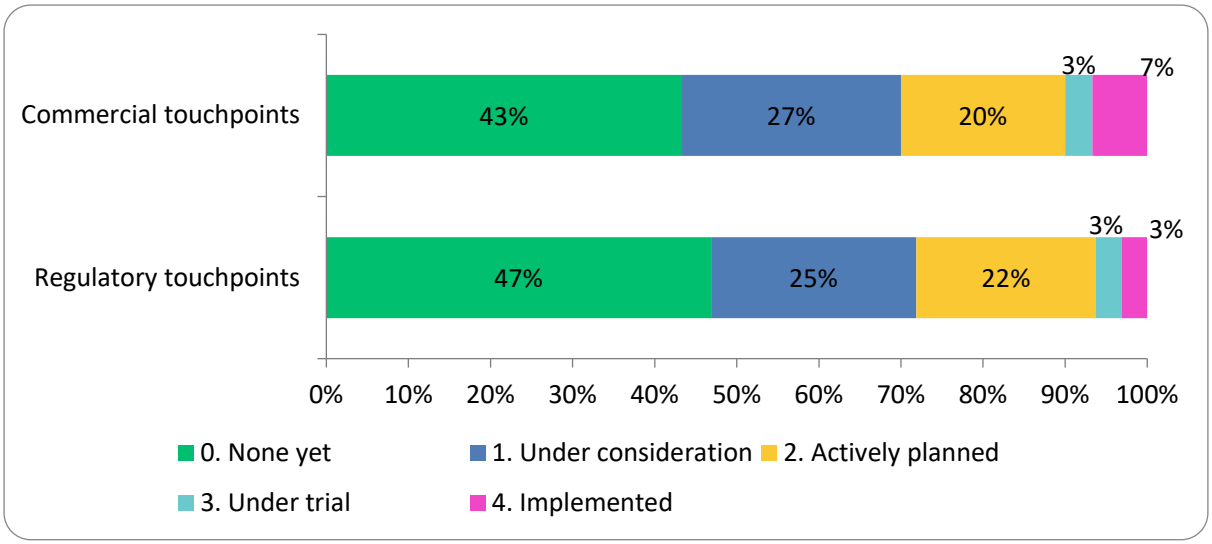
Q: For the following transit touchpoints you selected earlier (i.e., indicated "Under trial"), what is the nature of the trial that is underway? [No. of responses: 0]

N.A. (no responses)

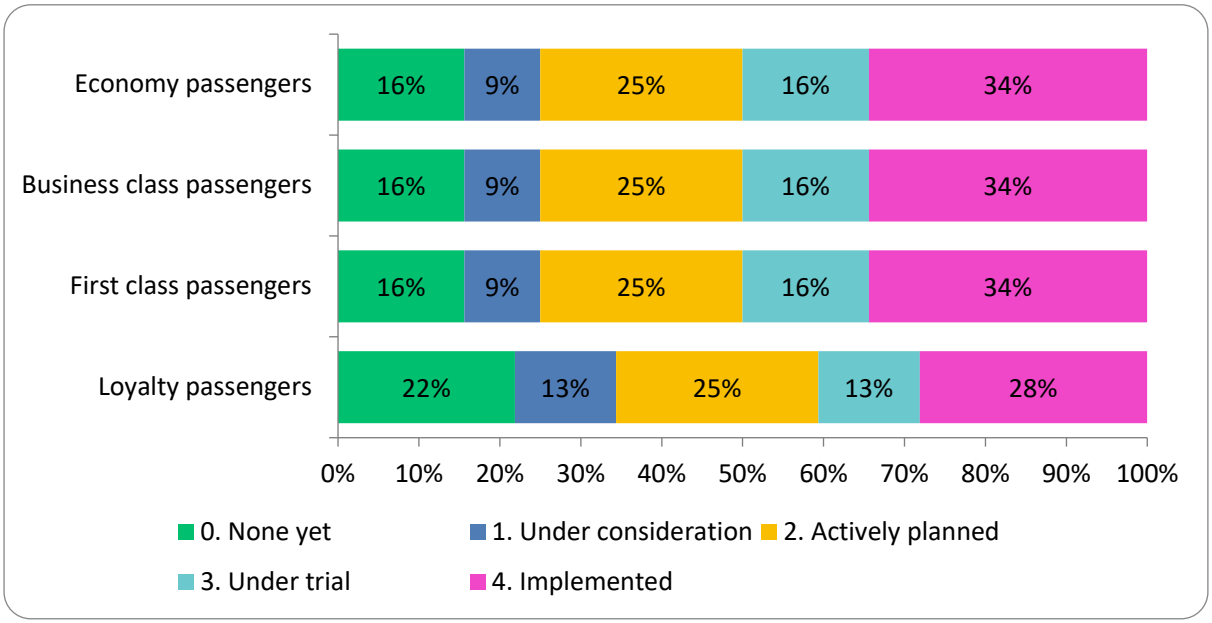
Q: For the following transit touchpoints you selected earlier (i.e., indicated "Implemented"), was a trial conducted prior to implementation? [No. of responses: 5]



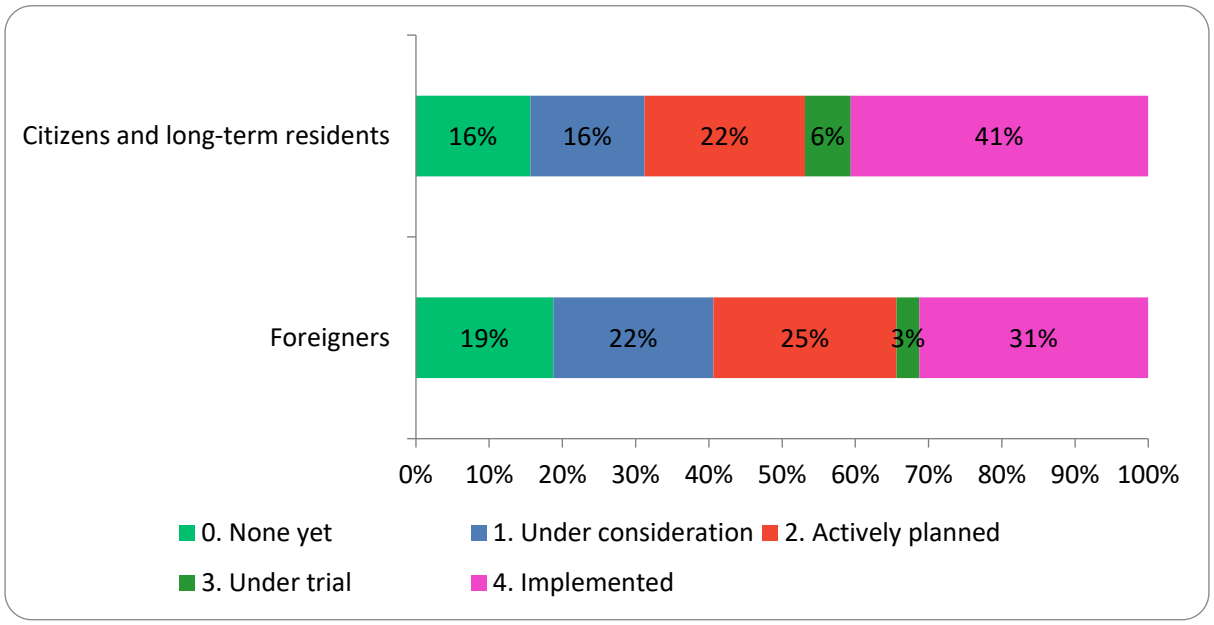
Q: Has there been any attempt at adopting a reciprocal/shared biometric identity for complete round-trip travel (both sides of the border) with another country/territory, foreign airline(s), or foreign airport(s)? [No. of responses: 32]



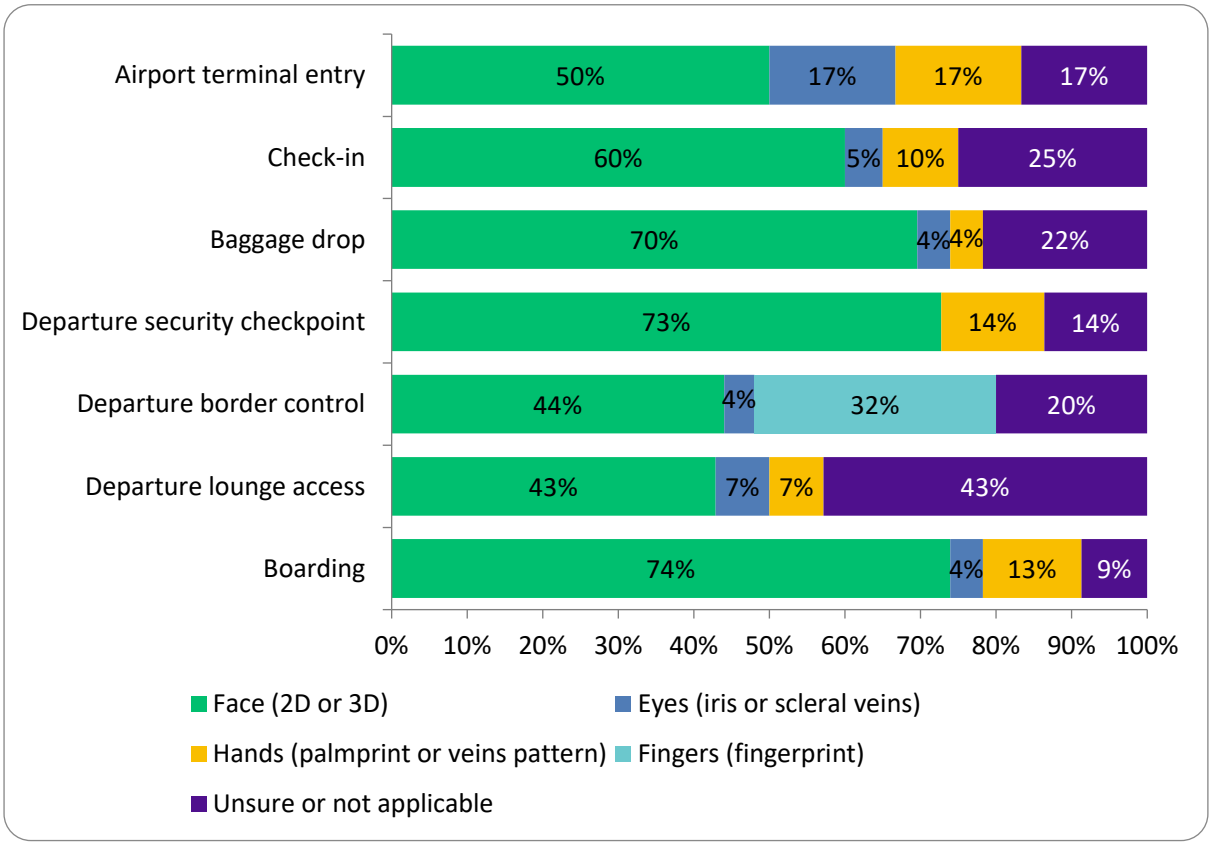
Q: How is biometric identity for cross-border travel being planned or implemented across travel classes or passenger status? [No. of responses: 32]



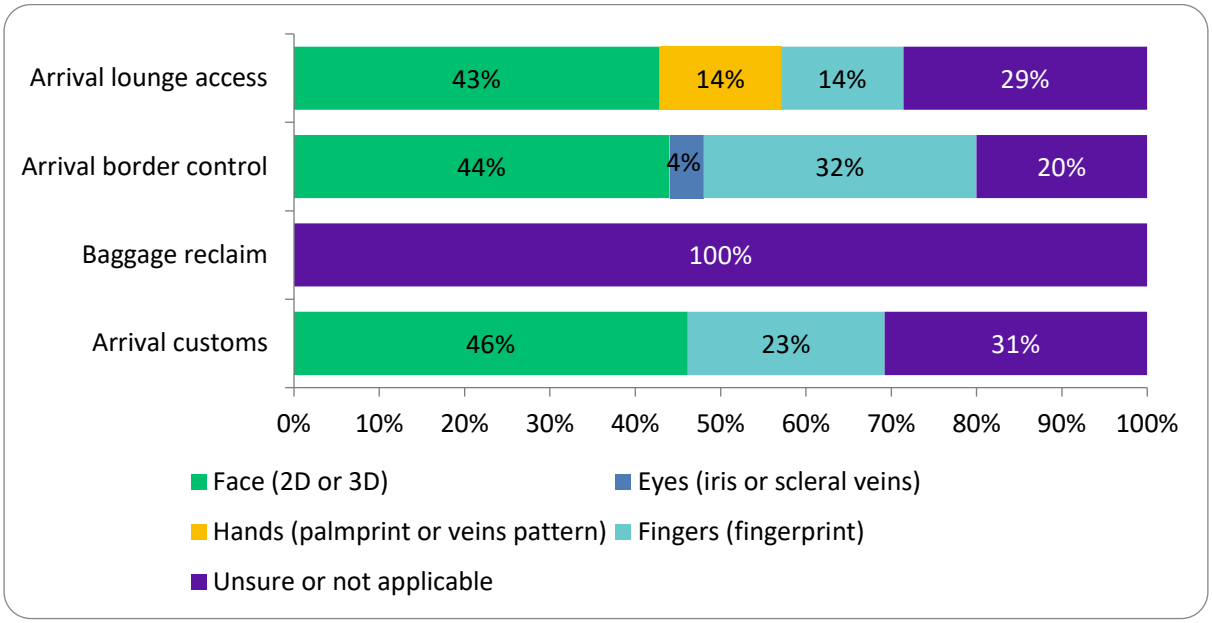
Q: How is biometric identity for cross-border travel being planned or implemented across nationalities? [No. of responses: 32]



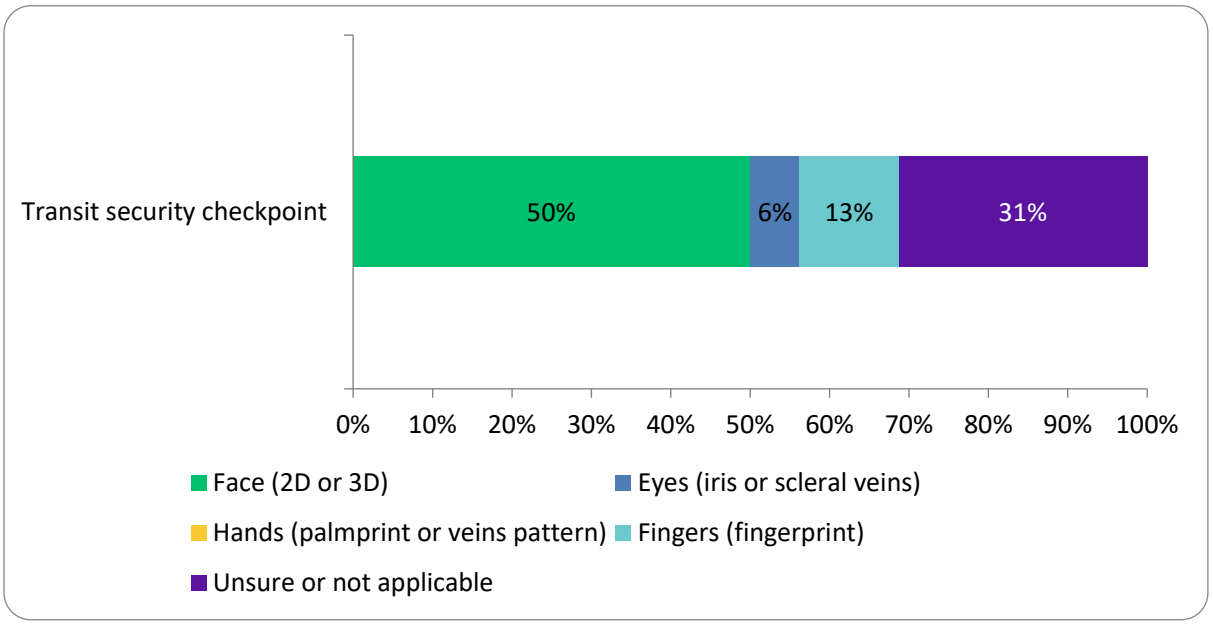
Q: For the following outbound touchpoints you selected earlier, which types of biometrics are being used? [No. of responses: 29]



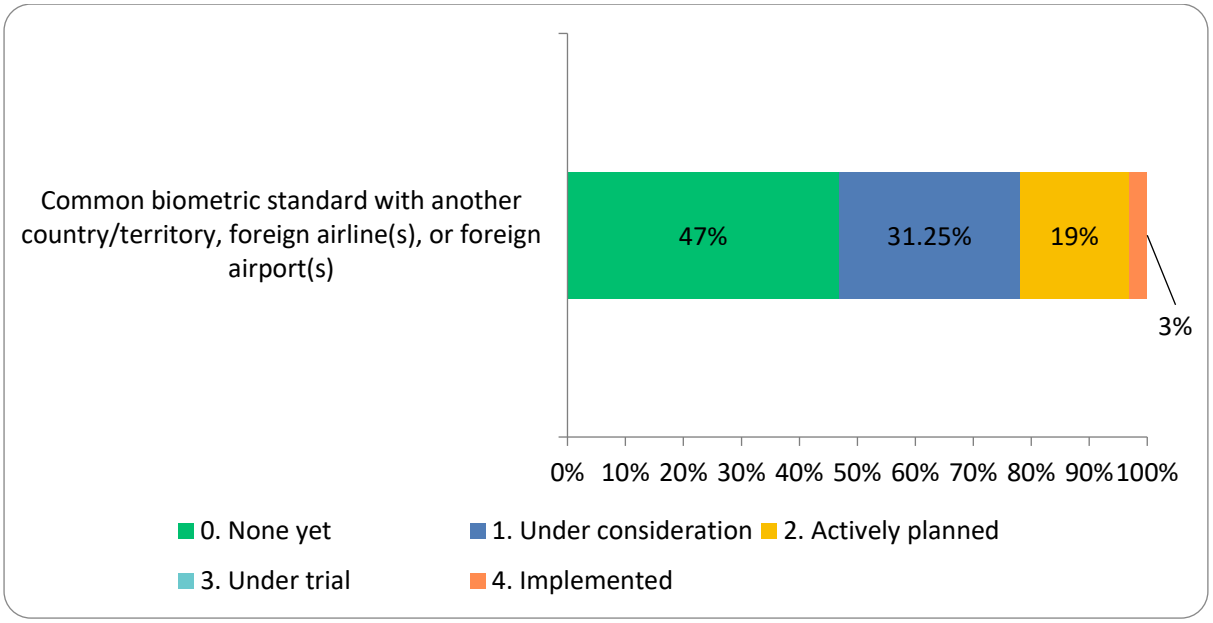
Q: For the following inbound touchpoints you selected earlier, which types of biometrics are being used? [No. of responses: 27]



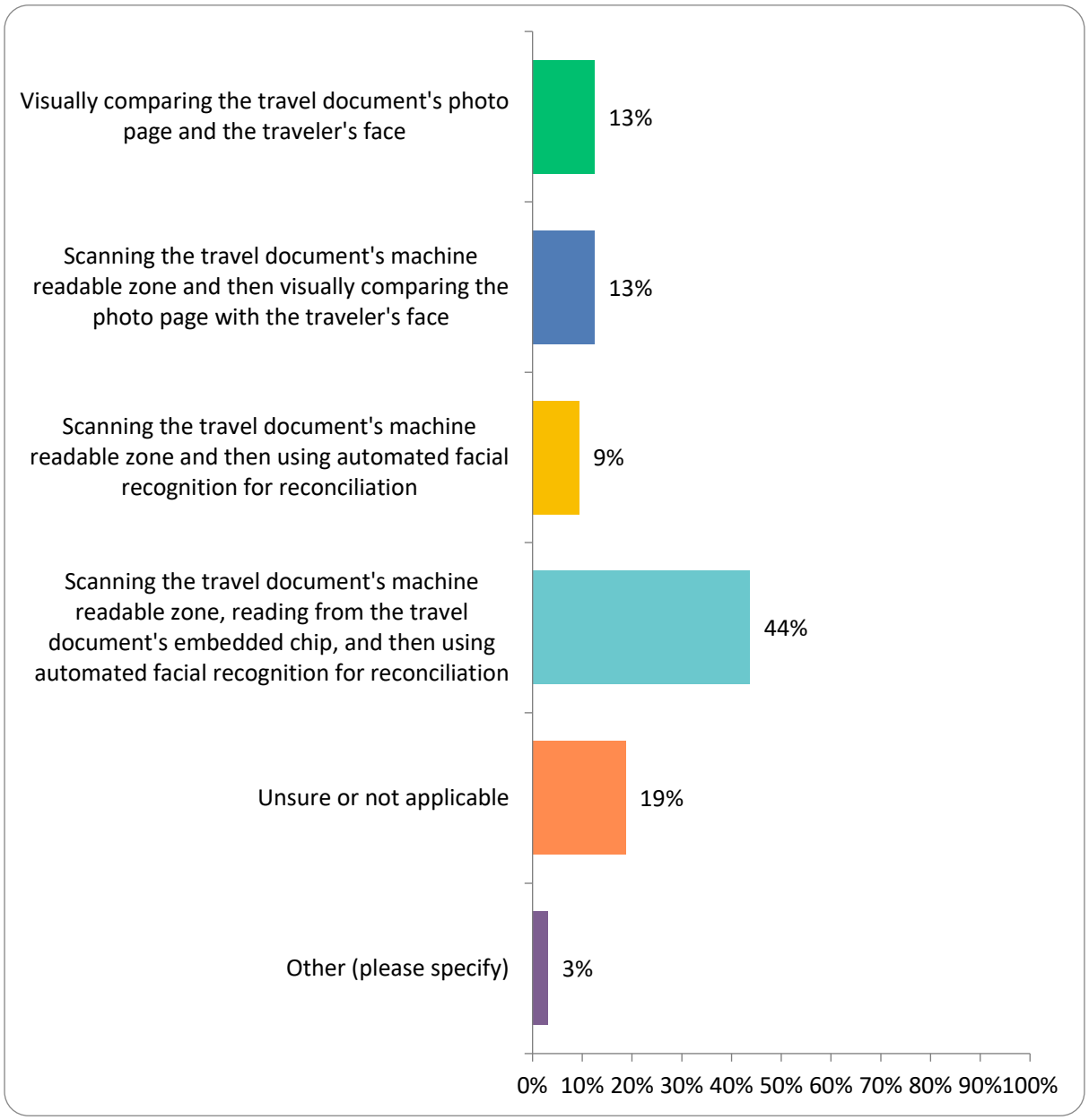
Q: For the following transit touchpoint you selected earlier, which types of biometrics are being used? [No. of responses: 16]



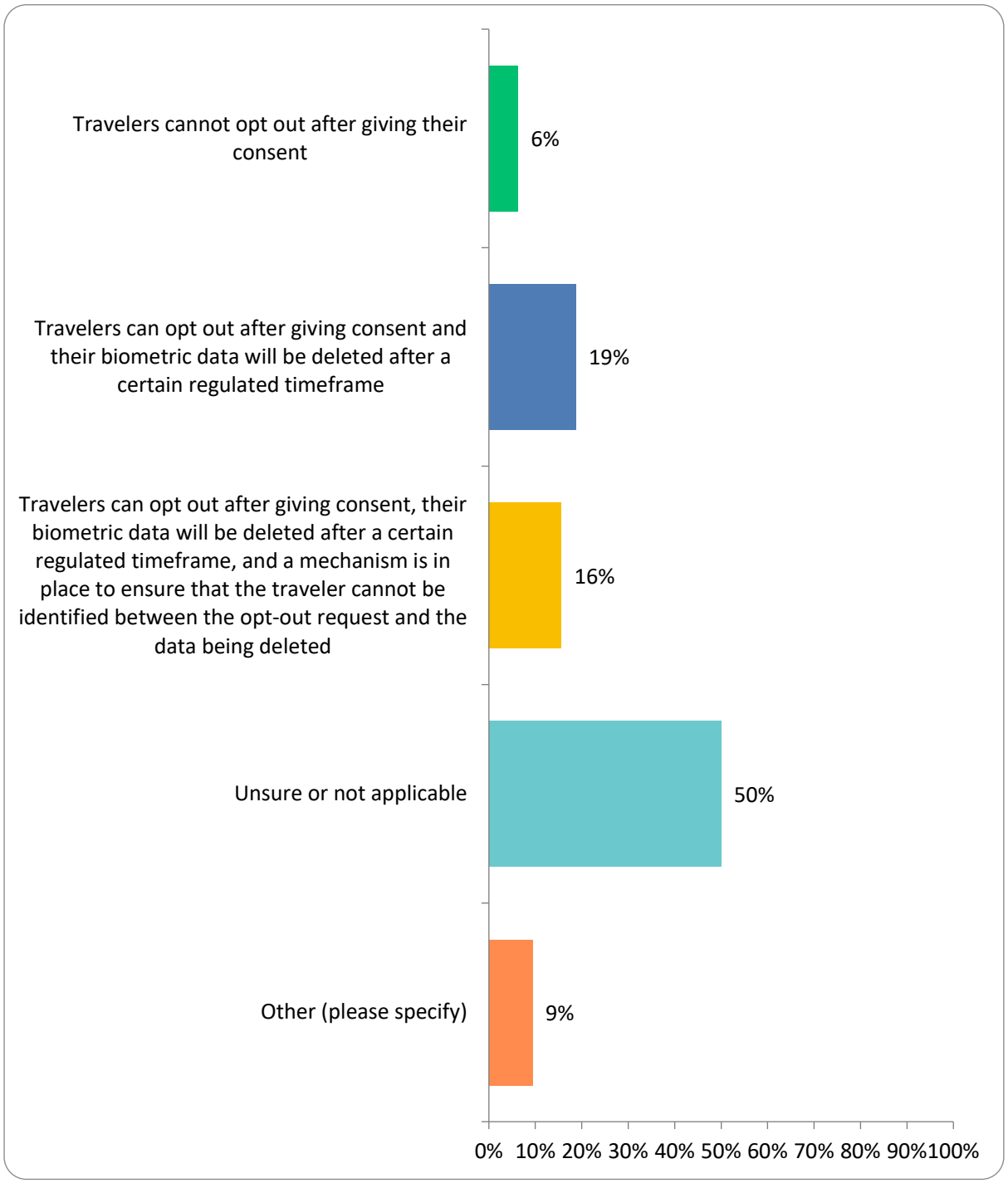
Q: Has there been any attempt in your country/territory, airline(s), or airport(s) at mutually recognizing the biometric in use with another country/territory, foreign airline(s), or foreign airport(s), so that the same standard applies on both sides of the border? [No. of responses: 32]



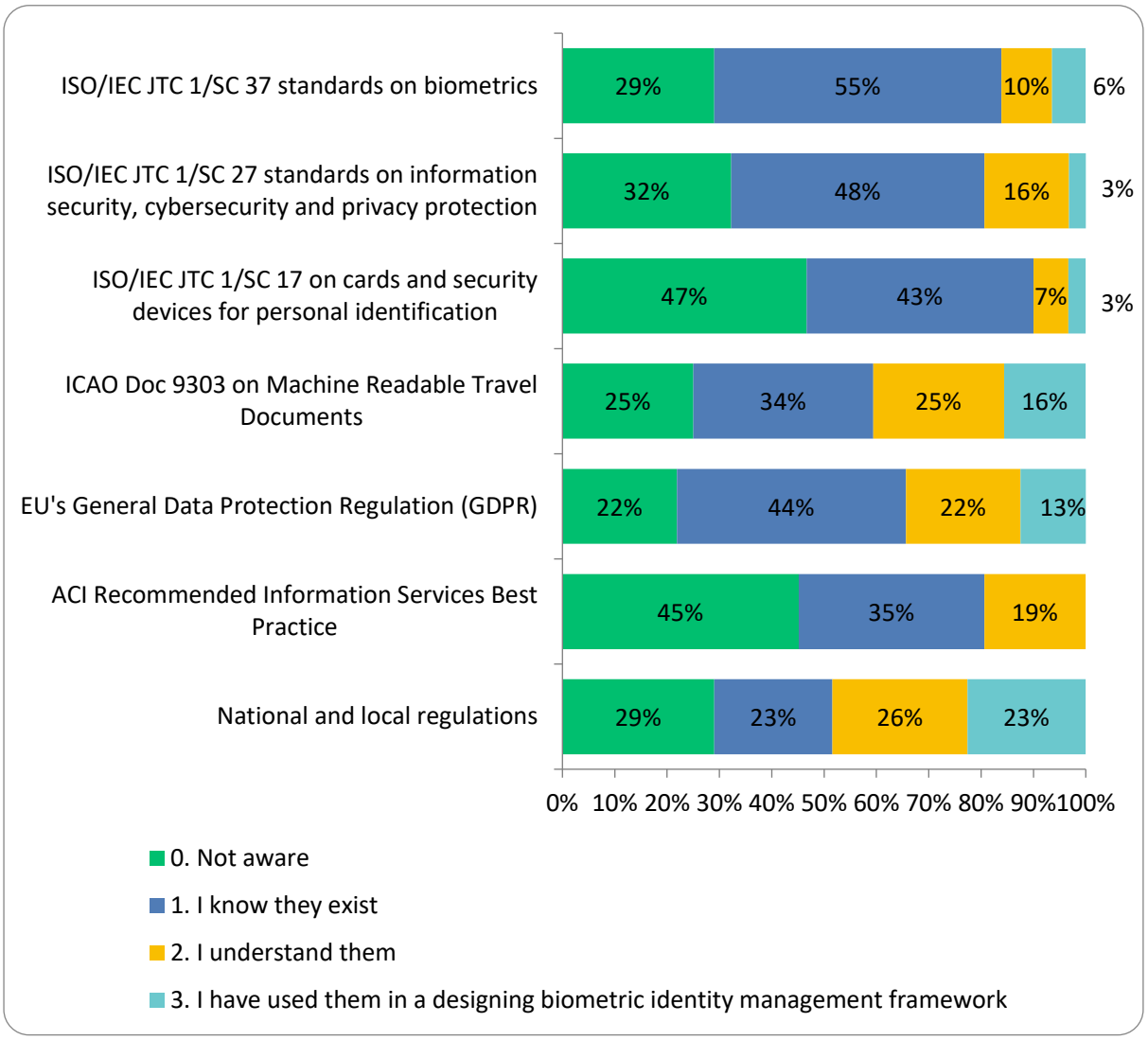
Q: How is the cross-border traveler's face reconciled with their travel document (e.g., passport) in your country/territory, airline(s), or airport(s)? [No. of responses: 32]



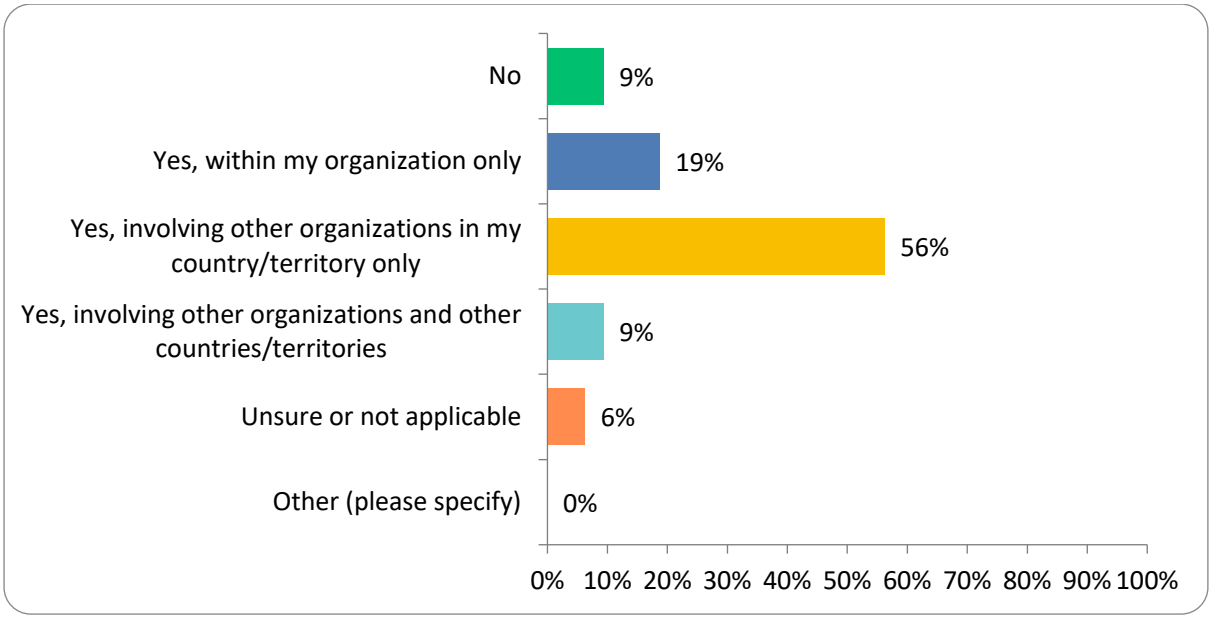
Q: Is a process in place for the subsequent opting-out of biometric data? [No. of responses: 32]



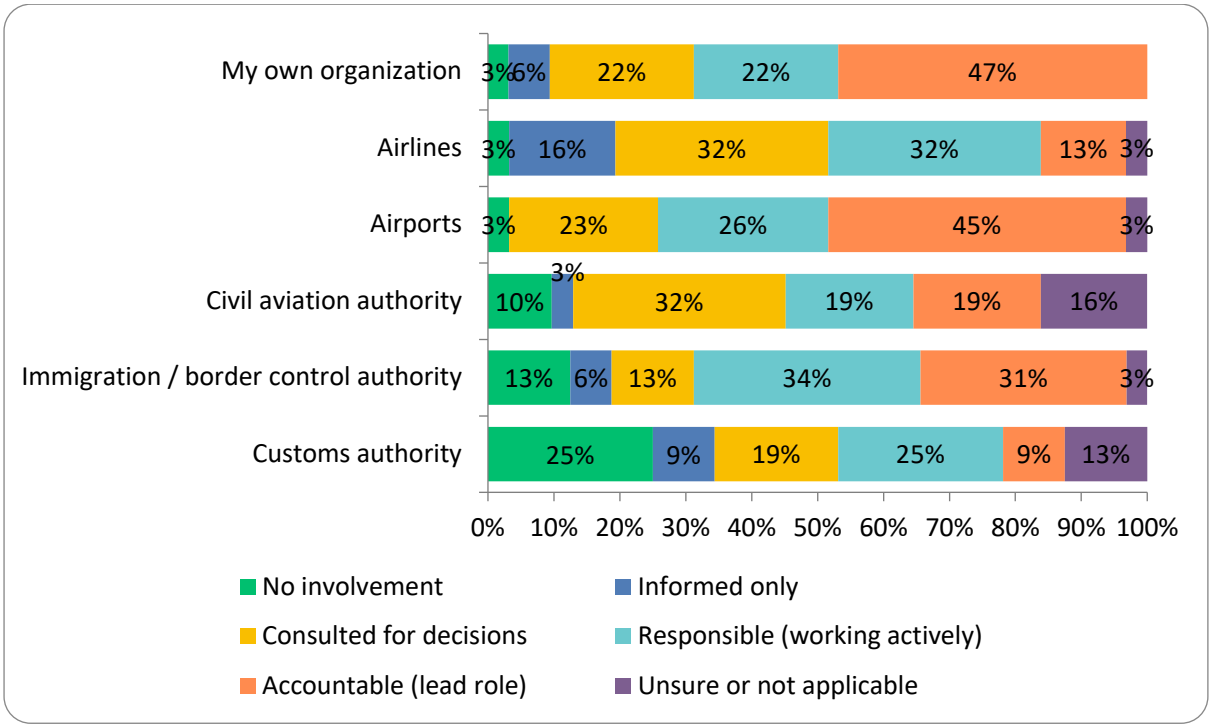
Q: How aware are you of the following standards, recommended practices, and regulations? [No. of responses: 32]



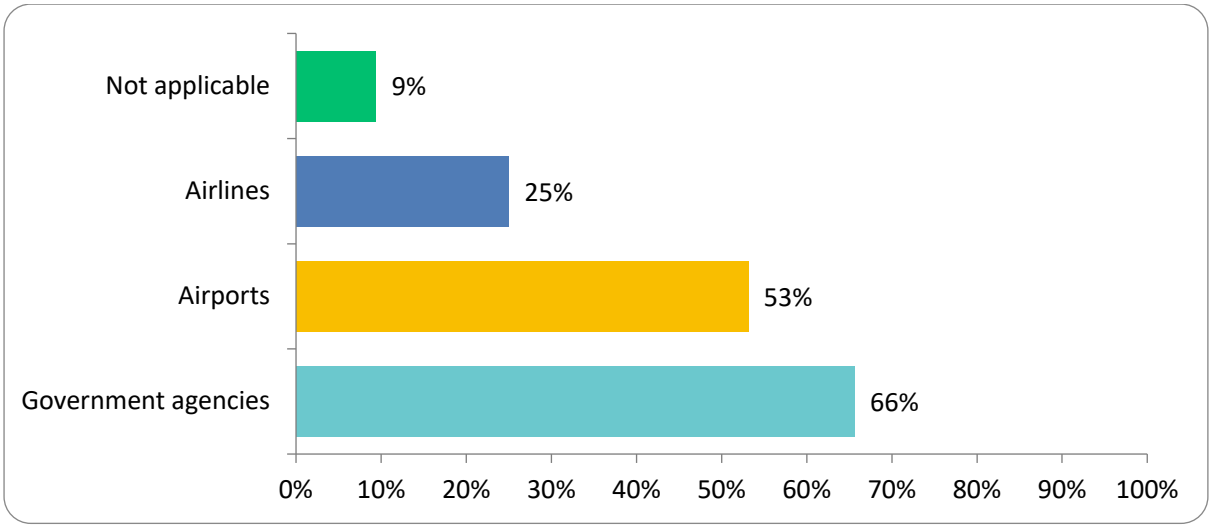
Q: Is there a forum or working group to assign responsibilities, plan activities, and track progress in the implementation of biometrics for cross-border air travel? [No. of responses: 32]



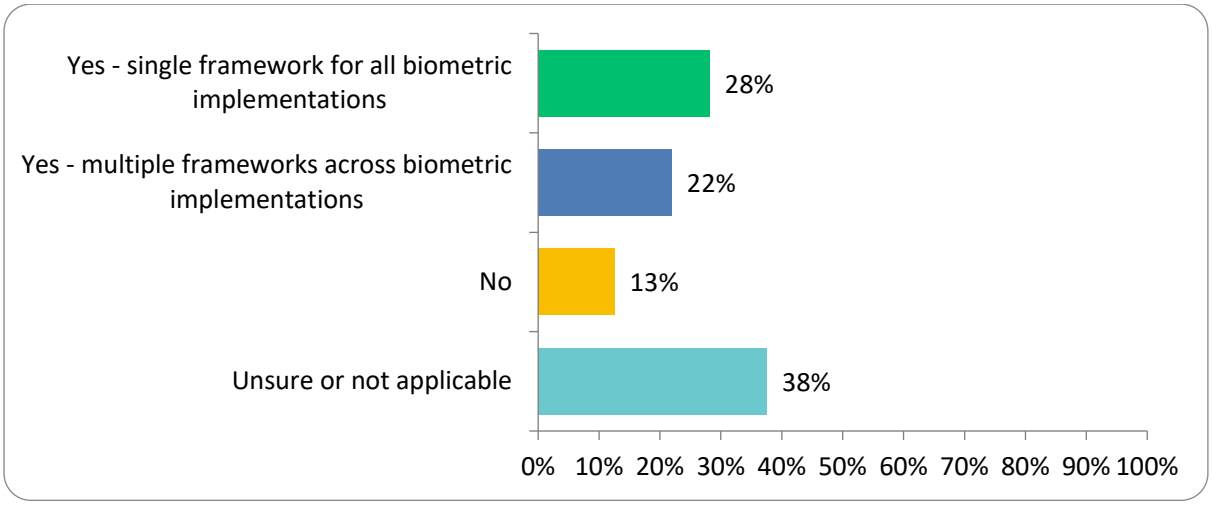
Q: Which stakeholders are involved in planning the implementation of biometrics for cross-border air travel in your country/territory, airline(s), or airport(s)? [No. of responses: 32]



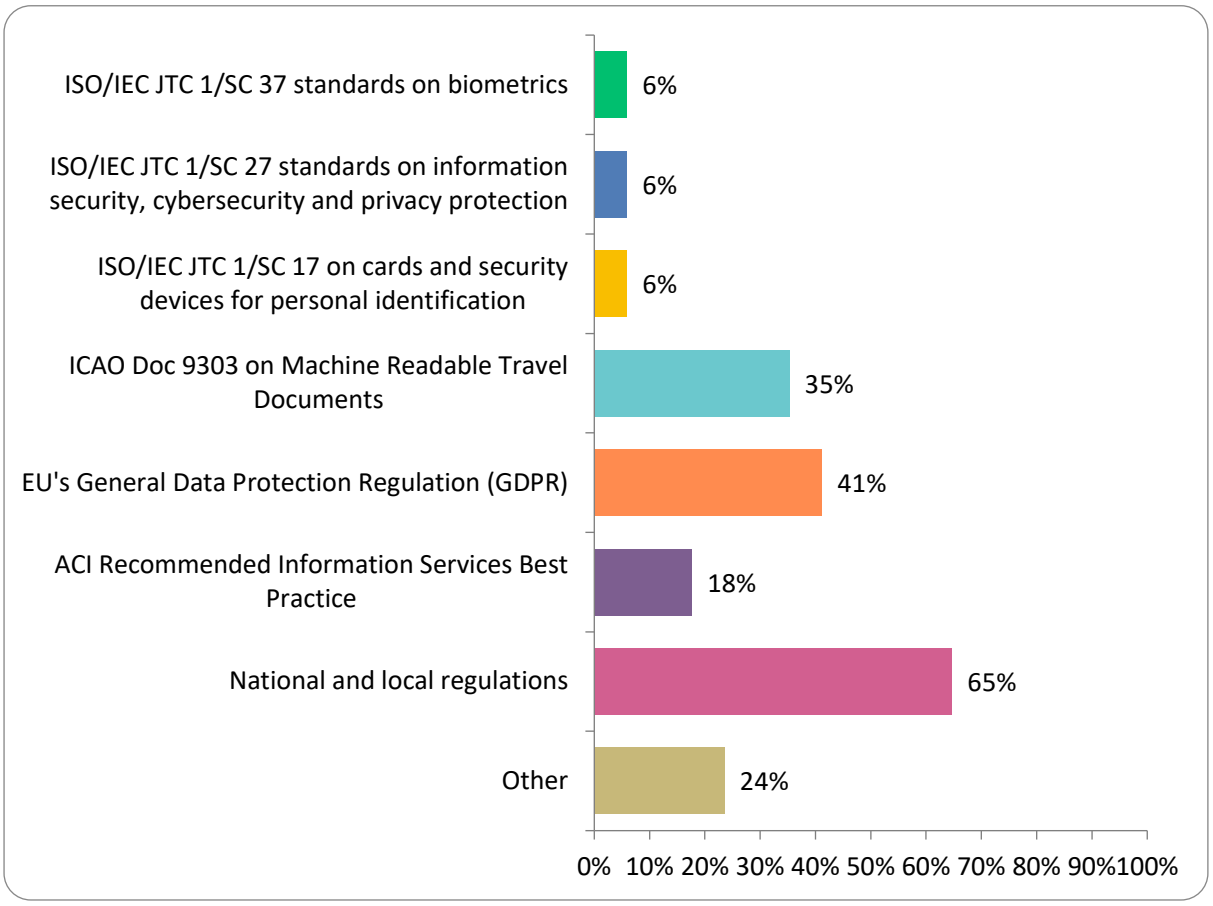
Q: Which organization(s) currently collects, or is planning to collect, biometric data from the cross-border travelers in your country/territory, airline(s), or airport(s)? [No. of responses: 32]



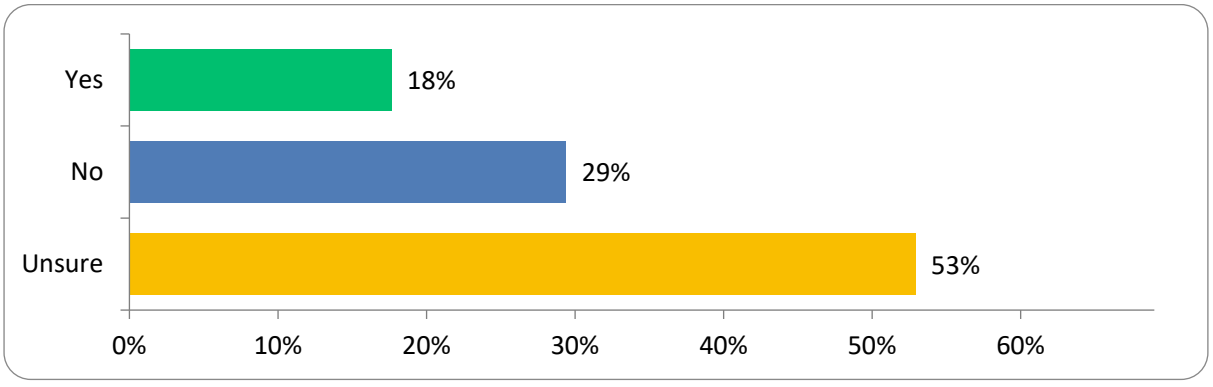
Q: Is there a published framework or policy document that specifies the collection, handling, storage, and use of biometric data in your country/territory, airline(s), or airport(s)? [No. of responses: 32]



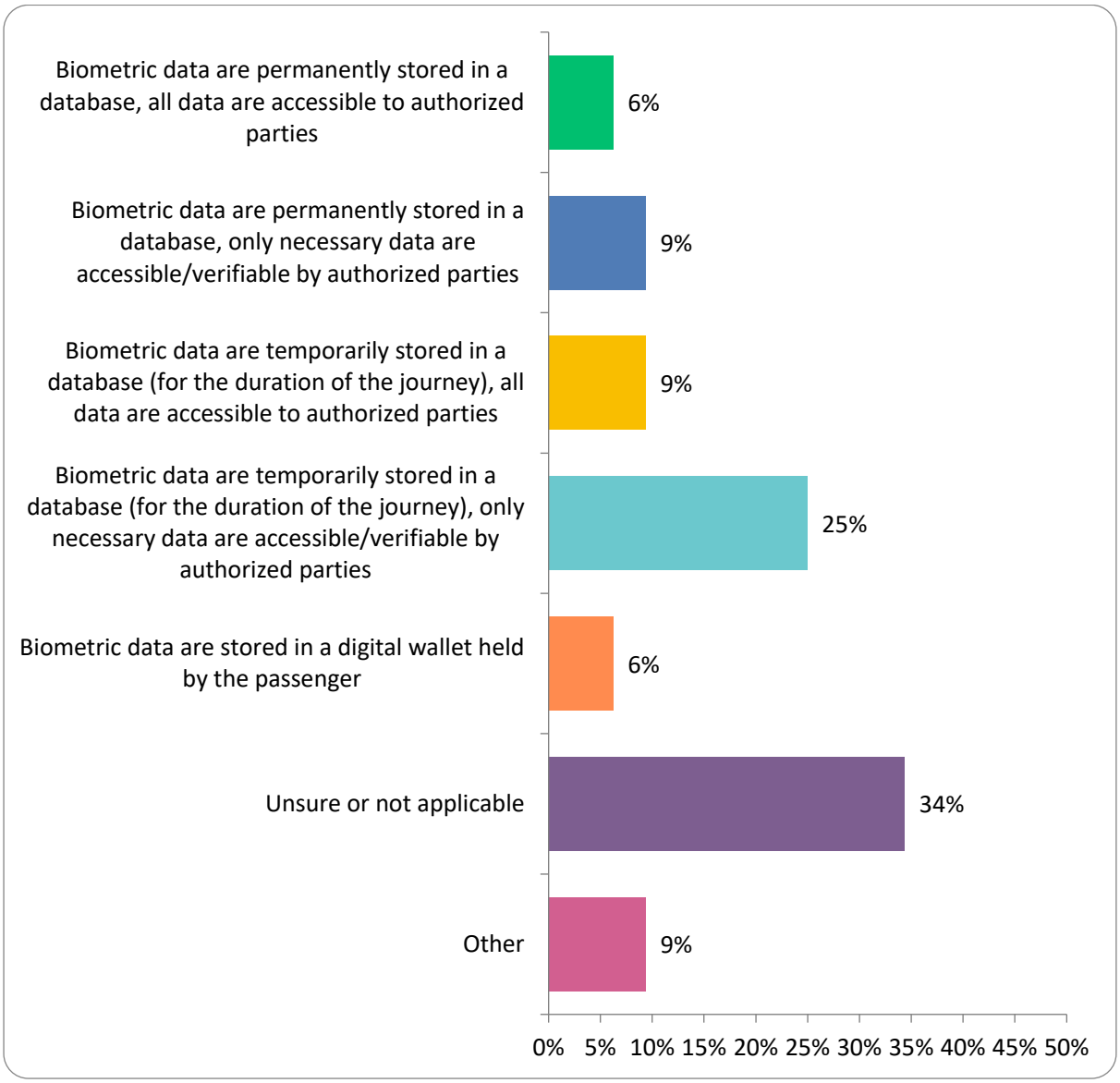
Q: What existing international standards, recommended practices, and regulations do this/these framework(s) leverage? [No. of responses: 17]



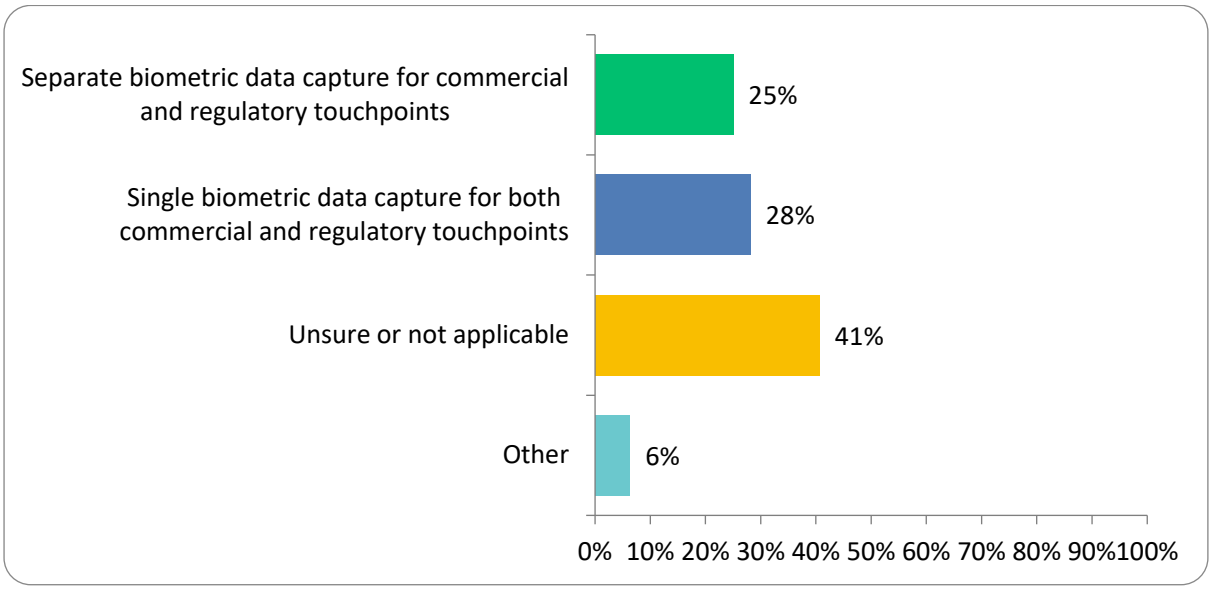
Q: Was this/these framework(s) developed collaboratively with and adopted by other countries/territories? [No. of responses: 17]



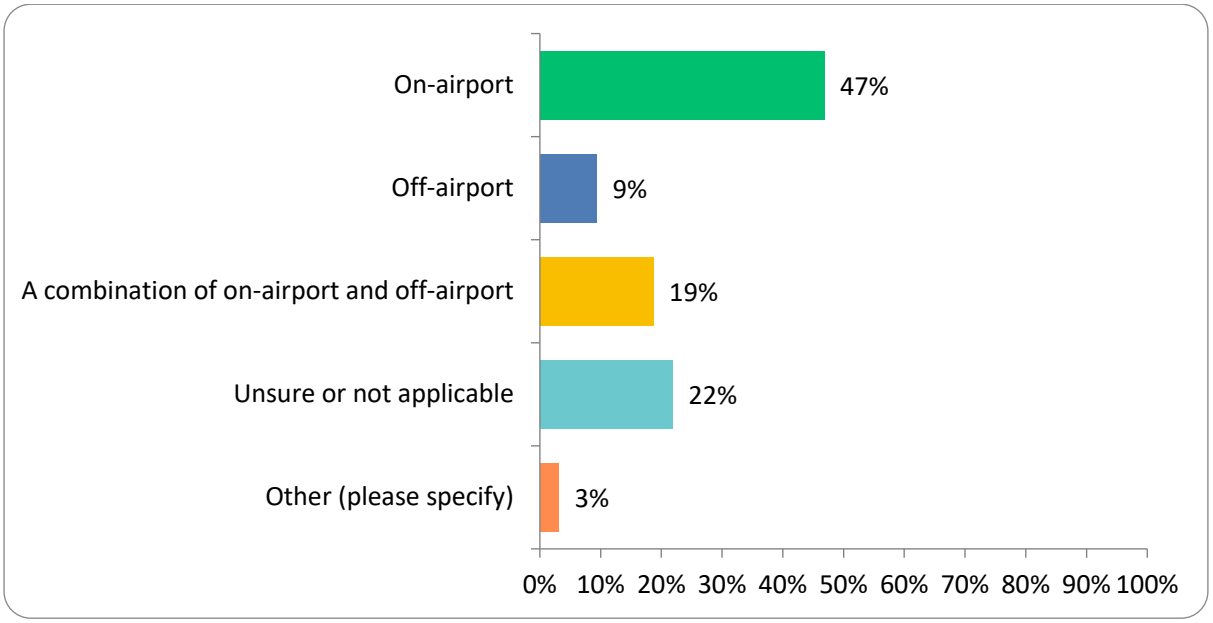
Q: How is the privacy and security of the biometric data achieved? [No. of responses: 32]



Q: How is the enrollment of travelers performed? [No. of responses: 32]



Q: Where is the enrollment of travelers performed? [No. of responses: 32]



Appendix B: Key discussion topics during stakeholder interviews

IATA Consulting has conducted interviews with airport operators, authorities (e.g., border control and civil aviation authorities), and vendors to obtain a wider perspective and better understanding of biometric implementations around the world. The key topics that were discussed during the interviews are as bellow.

For airport operators and authorities

- How the project began
- Stakeholders involved and their key responsibilities
- Key requirements needed to be fulfilled before implementation
- Data management and handling
- Challenges and how they were resolved or handled
- Key success factors

For vendors

- Perception of the differences between projects led by governments and projects led by the private sector (e.g., airport operators)
- Opinion on maturity in biometric implementations
- Key requirements that should be fulfilled before approaching vendors
- Challenges and key success factors

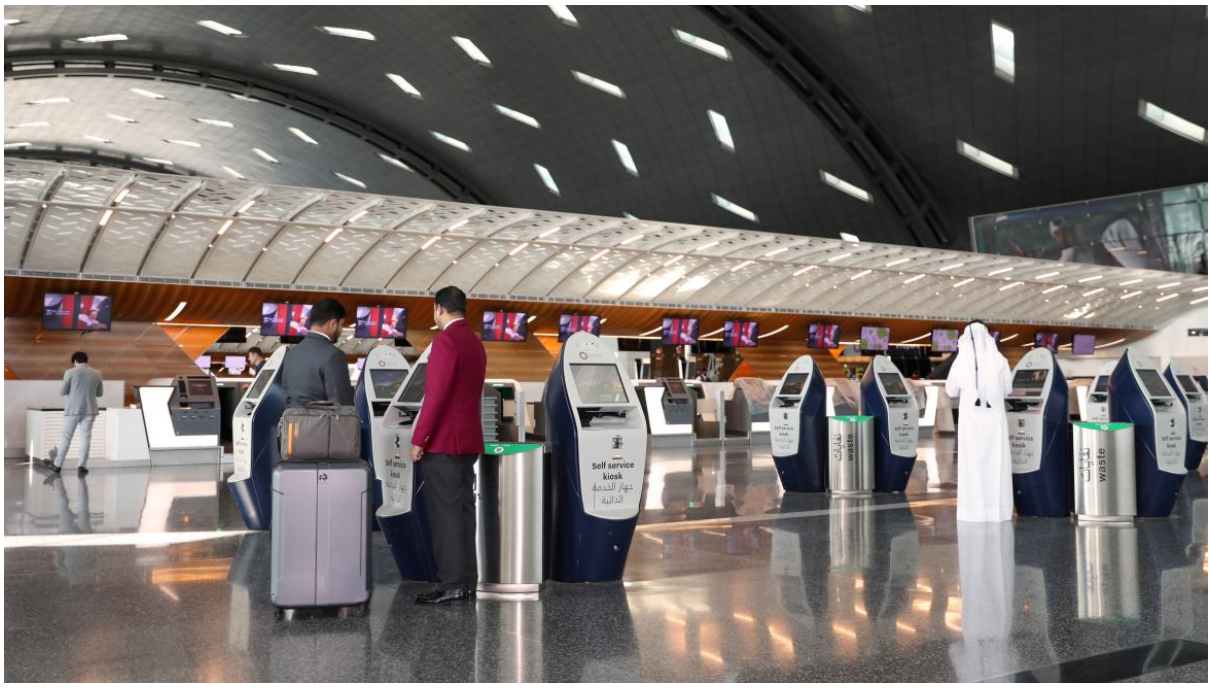
Appendix C: Biometric implementation at top 10 ranking airports

The top ten airports in the world, based on SKYTRAX rankings utilize biometric technologies at their traveler processing touchpoints.

a) Hamad International Airport

In 2019, Hamad International Airport launched the second phase of its Smart Airport program, introducing biometric systems across the entire passenger journey. In this implementation, facial recognition technology is utilized at bag drop, security, and boarding, with the biometric information registered during check-in at a kiosk or via an application.

Figure 14: Self-check-in kiosks that can capture facial biometrics at Hamad International Airport (Hamad International Airport, 2019)



b) Tokyo Haneda International Airport

In July 2021, Tokyo Haneda Airport completed the deployment of Collins Aerospace's ARINC SelfPass biometrics solution. This solution, coined the 'Face Express' system, allows passengers to efficiently proceed through touchpoints at the airport (bag drop, security checkpoint entrance, boarding gate) by utilizing facial recognition, eliminating the hassle of showing their passport and boarding pass.

Figure 15: Facial recognition technology used at Tokyo Haneda Airport at check-in (top left), airside access (top right), and boarding (bottom) (All Nippon Airways Co., Ltd, n.d.)

c) Singapore Changi Airport

Changi Airport first enabled biometric passenger screening in Terminal 4 back in 2017. In 2022, Singapore rolled out an initiative to allow departing passengers at Changi International Airport to only have to present biometrics for verification at various touchpoints without needing physical identity or travel documents. It is planned for Singapore residents leaving or arriving at Changi to be able to clear immigration without needing to present their passports, with identities verified using iris and facial biometrics as they walk through clearance gates.

d) Tokyo Narita Airport

In 2021, Narita International Airport began the Face Express approach with All Nippon Airways and Japan Airlines, which utilizes facial recognition technology to seamlessly process passengers at various airport touchpoints, including check-in, bag drop, security, and boarding.

Figure 16: Overview of biometric identification at touchpoints at Tokyo Narita Airport (Narita Airport, 2021)

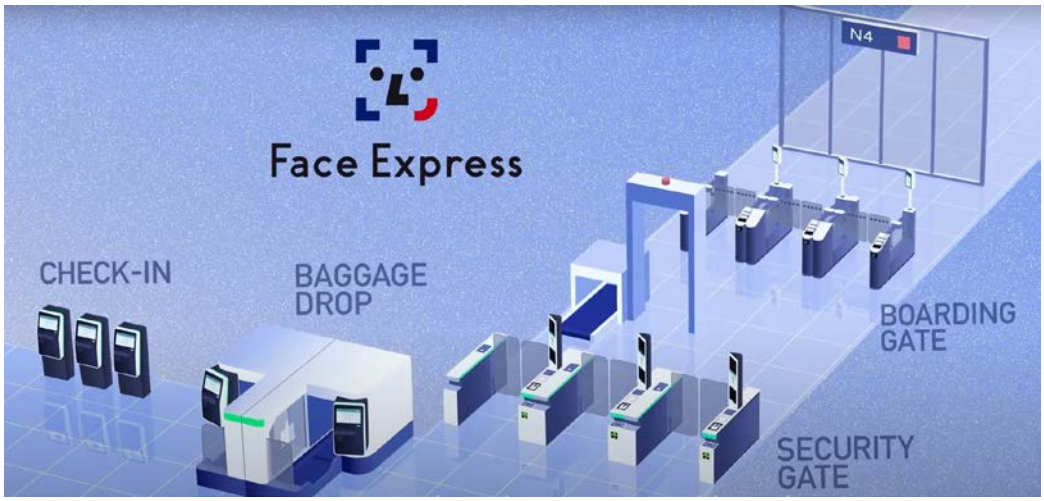
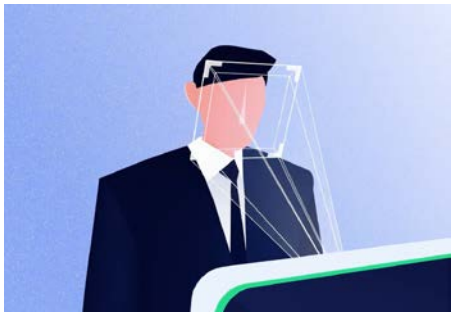


Figure 17: Biometric ID processing at NRT (Narita Airport, 2021)



Facial image captured at check-in, after scanning passport

Bag drop can be done with just facial recognition, without any form of physical ID

Security clearance can be done without showing any identity/ travel document

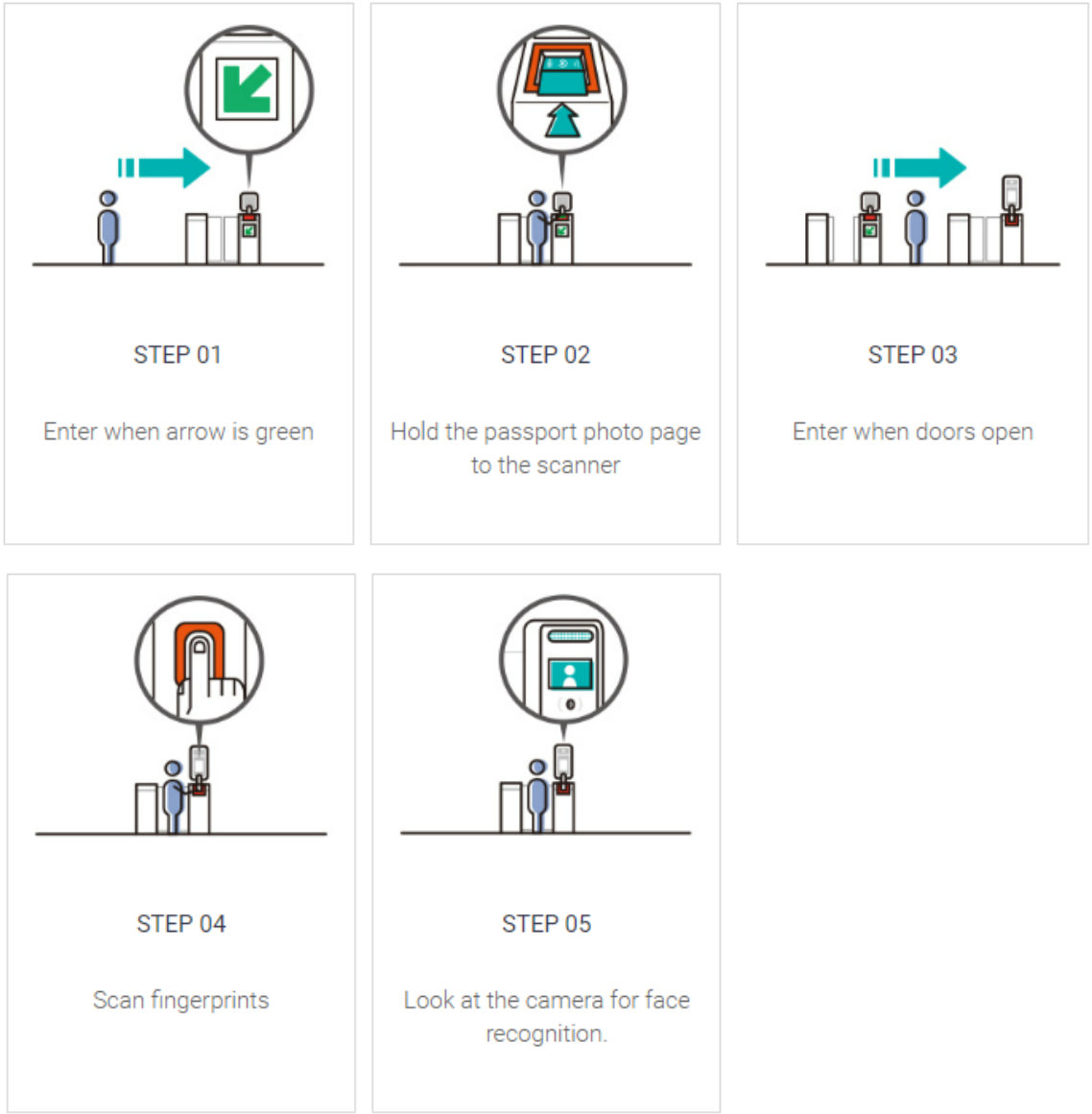
Contactless boarding without physical identity or travel document

e) Seoul Incheon Airport

Incheon Airport uses automated gates using biometric identification systems at its immigration. Currently, at this report's writing, fingerprints and facial images are captured at immigration clearance (Figure 18).

'Smart Pass Service' will also be introduced at the airport, allowing users to easily board an aircraft using biometric information such as face recognition. Expected to be fully implemented in 2024, biometric identification will be adopted at check-in, security (airside entry), and boarding.

Figure 18: Automated immigration process at Incheon Airport (Incheon Airport, n.d.)



f) Paris CDG Airport

Charles de Gaulle Airport first introduced the biometric solution for automated passport control in 2009. At the airport, passengers may register through a dedicated biometric terminal where they will scan their boarding passes and identity documents before presenting their faces to link with their travel information. Passengers will not require their boarding passes and identity documents at bag drop and boarding, where their facial image will be captured instead. The use of biometric identification is planned to be expanded at the airport as a key performance indicator in Groupe ADP's 2022-2025 strategic roadmap

(Groupe ADP, 2022) which includes the aim of providing 50% of passengers at Paris-Orly and Paris-CDG with biometric facilitation in their departure journey.

g) Munich Airport

Since mid-November 2020, Munich Airport has implemented Star Alliance Biometrics. When an enrolled customer travels through Munich Airport on Lufthansa, Austrian or SWISS airline, Star Alliance Biometrics facial recognition technology matches the customer's live image to the boarding pass information and biometric profile. This allows the individual to pass through security and boarding gates using facial recognition, in a touchless manner. Star Alliance plans to use biometric e-gates for 50% of its boarding pass control by 2025 (Reuters, 2022).

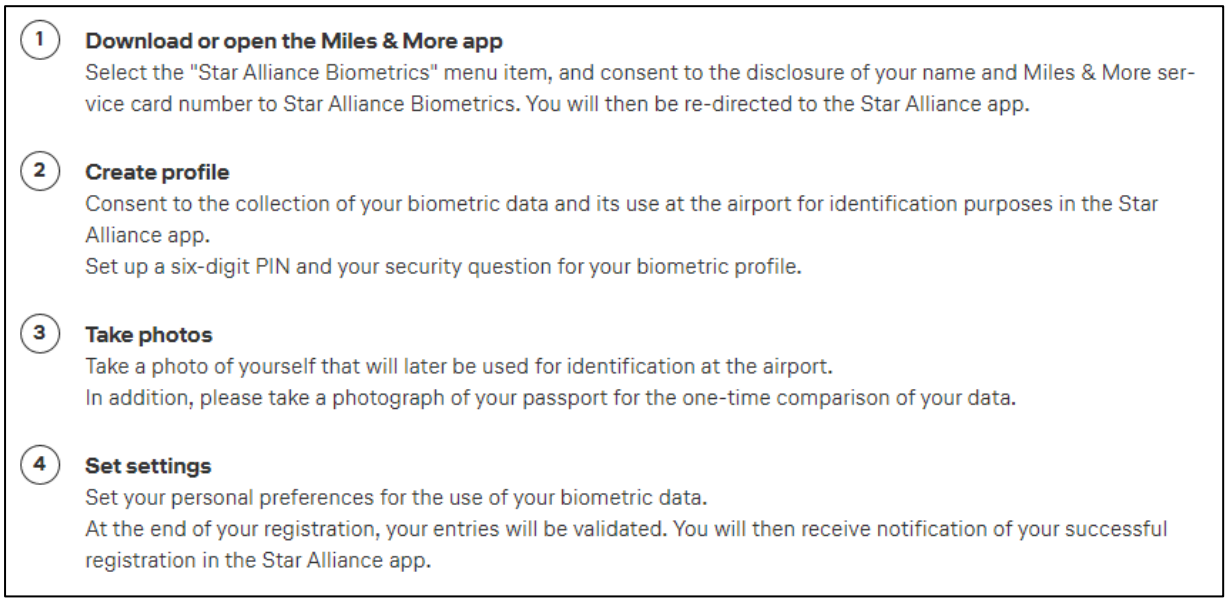
h) Istanbul Airport

Istanbul Airport utilizes an e-passport system where fingerprint and facial images are taken to verify against the biometric data in the passport. It also concluded a six-month trial for biometric boarding (after capturing a facial image at check-in) in 2021. In this trial conducted with Turkish Airlines, enrolled passengers could use their faces for security checks, lounge access, and boarding without touching any surfaces.

i) Zurich Airport

Zurich Airport implemented automated biometric passport control systems in 2017, allowing certain passengers to choose to use face scanners rather than present their passports to immigration control officers. Zurich Airport is also one of the few airports with Star Alliance Biometrics implemented (similar to Munich airport), allowing customers to use facial recognition to pass security and board seamlessly.

Figure 19: Registering with the Star Alliance Biometrics (Miles & More, 2021)



j) Kansai International Airport

In 2020, pre-security gates with biometric facial recognition were deployed at Kansai International Airport. Currently, biometric solutions are utilized at departure and arrival border control and customs. The airport operator is also considering biometric systems for other touchpoints, including check-in, bag drop, and boarding.

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