NextGen Advisory Committee (NAC)
June 21, 2021 Meeting Summary

The NextGen Advisory Committee (NAC) convened virtually June 21, 2021. The meeting discussions are summarized below. Reference the attachments for additional contextual information.

List of attachments:

- Attachment 1: NAC Presentation Deck
- Attachment 2: Attendance List
- Attachment 3: Public Statements
- Attachment 4: Approved *Automatic Dependent Surveillance – Broadcast (ADS-B) Commercial Application Technologies Ad Hoc Team NAC Task 20-1 / 21-2 Report*
- Attachment 5: Approved *Vertical Navigation (VNAV) Ad Hoc Team NAC Task 20-2 Report*

Opening of Meeting

NAC Chairman Mr. Chip Childs (SkyWest, Inc.) opened the meeting and welcomed virtual attendees.

Public Statements

After administrative housekeeping notes, Mr. Greg Schwab (FAA) invited the following public speakers to make their respective pre-approved public statements. Please reference Attachment 3 for the full text of the statements.

- Ms. Cindy Christiansen of National Aviation-Impacted Communities Alliance and BOS Fair Skies
- Ms. Darlene Yaplee of Concerned Residents of Palo Alto and the Aviation-Impacted Communities Alliance (AICA)
- Mr. Mark Shull of Palo Alto, CA

Chairman's Report

Mr. Childs then provided the Chairman's Report. To begin, he called for a motion to approve the March 18, 2021 NAC Meeting Summary Package, which the NAC approved.

Outcome: The NAC passed a motion to approve the March 18, 2021 NAC Meeting Summary Package

Mr. Childs continued by saying that after the stress of assessing and mitigating the impacts of COVID-19 throughout the last three NAC meetings, it is bit of a relief to begin this meeting with new optimism for the future of the aviation community as it emerges from the impacts of the pandemic. He added that he hopes that the current strong rebound in demand for domestic U.S. air travel is just a precursor for full domestic recovery for the remainder of the year, as well as a precursor to a similar rebound in international travel very soon.

He said that he had the opportunity to share this sentiment, in his capacity as NAC Chairman, with the House Transportation and Infrastructure (T&I) Aviation Subcommittee Roundtable that met on May 18, 2021. He explained that during his opening remarks and in the questioning session that followed, he

portrayed the NAC's work as vital collaboration between the aviation community and the FAA. Mr. Childs said the roundtable was primarily focused on NextGen issues identified in a recent Department of Transportation Inspector General report. However, much of the conversation revolved around potential government financial incentives for airline equipage as part of a proposed infrastructure bill.

He said he concluded his roundtable comments by emphasizing the following points:

- The NAC has advanced several key taskings in recent years, even through the course of a global pandemic.
- As the industry emerges from the pandemic, the NAC is anxious to continue on-site implementation of the NextGen priorities.
- The NAC's consensus on the Minimum Capabilities List (MCL) is a major achievement, but getting aircraft equipped to the baseline MCL is truly essential to successful NextGen implementation.

Mr. Childs said they also discussed the need for infrastructure spending help and credits to facilitate equipping airline fleets, noting that this help is needed to help remove some of the insurmountable barriers that industry faces. He said he is hopeful that these and other efforts will allow industry to break through mixed equipage barriers.

Next, Mr. Childs handed off to NAC Member Mr. Brad Pierce (N.O.I.S.E.) to provide an update on his offer from the March 18, 2021 NAC to take the lead on developing some thoughts on how the NAC might provide more insight into building greater support for community engagement efforts.

Mr. Pierce said that from the perspective of the Environmental voice on the NAC, there is potential and value in stakeholders coming together to discuss how to engage the community—but also be partners in proactive abatement and mitigation strategies. He said this would help demonstrate that noise is an issue to be addressed before and during implementation. He added that this effort could include N.O.I.S.E. leadership and staff stakeholders, FAA, and industry stakeholders (e.g., carriers and airports) with the goal of creatively adding to the community engagement efforts the FAA is already doing. He said this would entail two to three meetings with a report out at the Fall 2021 NAC Meeting of recommended policy or initiatives to be adopted.

Outcome: The NAC Chairman supported NAC Member Brad Pierce's (N.O.I.S.E.) proposal to hold a series of meetings to identify how the NAC can support Community Engagement efforts in partnership with the FAA, Industry, and Airports, then report back at the Fall 2021 NAC Meeting

Mr. Childs then concluded the Chairman's Report and handed off to Mr. Bradley Mims, FAA Deputy Administrator and NAC Designated Federal Officer (DFO), for the FAA Report.

FAA Report

Mr. Mims said the FAA Report will focus on a wide range of topics to provide the NAC with insight into what the FAA has been working on since the March 2021 NAC Meeting. He first handed off to FAA Administrator Mr. Steve Dickson for some insights.

Mr. Dickson said that Mr. Child's comments on the remarkable rebound in domestic air travel demand and the hope for a similar rebound in business and international travel is both exciting and a welcome development for the aviation and aerospace community and economy. He said he had the honor of

speaking on international travel recovery at the European Civil Aviation Conference earlier in the month. He said he characterized the FAA's partnership with European counterparts as even more critical today as the world fights a pandemic and works together to safely restore international air travel. He added that despite the extreme challenges of the ongoing crisis and the unpredictability of the recovery, the trans-Atlantic relationship in aviation remains strong and is vitally important to the FAA.

He continued by saying that he is also excited to share that commercial space remains a very busy part of the FAA's mission. He displayed a video showing Virgin Galactic's SpaceShipTwo Unity spaceplane conducting a suborbital flight, launching inflight over New Mexico on May 22, 2021. He said this marked the 400th flight the FAA has licensed, operating from a dozen licensed U.S. spaceports.

Mr. Dickson said that in response to the growing demand for commercial space operations, the FAA recently deployed the operational prototype of the Space Data Integrator (SDI). This capability vastly improves the FAA's situational awareness of exactly where a space vehicle is as it travels up to space or as it returns to Earth. It also provides decision support to reduce air traffic disruptions and reopen closed airspace for other users as quickly and as safely as possible. He said the SDI operational prototype was first used on May 26, 2021 with the launch of SpaceX's Starlink-28 and offered immediate improvements.

He said that there have also been many new aviation technologies announced in the press from some NAC member organizations. He specifically mentioned future investments and operational concepts being pursued in Advanced Air Mobility (AAM), which is focused on using air taxis to get passengers and freight to some of the largest U.S. airports to transload on to legacy passenger and cargo airlines. He said he recently read a publicly available research report from a multinational investment bank where it is estimating that AAM will be a $1 trillion industry by 2040, with estimates reaching $9 trillion by 2050. He described the key message as tempering excitement on AAM with patience. The researchers believe the market opportunity for this technology could be far greater than previously imagined, but that it may require decades to reach high-volume commercialization.

More recently, he said he saw an announcement from a network carrier of investments in future supersonic aircraft. Supersonic travel has the promise of reducing oceanic travel times in half. There is still a lot of work ahead to get back to regularly scheduled supersonic flight by the end of the decade, but these announcements have triggered a wave of excitement in the aviation world. He also mentioned press reports about another network carrier adding artificial intelligence-powered applications into its flight dispatch function. He said that investing in more advanced and powerful flight planning systems might even result in advantages moving forward into a NextGen TBO environment.

He concluded by saying that a truly fascinating aviation future continues to emerge. He said this future will arrive with previously unimagined advances in travel, but will also bring challenges. These challenges will require constant dialogue to ensure operators, manufacturers, airports, and all aviation stakeholders continue to work together to ensure delivery of the most flexible and the safest transportation options possible for the American people.

Mr. Dickson then formally recognized and thanked one of the NAC's longstanding members, Mr. Paul Rinaldi (NATCA). He said Mr. Rinaldi's term as NATCA President will end on September 1, 2021. He thanked Mr. Rinaldi for his commitment to aviation safety and to FAA personnel. Mr. Dickson said that, working together, they have achieved a culture that recognizes stakeholders, values diverse

perspectives, and promotes collaboration at all levels of the organization. He also acknowledged Mr. Rinaldi's partnership in both the NAC and the FAA's Management Advisory Committee. Mr. Dickson then handed off to Mr. Mims.

Before Mr. Mims continued with the FAA Report, Mr. Rinaldi expressed his gratitude for the remarks. NAC Members Mr. Pete Dumont (ATCA) and Mr. Joe DePete (ALPA) also offered respective well wishes to Mr. Rinaldi. Mr. Mims then handed off to Assistant Administrator for NextGen Ms. Pamela Whitley.

Ms. Whitley began by also expressing her appreciation for Mr. Rinaldi, mentioning that modernization would not have been possible without the relationship built with NATCA. She continued by saying that she and Air Traffic Organization (ATO) Chief Operating Officer (COO) Ms. Teri Bristol also participated in the House T&I Aviation Subcommittee Roundtable that Mr. Childs mentioned previously. She described the engagement as a great opportunity for NextGen stakeholders, including the NAC Chairman, A4A, ALPA, and NATCA to discuss the status of modernization and NextGen efforts with the subcommittee members.

She said she reported the following during her opening remarks:

- To date, NextGen modernization efforts have delivered 21st century technology that makes the National Airspace System (NAS) safer and more efficient.
- Collaboration and support from Congress and aviation stakeholders in the NAC has been, and will continue to be, essential to NextGen accomplishments.
- The FAA remains committed to operationalizing NextGen and leveraging new and innovative concepts and technologies to continuously modernize the U.S. Air Traffic Management System.

Ms. Whitley said she emphasized that it is in the operationalizing of NextGen where the collaboration with the NAC will continue to be essential. Most of this collaboration is centered on the NAC's NextGen priorities documented in the NextGen Joint Implementation Plan (NJIP). She then announced the publishing of the *NAC NextGen Priorities Joint Implementation Plan CY2019–2022: 2021 Update*, which she said is derived directly from the work of the NAC's working groups. She described this annual report as representing the most up-to-date information available at this time. The working groups continue to lean as far forward as possible during the pandemic and are making progress, but there are still milestone dates they are not yet able to forecast. However, she added that she is pleased to report there are 17 fewer milestones in a TBD status than reported in 2020. Ms. Whitley promised that the FAA will provide the NAC continuous updates as changes to the NAC priority milestone dates become clearer. She also mentioned that the report will also serve as the basis for the annual update to Congress on NextGen priority focus areas.

Outcome: The FAA announced the publication of the *NAC NextGen Priorities Joint Implementation Plan CY2019–2022: 2021 Update*

She concluded by saying NextGen has made enormous progress over the past decade. She said she is positive that with the majority of the NextGen infrastructure in place, along with the barriers caused by the pandemic receding, they are well on their way to a dynamic NAS. She added that for NextGen to be truly successful, the FAA needs operators to equip aircraft to the MCL level. She said the conversation is very healthy today and that the FAA is willing to provide whatever is needed to support the ongoing MCL conversation. Ms. Whitley then handed off to Mr. Mims.

Mr. Mims then handed off to Ms. Bristol, FAA Air Traffic Organization Chief Operations Officer, for ATO updates. Ms. Bristol stated that one of the most important topics discussed at the House T&I Aviation Subcommittee Roundtable was the effort to operationalize NextGen. Ms. Bristol said she expressed that the ATO is fully committed to operationalizing NextGen alongside FAA NextGen and Aviation Safety. However, she said operationalization cannot occur without the full participation and support of our NAC aviation community partners. In addition to operationalizing NextGen, she also committed to ensuring that the NAS remains the gold standard as the safest, most complex, and most capable airspace system in the world. She provided some statistics that show the NAS is getting busier, specifically that Instrument Flight Rules (IFR) traffic has rebounded to 47,195 IFR flights recorded on June 10, 2021. She said this is up from a low point of 14,833 IFR flights in April 2020. She added that for some perspective, the seven-day period ending June 16, 2021 was only 11% below the seasonally adjusted baseline.

Ms. Bristol said the FAA is also experiencing a significant increase in commercial space operations. She said to accommodate these increases, the ATO successfully employed Time-Based Launch Procedures and Dynamic Launch and Reentry Windows working with space operators. Ms. Bristol said these two procedural efforts were first employed last fall during the height of the COVID pandemic. These procedures facilitate collaborative efforts between the FAA, industry and the federal ranges. She said that SDI will advance these procedural efforts by facilitating even more dynamic management of the airspace associated with launches and reentries. She said they are optimistic that projects like SDI can be leveraged even more as part of the decision making process to ensure the NAS remains safe, efficient, and resilient.

Ms. Bristol continued by thanking the NAC for the great work on the ADS-B In Commercial Application tasking. The FAA needed clearer insight into what technologies commercial fleet operators were looking to acquire to inform future FAA investments. She said the FAA looks forward to analyzing the results and will provide a response at the next NAC.

She said that in response to the NAC's Performance Based Navigation (PBN) Clarification Report, at the March 18 NAC Meeting, the FAA presented its plan to develop an Airspace Modernization Roadmap. She said the Airspace Modernization Group is developing the roadmap to ensure national strategic alignment. She said this roadmap will include actions related to the PBN NAS Navigation Strategy, PBN Clarification Report, PBN NextGen Integration Work Group (NIWG) work, legacy procedures, and resiliency requirements. She said the FAA will continue to engage stakeholders as the roadmap takes shape. The FAA is planning on providing a progress briefing at the Fall 2021 NAC meeting.

Ms. Bristol then thanked the NAC for the advice on Section 547 provided at the March 18, 2021 NAC Meeting. She said the FAA was able to select three of the eight pilot program recommendations. The three selected initiatives were assessed as executable within the time period Congress stipulated (September 2021 through September 2023) and took into account the operational challenges the pandemic caused. She reviewed the following selections based on Congressional criteria and known program opportunities:

- PBN at Los Angeles International Airport (LAX): This pilot program will focus on reducing flying distances by offering Established on RNP (EoR) approach services at LAX

- ADS-B Out at Oakland Center: This pilot program will focus on increasing airspace capacity by offering reduced in trail separation, 5 nautical miles (NM) down to 3 NM, in portions of Oakland Center's airspace
- Data Comm at Orlando International Airport: This pilot program will focus on expediting reroute clearance deliveries via Controller-Pilot Data Link Communication (CPDLC) – Departure Clearance (DCL) during adverse weather events when departing Orlando

She clarified that although the remaining five recommendations were not selected as part of the Section 547 Pilot Program, the FAA is committed to their continued progress and they will remain on the Airspace Modernization Group's radar as part of their national strategic oversight. She also committed to providing periodic updates on the performance of the three selected initiatives.

Lastly, she said the FAA is fulfilling the promise to lean forward in providing access for NAC priorities work in the field facilities once it was safe to do so. She said that as of June 18, the Terminal Flight Data Manager (TFDM) team has been meeting and working with technical staff at the FAA Technical Center to advance the TFDM effort and conducting site survey activities at field facilities including in Las Vegas and Columbus, OH. She also mentioned that the Data Comm team is at the FAA Tech Center preparing for a restart of the deployment to the remaining 17 Air Route Traffic Control Centers, with Jacksonville Center and Oakland Center being the next two sites on waterfall. She also mentioned that members of the national training cadre have been on site and ATO is planning to begin controller training in the September timeframe.

She said that moving forward, the FAA will continue to take a methodical, risk-based approach to expanding on-site work with a focus on the safety of controllers and other professionals in the operational facilities.

Before concluding, she also wished Mr. Rinaldi well in future endeavors.

NAC Member Mr. Don Dillman (FedEx) thanked Ms. Bristol and her team for the quick response to a recent NAIMES outage. He also requested a briefing on the results of the tabletop exercise related to the outage.

Action: The FAA agreed to a NAC Member request for an FAA briefing at the Fall 2021 NAC on the results of an upcoming tabletop exercise related to a recent NAIMES outage

Mr. DePete emphasized the need to integrate the efforts of all airspace users (traditional, drones, etc.) and said that he is encouraged. Ms. Bristol agreed and said it is going to be exciting. Ms. Bristol then handed off to Mr. Mims.

Next, Mr. Mims introduced the new Deputy Associate Administrator for Aviation Safety Mr. Chris Rocheleau. Mr. Mims said that many in the NAC are very familiar with Mr. Rocheleau, as he has been with the FAA for many years serving in various leadership capacities. Mr. Mims also said with former Associate Administrator for Aviation Safety Mr. Ali Bahrami's recent retirement announcement, Mr. Rocheleau will also assume the role of acting Associate Administrator until a new Associate Administrator is appointed. Mr. Mims then handed off to Mr. Rocheleau.

Mr. Rocheleau agreed with Ms. Bristol that NAS operational levels are rebounding fast but the FAA can never take its eye off of the aviation North Star—safety. He said the NAC's work for NextGen will indeed increase safety in the NAS with more precise routings, more stable approaches, more efficiency in the

cockpit with Data Comm, and a willingness to attack the barriers to these safety improvements with the NAC's work on ADS-B In and VNAV. He specifically thanked the NAC for the VNAV work. He said he is confident that the advice will take the FAA and the NAC to the next level of understanding on this critical issue.

He also thanked the Performance Based Operations Aviation Rulemaking Committee (PARC) for its report on the ADS-B Out exemption 12555. This exemption grants time-limited relief from the GPS performance requirements in the ADS-B Out rule to give the exempted aircraft operators until December 31, 2024 to upgrade their GPS to be fully rule compliant. This report and its recommendations were delivered to the FAA this month and the team will be reviewing them over the next several months.

Mr. Rocheleau said that at the last NAC meeting, Mr. Pete Bunce (GAMA) and Mr. Ed Bolen (NBAA) asked for more insight from the FAA on Advanced Air Mobility (AAM). To provide greater context on this issue, he said NAC Member Mr. Bob Pearce from NASA Aeronautics has graciously agreed to provide the NAC with history and NASA's view of AAM a little later in the meeting. Following Mr. Pearce, he said his Aviation Safety team will give the NAC some insight from the regulator perspective. He described AAM as an exciting opportunity for the aviation community but emphasized the need to remain clear eyed on how to move forward as safely and effectively as possible.

Mr. Rocheleau also thanked Mr. Rinaldi for his service. He then handed off to Mr. Mims.

Mr. Mims concluded with remarks on infrastructure. He said that when talking about infrastructure and sustainment investment in the country as a whole, aviation infrastructure must be right up there with highways, railways, and waterways in terms of importance. He said a big part of his job at the FAA is to make sure it gets the infrastructure support that it needs, as well as to remove any barriers from recruiting the next generation of aerospace workers who will operate that infrastructure. He said that with a workforce with the best, brightest, and most diverse group of people from all walks of life and major investments in aviation infrastructure, the aerospace system can be greener, will continue to fuel the U.S. and world economies, and once again bring people, cultures, and ideas closer together.

Mr. Mims then concluded the FAA Report and handed off to Mr. Childs.

Chairman's Roundtable

Mr. Childs thanked Mr. Mims and introduced the Chairman's Roundtable agenda item. He described the roundtable as a continuation of the discussions from the last two NAC meetings. He said this is time for NAC members to explore ideas and issues with the benefit of the group's collective expertise. He said today's topic is Airports.

He continued by saying that he asked NAC Member Ms. Candace McGraw (Cincinnati/Northern Kentucky International Airport [CVG]) to help the NAC gain insight into what she is faced with as an airport operator and how NextGen factors in as the CEO of CVG. He said he also asked her, as a board member of Airports Council International-North America (ACI-NA), to provide a quick look at other airport infrastructure projects from around the country. He added that he heard she also pulled Mr. Huntley Lawrence (Port Authority of New York & New Jersey) into the conversation with details on the infrastructure updates at the New York airports. He then handed off to Ms. McGraw.

Ms. McGraw thanked Mr. Childs for the opportunity and said that her presentation is not switching gears—it is an extenuation of how infrastructure is important so all stakeholders understand the benefits of NextGen. Before continuing, she thanked Mr. Chris Oswald (ACI-NA) who helped to develop her presentation. She began by reviewing some developments at CVG. She said that years ago, CVG was 90% connecting and has had to adapt to now being a 90% origin and destination airport. Ms. McGraw continued that they did not want to rely on one source of revenue and spent time recession-proofing the operation, which has helped during the pandemic. She said CVG has focused on diversifying the carrier base and cargo operations. Additionally, she said they explored how to use some land for non-aero purposes such as retail.

She reported significant air cargo growth—up 24% year-over-year. She said that CVG is the number two airport for DHL, adding that cargo was a godsend during the pandemic both financially and for keeping the global economy moving. She said that they will soon be working with Amazon, mentioning the first phase of the $1.5 billion investment will be operational before the holiday season, which will be the largest hub in the country. Ms. McGraw said that CVG is leaning in to innovation, including working on autonomous baggage delivery that she characterized as a great improvement. She mentioned that this involves retrofitting existing equipment. Ms. McGraw then thanked the FAA for stepping up Data Comm implementation. She said they are pleased with this project that will be implemented in November and tie to a $60 million CVG runway project.

Ms. McGraw then moved on to discussing the broader US picture for Airports and NextGen. She said there are great examples of infrastructure projects going on throughout country as many airports move forward with modernizing infrastructure and improving aging facilities. Specific examples she described included: Newark Liberty International Airport (EWR) Terminal One, Orlando International Airport South Terminal, Chicago O'Hare International Airport (ORD) Global Terminal, Kansas City International Airport New Terminal, LAX Landslide Access Modernization Program Project, and Pittsburgh International Airport New Terminal, among others. She said that these projects will address aging infrastructure, passenger constraints, and be greener.

In describing pandemic impacts to development, she said US airports have reassessed capital improvement programs in light of pandemic air travel demand reductions and revenue losses. Many projects were delayed, deferred, or resized to reflect expected post-pandemic realities. However, airport capital investment needs remain strong in the U.S., much of it focusing on upgrading aging terminal and ground transportation facilities. She said that while airports saw significant reductions in demand and revenues during the pandemic, they still have capital needs of over $115 billion through 2025. She added that while airports did receive significant funds through the Coronavirus Aid, Relief, and Economic Security Act, this was focused on meeting payroll and outstanding debts. She said that while all airports and respective challenges are unique, they want to focus on working together on key objectives to meet or exceed customer expectations.

In describing how airports tie to NextGen, she said it is really about having a total curb-to-curb experience with each part of system working with the others, emphasizing that modernized terminal facilities are part of balanced aviation system development. She reviewed several NextGen capabilities of high value to airports, including:

- Enhanced surface operations via TFDM deployment, Airport Collaborative Decision Making (A-CDM), and more advanced surface management capabilities

- Enhanced efficiency/capacity through improved parallel and converging runway procedures and Air Traffic Management (ATM) automation
- Improved airport sustainability and community compatibility via PBN procedure refinement
- Increased use of NextGen automation capabilities and System Wide Information Management (SWIM) data
- Safe integration of new airspace users, particularly commercial unmanned aircraft systems (UAS) and AAM operators

She concluded by reviewing some of the challenges the airports community faces including community acceptance, airport capabilities to utilize SWIM data, and resource constraints. She then handed off to Mr. Lawrence.

Mr. Lawrence explained that although COVID took a huge bite out of finances, they were able to continue to pay attention to investments in the New York area, including redevelopment projects at Newark Liberty International Airport, John F. Kennedy International Airport, LaGuardia Airport (LGA). He continued to provide specifics on some of the projects including LaGuardia Terminal B / Terminal C and Airtrain LGA. He said that redevelopment shifts terminals to the south, allowing for increased ramp and taxi lanes. Taxi lane congestion is reduced with dual taxiways in most alleyways. He said that Terminal B and C/D redevelopment will allow for departure metering, reducing taxi delays and aircraft emissions. He clarified that while departure metering is a key component of the TFDM program, the surface improvements may allow PANYNJ to initiate a departure metering operation in the coming years while waiting for TFDM. Many of the surface chokepoints that impeded a smooth flow of traffic to and from the gates have been eliminated.

He concluded by reviewing next steps, including airport inclusion in the Collaborative Decision-Making process, continuing to advance data-sharing capabilities in order to drive efficiency, investing in near- and long-term infrastructure, accelerating NEC recommendations, and advancing the Multiple Airport Route Separation (MARS) concept, PBN development, and Trajectory Based Operations (TBO) in the Northeast Corridor with a specific focus on the New York operation.

Ms. McGraw then said that what they wanted to illustrate is that airports are pleased to be critical NextGen partners and appreciate the curb-to-curb focus.

Mr. Childs thanked Ms. McGraw for organizing a fascinating roundtable session. He said he thinks the NAC has a better understanding of the efforts underway for airport operators, adding that he especially appreciates connecting back to NextGen. He then asked Mr. Dickson for his reaction, as he had previously suggested it was important to look into the combined efficiencies of airport, airspace, and aircraft modernization at an airport like LGA.

Mr. Dickson said he appreciates the insights. All these things have to work together, specifically mentioning that the NEC has been on the radar for years because, without that, there will be limited benefit from all technology investments in the system. He said LGA is one of the biggest examples of a decades-old airport that cannot outgrow its real estate. Redevelopment efforts are very important. He said the FAA Command Center has to make decisions based on that constraint, describing the impact on air traffic as huge and a big driver in how the FAA makes decisions. He recommended remaining cognizant of this along with the technology and operationalizing of NextGen and the additional resulting flexibility, reliability, and resilience.

Mr. Mims said that he is going to work with the airports community on dealing with this issue to make sure that they get a great share of infrastructure money coming down the pipe. He also thanked the presenters.

Mr. Bunce asked whether the presenters are seeing expansion of the Sustainable Aviation Fuel (SAF) capability—further clarifying that as more of the ground structure is electrified, he asked whether there is any conversation about energy storage.

Ms. McGraw said she knows both topics and there is a huge ongoing conversation. She said in the Midwest US they are leaning heavily in to the SAF conversation and the battery space, describing that benefits there mean benefits throughout the system.

Mr. Huntley said there is a SAF group across the industry with airlines that PANYNJ participates in. He said in recognizing that California is leading the nation, they are looking at how policy changes can help push across airports. He said that all redevelopment programs have an electrical component and they are preparing for low emissions and other initiatives at every airport.

Mr. Dillman expressed support for Mr. Lawrence's and Mr. Dickson's respective comments. He said FedEx has made a carbon neutral commitment by 2040. He added that he supports prioritization of progress on MARS and TBO in the NEC.

Mr. Bryan Quigley (United Airlines) also expressed support for the advancement of TBO, MARS, and other key enablers. He added that these key enablers for the NEC are going to be fully promoted by the initiatives Mr. Lawrence mentioned.

Mr. DePete said he is happy the NAC is discussing space and UAS, in reference to earlier comments from Mr. Dickson and Ms. Bristol on the topics.

Mr. Mims then announced that Ms. Shannetta Griffin (FAA) is taking over as the new leader for the FAA's Airports office. Ms. McGraw and Mr. Lawrence expressed support for the selection.

Mr. Childs said he looks forward to continuing this roundtable series so that the NAC can benefit from the expertise of all members.

Advanced Air Mobility Update

Next, Mr. Childs introduced Mr. Pearce and Mr. Bill Crozier (FAA) who provided an update on Advanced Air Mobility (AAM).

Mr. Pearce first provided the NASA perspective. He said that NASA is excited to be part of this emerging market. He said that it is too important for the US to follow this effort, adding that it is part of NASA's role is to help the US lead. He said they define AAM as safe sustainable, affordable, local, and interregional missions. He said that increasing populations, increasingly wealthy populations, and increasingly urbanized populations all drive demand. He continued by saying that as more people live in urban areas, ground transportation is increasingly challenged. He said that air traffic operations could also serve important public good opportunities such as wildfire fighting and improving access to healthcare.

He said that NASA helps the innovation of systems by developing the technology to solve challenges, such as risk reduction. Mr. Pearce said this supports the FAA in making sure it can do its job in terms of safely certifying the advancements with the results of NASA research. He described this critical

commitment as looking at overall architecture, determining requirements, then performing research to support the requirements in concert with Industry, the FAA, and the private sector. He said the AAM Executive Board helps to ensure NASA and the FAA are working in lockstep with aligned strategies. He added that NASA is also active in standards bodies.

He then described elements of NASA's three-pronged strategy to address AAM challenges, which includes a Research and Development (R&D) portfolio (extending suitable UAS Traffic Management research), robust ecosystem partnerships (leveraging the NASA brand to bring people together through working groups for collaborative innovation), and an AAM National Campaign Series (looking at 2030 with the goal to achieve an architecture that can support thousands of daily operations).

Mr. Pearce said that in addition to AAM, NASA is taking on other important challenges such as Upper E Traffic Management (ETM) efforts to enable more regularized operations in class E airspace, mentioning supersonic as an example. He also mentioned that in the presidential budget request there is an additional $10 million to support trajectory management/trajectory optimization to reduce fuel burn and carbon emissions, working in close partnership with the FAA and Industry.

Mr. Pearce then handed off to Mr. Crozier. He said the FAA's regulatory framework will support industry's efforts to enable near-term AAM operations. The FAA will utilize waivers or exemptions as necessary. He clarified that near-term AAM passenger/cargo operations will be certified under the current regulations. He said the FAA's focus covers five areas of AAM (aircraft, airspace, operations, infrastructure, and community). He described this as based on current industry concepts and the associated assumptions surrounding AAM near-term operations.

He then reviewed the following key FAA assumptions surrounding AAM near-term operations based on current industry concepts:

1. AAM aircraft will incorporate varying degrees of automation
2. Near-term operations will likely utilize existing airports and heliports
3. The AAM ecosystem includes all aspects of these five areas: Aircraft, airspace, operations, infrastructure, and community
4. At a minimum, AAM pilots will hold a commercial pilot certificate with an instrument rating
5. In the near term, AAM aircraft are anticipated to be predominantly electrically powered
6. The FAA may grant relief through waivers, exemptions, deviations, or other authorizations when necessary, to enable near-term operations

Mr. Childs said it appears that a number of manufacturers are making investments in lower-passenger aircraft, mentioning that seeing everything has to be a challenge. He said this technology is going to come incredibly fast.

Mr. Crozier said one of the challenges with the technology moving forward is that some responsibilities a pilot might have will transition to equipment. He said they are having to find different ways to handle pilot responsibilities.

Mr. Childs said that as these technologies evolve, he recommends that there be an MCL for these types of aircraft to avoid a future discussion on AAM equipage.

Mr. Bunce complimented both briefers and their organizations. He pointed out that most AAM vehicles will be piloted at initial launch (near to mid-term). He said this is potentially a great breeding ground

for new pilots to gain pilot skills that will directly transfer, which could be a tremendous feeder for pilot organizations.

NAC Subcommittee (SC) Chair's Report - NAC Taskings Status

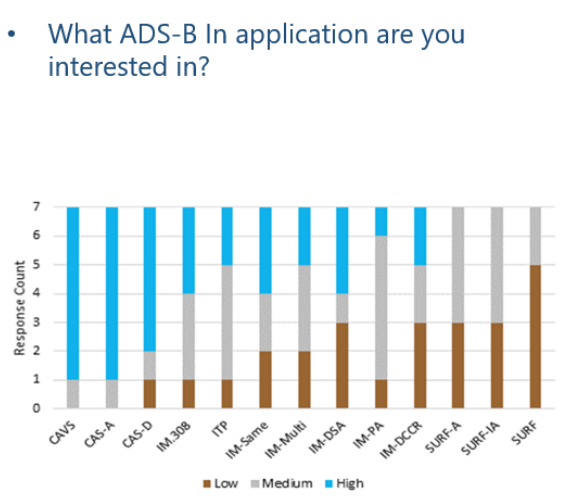
Next, Mr. Childs handed off to NAC Subcommittee Chairman Mr. John Ladner (Alaska) who walked through the current NAC SC issues with the working group leads.

Mr. Ladner said that since taking over as NAC SC Chairman in March, it has been incredible to witness the dedication of the many Industry and FAA experts working the issues at the NAC SC and working group levels first-hand. He then reviewed the NAC SC Chairman's Report topics, specifically clarifying that the ADS-B In and VNAV Ad Hoc Teams are briefing their respective final reports to the NAC for approval as advice to the FAA.

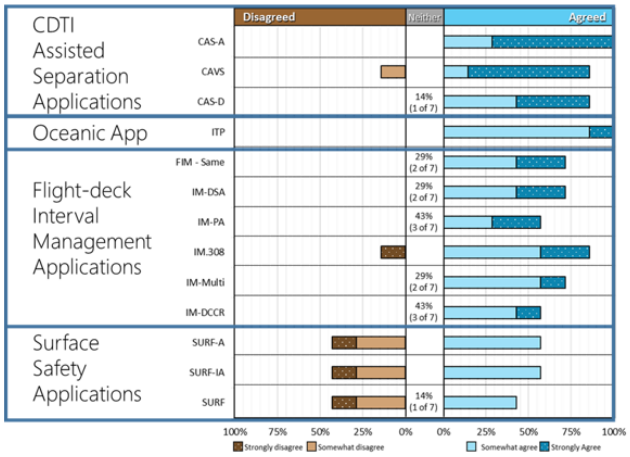
NAC Task 20-1: ADS-B In Commercial Application Technologies

Next, Mr. Ladner handed off to ADS-B In Ad Hoc Team Co-Leads Mr. Don Kauffman (Honeywell) and Mr. Dave Surridge (American). Mr. Surridge began by reviewing the operators that provided feedback and some specifics of their feedback. The operator questionnaire specifically focused on:

What ADS-B In Application do you value? (results depicted below)

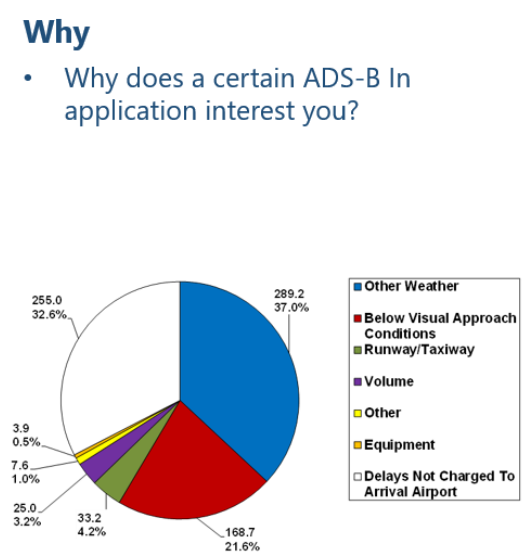


Alaska, American, Delta, FedEx Express, JetBlue, United, and UPS Priorities

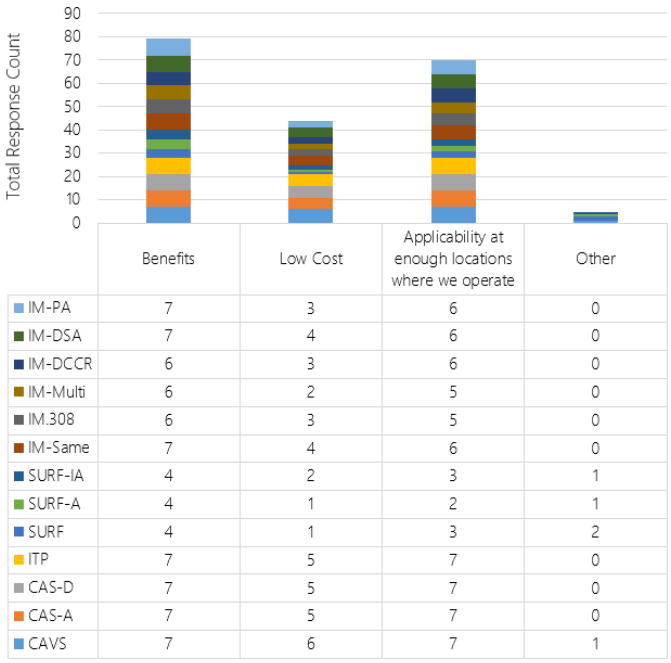


Alaska, American, Delta, FedEx Express, JetBlue, United, and UPS Level of Interest

Why does a certain ADS B In application interest you? (results depicted below)



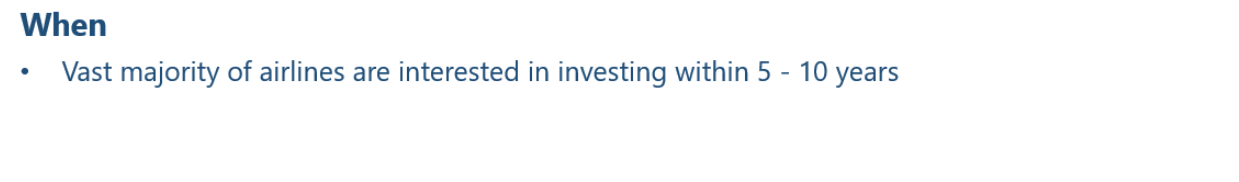
OPS Net Delay

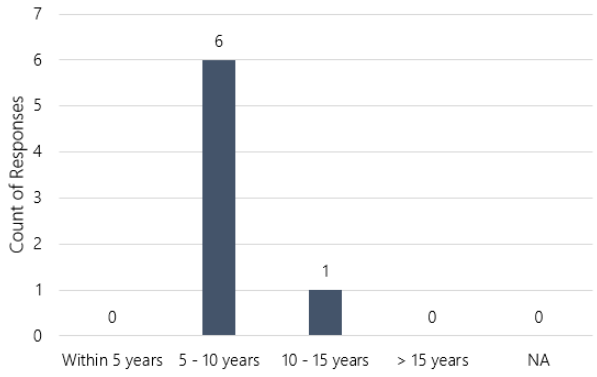


	Benefits	Low Cost	Applicability at enough locations where we operate	Other
IM-PA	7	3	6	0
IM-DSA	7	4	6	0
IM-DCCR	6	3	6	0
IM-Multi	6	2	5	0
IM.308	6	3	5	0
IM-Same	7	4	6	0
SURF-IA	4	2	3	1
SURF-A	4	1	2	1
SURF	4	1	3	2
ITP	7	5	7	0
CAS-D	7	5	7	0
CAS-A	7	5	7	0
CAVS	7	6	7	1

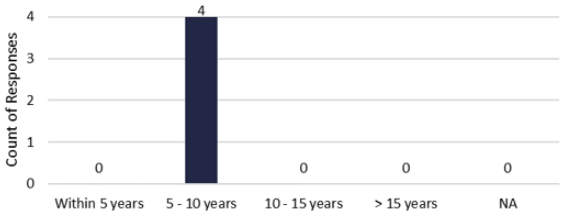
Alaska, American, Delta, FedEx Express, JetBlue, United, and UPS Priorities

When does your company plan on having the majority of aircraft equipped? (results depicted below)





Alaska, American, Delta, FedEx Express, JetBlue, United, UPS



4 Regional Airlines

It also probed barriers to investments in ADS-B In. Mr. Surridge reviewed the top seven barriers that would keep the participants' airlines from investing, including:

1. Insufficient funds

2. Unclear FAA commitments on automation investments
3. Lack of benefits data
4. Unclear FAA commitments on necessary procedure changes
5. Lack of information on avionics costs
6. Lack of information in avionics installation requirements
7. Training costs

Mr. Kauffman reviewed the following original equipment manufacturer (OEM) feedback portions of the report:

Timeline for Product Development (results depicted below)

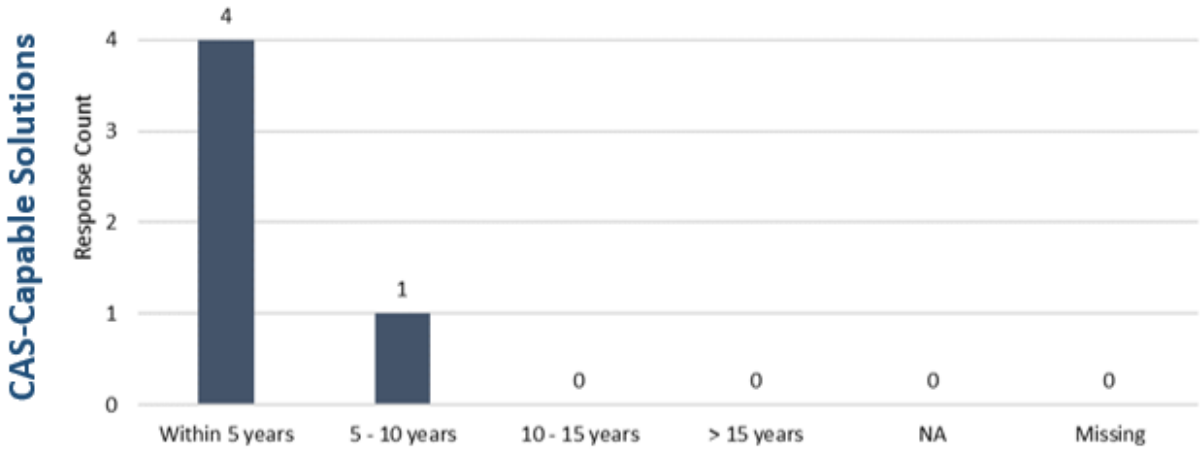


Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3Harris Responses
GAMA: 2 within 5 years, 1 in 5-10 years

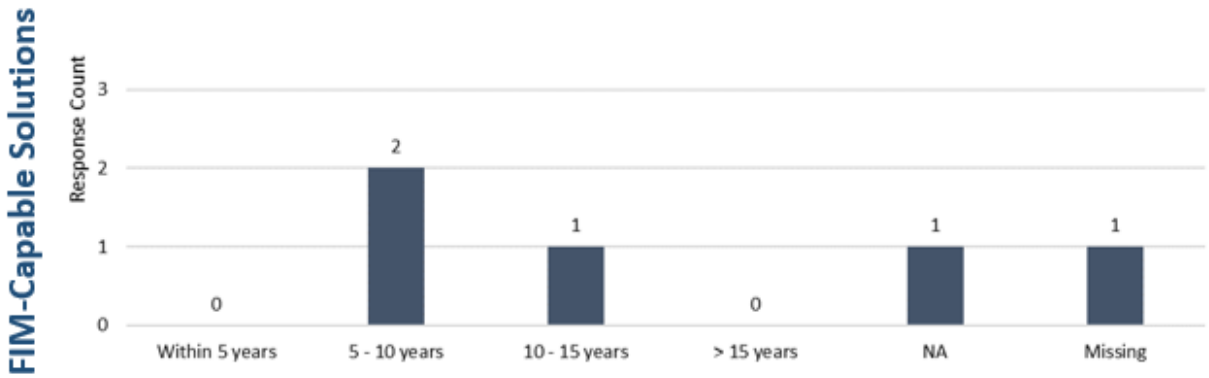
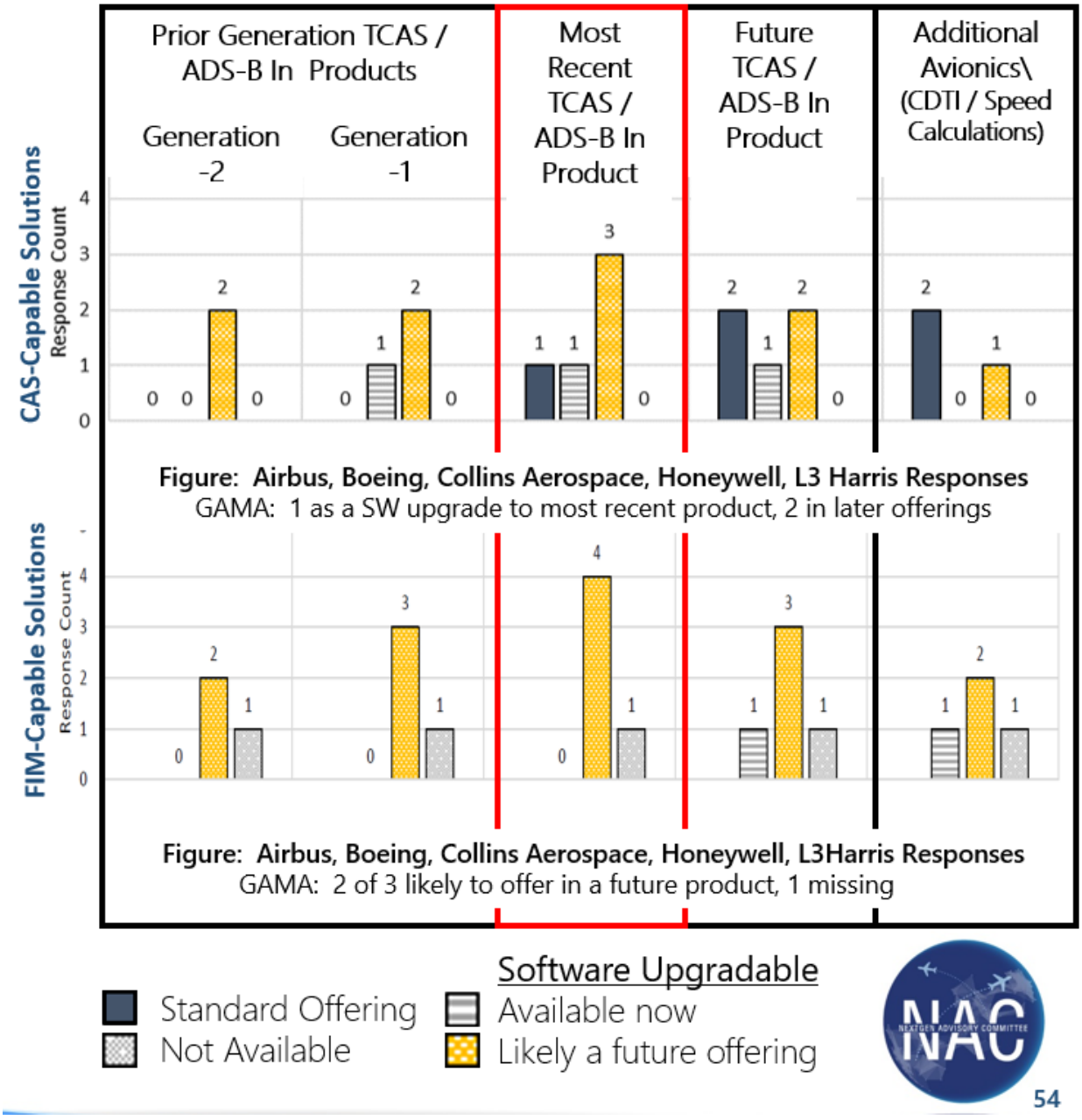


Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3Harris Responses
GAMA: 1 in 5-10 years, 1 in 10-15 years, 1 missing

Product Availability (results depicted below)



Interest in Operational Benefits Validation (results depicted below)

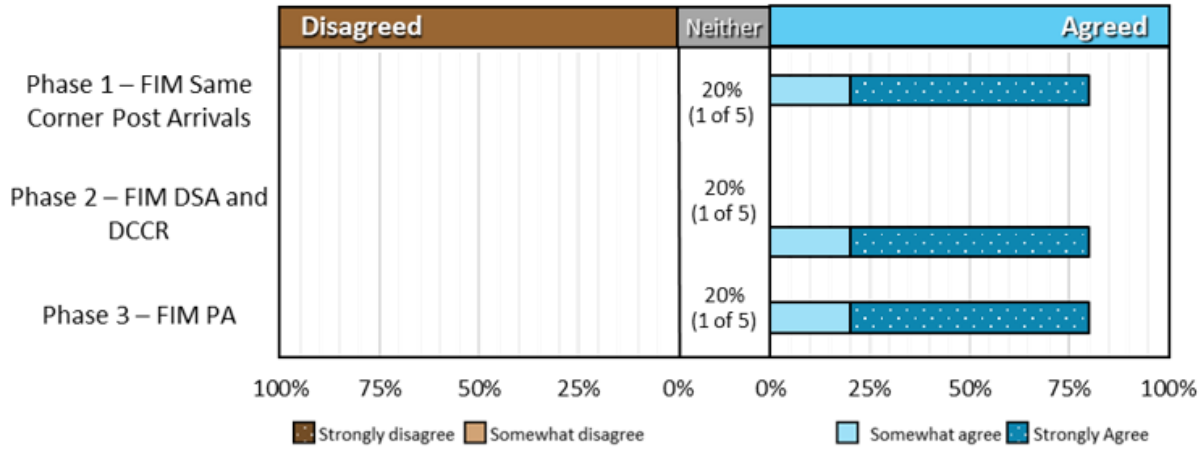


Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3 Harris Responses
GAMA: 1 of 3 Strongly Agree, 2 of 3 Neither Agreed nor Disagreed

Mr. Kauffman reviewed the top six barriers that would keep OEMs from investing, including:

1. Unclear interest from airline and aircraft OEM customers
2. Insufficient funds
3. Unclear FAA commitments on necessary procedure changes
4. Unclear FAA commitments on automation investments
5. Pilot acceptability
6. Controller Acceptability

The team reviewed the following specific FAA recommendations:

- Formally notify Operators and OEMs when the FAA makes investment decisions or changes previously communicated investment approaches
    - Operators and OEMs are unwilling to make investment decisions until they know the FAA has the infrastructure necessary to use ADS-B In applications
- Provide opportunity to interested Operators, Pilot Associations and NATCA to discuss, develop and implement procedural changes, prior to the introduction of new ADS-B In Applications into the NAS
    - Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctant to adopt the ADS-B In Applications
- Develop safety cases that show the proposed ADS-B In Applications meet or exceed an equivalent level of safety
    - Maintaining current level of safety is important to Operators, Pilot Associations and NATCA
- Offer funding support for Operators and OEMs participating in Operational Benefits Validation field trials

    - Operational Benefits Validation field trials benefit the entire industry, the costs and risks should not be fully borne by a few industry participants; Government funding support is appropriate in situations such as this
- Formalize an FAA-approved concept of operations for the use of Flight-deck Interval Management applications with Time-Based Management procedures such as Time of Arrival Control (ToAC) and communicate it to Operators, OEMs, pilots and air traffic controller associations, and standards developing organizations as changes occur
    - While MITRE has performed analysis of how ToAC and FIM could be implemented in the NAS, an FAA approved concept of operation for the use of these flight-deck based speed control technologies, preferably coordinated with other ANSPs world-wide, would give Operators and OEMs more confidence to move forward with their investment decisions
- Create a stepped approach for MOPS, TSOs and ACs for FIM applications, concurrent with FAA investment decisions, to advance ADS-B In Applications as they evolve
    - Industry is concerned that their initial investments will be at risk to ever changing MOPS over the more than ten-year span of the FAA Investment Concept
- Explore, with the Operator community, methods to provide operational incentives for Operators to equip
    - A two rate-Ground Delay Program (GDP) 10F that does not penalize those who do not equip, is one possible solution

The Final Report also includes recommendations for:

- Operators
- Aircraft and Avionics OEMs
- Pilot Associations
- NATCA

After reviewing the list of acknowledgements, the team requested NAC approval of the final report requested that the Ad Hoc Team be deactivated.

Mr. Mark Baker (AOPA) asked how many big gap areas are there in the ADS-B network and, if there are gaps, how much of an impediment that might be. Mr. Surridge said that given ADS-B Out mandate, all features are craft-to-craft communications and that ADS-B In does not depend on ground infrastructure.

Mr. Ladner recommended the NAC approve the ADS-B In Ad Hoc Team's report as NAC advice to the FAA for their consideration in response to NAC Tasks 20-1 and 21-2. Mr. Childs called for a motion to approve the report as advice to the FAA, which the NAC passed.

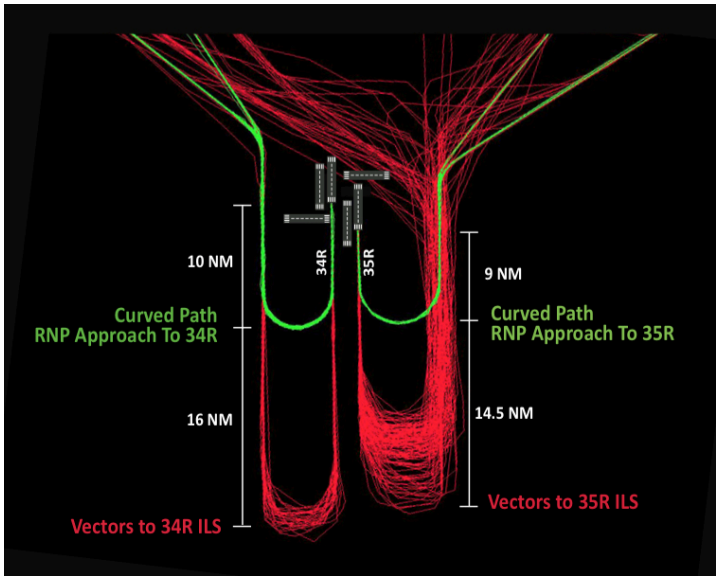
Outcome: The NAC passed a motion to approve the *ADS-B In Commercial Application Technologies Ad Hoc Team NAC Task 20-1 / 21-2 Report* as advice to the FAA

NAC Task 20-2: Vertical Navigation (VNAV)

Next, Mr. Ladner handed off to VNAV Ad Hoc Team Co-Leads Mr. Greg Young (Delta) and Mr. Michael McDowell (Collins Aerospace).

Mr. Young began by providing a quick review of Area Navigation (RNAV) approaches, explaining that they are used in NextGen because they are more efficient. In explaining why Vertical Navigation (VNAV) is good, he said they calculate constant angle, or smoothed, guidance on descents with altitude/airspeed constraints (avoids step-downs) that are more stable, fuel efficient, and accurate.

He said that the issue the VNAV Ad Hoc Team worked to address is that currently aircraft with Lateral Navigation (LNAV) Only guidance are not permitted to fly RNAV approach procedures when simultaneous parallel runways are in use, expanding that they require special handling and create frictions that disrupts operations. Mr. Young explained that RNAV is critical to unlocking NextGen benefits as it the flexibility enables more efficient traffic patterns, specifically citing the example of Established on RNP (EoR) configurations detailed in the image below.



He said that the VNAV Ad Hoc Team examined this "equipage gap" in vertical guidance capability, between those aircraft with only LNAV guidance and those with LNAV/VNAV or Localizer Precision with Vertical Guidance (LPV) vertical guidance. He then showed an approach video that depicted his point that it only takes one non-eligible aircraft to break the chain of use as the capable aircraft have to follow the non-equipped lines.

Next, the team explained the evolution of their tasking, which they clarified due to the COVID operational impact. The updated goals were to look at:

- Current Equipage Landscape
- Affected Models / Quantities / Retirement Plans
- Upgrade Options Available
- Impediments to Upgrading

The team reviewed the following fleet data:

- Op Specs Authorized VNAV Capability
    - D085 Op Spec data filtered for Part 121 aircraft
        - 1,245 aircraft (17 %) were identified as having LNAV Only capability
    - Two Findings on Regional aircraft

        - They are only 28% of total Part 121, but 74% of LNAV Only fleet
        - They are almost *eight* times more likely (46% vs 6%) to be LNAV Only equipped vs Mainline aircraft

Based on the fleet data, they concluded that:

- Fleet size will likely remain close to present size
    - Market trends favoring smaller markets served by these aircraft
    - "Retired" aircraft may not actually stay retired
        - Often acquired and returned to service by another operator
        - This is likely, considering renewed demand
- Approximately 259 (31 %) are currently planned for upgrade

The team then reviewed the following upgrade challenges and solutions:

- Upgrade Challenges
    - Impact to Multiple Aircraft Systems
        - Flight Management System (FMS), Flight Director/Autopilot, Displays
        - Control Panels and Sensors
    - Update is Aircraft Configuration dependent
    - Product Obsolescence
- CRJ Upgrades (Collins)
    - CRJ–200
        - Avionics manufacturer supplemental type certificate for LPV is available
        - Autopilot Coupled VNAV planned, availability is to be determined (TBD)
    - CRJ–700/900/1000
        - OEM Service Bulletin for Autopilot Coupled VNAV/LPV is available
- ERJ-135/145 Upgrades (Honeywell)
    - Upgrade path for ERJ–145 is being developed as contracted by customers to include RNP, LPV, and VNAV capabilities
    - Will be available for ERJ–145/135 equipped with Honeywell FMS and requires dual installation
    - Upgrade availability TBD due to COVID delays

The team reviewed the following impediments to upgrading:

- Benefits difficult to identify
    - $75K-350K per tail; highly dependent on aircraft type and current configuration
- Regional Airline – Network Carrier Business Relationship
    - Operating contracts complicate investment decisions
    - Length of contract, competition, aircraft ownership are all in play
- Training Device Configuration
- Availability of Upgrade Hardware: low demand, obsolescence

In closing, Mr. Young said the tasking was focused on an assessment of impediments to full VNAV operations. However, improving the VNAV capability alone is not the only capability required to fully leverage NextGen benefits. The MCL also lists the following:

- Capability to fly curved Radius to Fix (RF) procedure segments

- Resilient position sources,
- RNP alerting and reporting features, and
- FANS 1/A over VDL Mode 2 Data Comm

They said to consider these requirements, executive leaders will need specific benefit data to support a successful business case favoring NextGen equipage investments. The team said more study is needed, and should examine:

- All capabilities required to maximize NextGen benefits
- How all capabilities work together, to include consideration that ensures safety at high density airports and reduces workload risks,
- Operational data from current NextGen implementations, and
- Projected data from planned implementations

The Working Group recommended that:

- Benefits be broken down in terms of which specific equipment provides which capabilities, delivering which benefits
- Capabilities be presented in a way which will contribute to business analysis, such as where the additional capabilities are most beneficial, where and how cost savings may be achieved, or where markets may become more accessible
- Recommendations be shaped for decision makers who may be less familiar with NextGen development and its goals.
- Any subsequent efforts must leverage the expertise of operators, OEMs, and other stakeholders

The VNAV Ad Hoc Team then handed off to Mr. Ladner.

Mr. Ladner recommended the NAC approve the VNAV Ad Hoc Team's report as NAC advice to the FAA for their consideration in response to NAC Task 20-2. Mr. Childs called for a motion to approve the report as advice to the FAA, which the NAC passed.

Outcome: The NAC passed a motion to approve the *Vertical Navigation (VNAV) Ad Hoc Team NAC Task 20-2 Report* as advice to the FAA

Multiple Runway Operations (MRO)

Next, Mr. Ladner introduced the MRO team, including Mr. Natee Wongsangpaiboon and Mr. Raul Zamora from the FAA and industry co-chairs Mr. Phil Santos (FedEx) and Mr. Scott Dehart (Southwest Airlines). The team reviewed the following accomplishments:

- FAA completed additional CWT standards conversion at 3 sites
    - Memphis (M03/MEM) – 3/24/21
    - Indianapolis (IND/GUS) – 4/26/21
    - Chicago (C90/ORD) – 5/26/21
- Completed/Closeout 1 FAA Milestone
    - CWT Implementation at 7 sites

Next, the team reviewed the following looking ahead information:

- Additional CWT implementation/conversion
    - A80/ATL - September 2021

    - N90/EWR - October 2021
    - D01/DEN - Jan 2022
- Separation Standards for Closely Spaced Parallel Operations (CSPO) with High Update Rate Surveillance (HUR) - Q2CY2021
    - Safety Risk Management (SRM) document has been developed and approved
    - On track for June 2021 publication cycle

Mr. Santos thanked the FAA for persevering through the pandemic.

Surface and Data Sharing

Next, Mr. Ladner introduced the Surface and Data Sharing team including Mr. Doug Swol and Mr. Ayaz Kagzi from the FAA and industry co-chairs Mr. Rob Goldman (Delta) and Mr. Steve Vail (Mosaic). The industry co-chairs briefed the following:

- New joint commitment: FAA and industry will review current and subsequent changes of the TFDM waterfall to ensure industry alignment no later than Q1CY2022 and continue through Q4CY2022
    - Reduces programmatic risk while maximizing benefits
    - When available, seizes opportunities to fill identified needs
- Data sharing = Equipage
    - Trajectory Based Operations (TBO) integrates ATC Automation programs ("T" programs)
        - For example, TFDM, a part of TBO, requires two SWIM connections plus process and technology changes in ramp towers and operation centers to achieve full benefits
    - NASA ATD-2 and Digital Information Platform, SWIFT, CDM, etc. are helping inform industry as well as FAA
    - Industry commitment to participate in SWIFT extended through 2022
    - Need to leverage data exchange to achieve an integrated ATM system focused on throughput, efficiency and sustainability

Mr. Kagzi then briefed the following TFDM program status:

- Build 1 Status (Key Site: PHX)
    - Accomplishments
        - Completed B1.2 software testing remotely leading to new 1.3 software build
        - Completed first travel to WJHTC/OKC for training, security scans and upgrade of TFDM training systems
- Planned Activities
    - Planning B1.3 operational risk reduction test at WJHTC in June-July 2021
    - Travel to PHX planned for July/August to install software and update interfaces
    - Formal WJHTC and PHX OT on 1.4 planned for Fall 2021
- Build 2 Status (Key Site: CLT)
    - Accomplishments
        - Initiated B2.0 informal software testing remotely
        - B2.1 will be the TFDM IOC build at CLT

        - Kicked off TFDM testbed activities with two industry partner (4/7, 4/21)
- Planned Activities
    - Conduct B2.0 formal software test in September
    - On ramp partners to TFDM testbed
    - Finalize TFDM testbed connection to SWIM Cloud Distribution Service

Mr. Kagzi then reviewed the following milestone impacts:

SURFACE & DATA SHARING		
PRE-IMPLEMENTATION COMMITMENTS	**Old Date**	**New Date**
TFDM program will complete the operational testing for Build 1	Q2 CY2020	**Q4 CY2021***
NASA ATD-2 interim technology transfer from Phase 2: Fused IADS at CLT	Q4 CY2019	**Complete**
NASA ATD-2 final technology transfer from Phase 3: Terminal departure IADS at DFW/DAL	Q3 CY2020	Q4 CY2021
IMPLEMENTATION COMMITMENTS	**Old Date**	**New Date**
TFDM program will achieve key site IOC for Build 1 at PHX	Q2 CY2020	**Q2 CY2022***
TFDM program will achieve the in-service decision (ISD) for Build 1 to allow additional TFDM system deployments into the NAS	Q4 CY2020	TBD
TFDM program will achieve IOC at 3 additional sites	Q1 CY2021	TBD
TFDM program will achieve the key site IOC for Build 2 at CLT	Q4 CY2021	TBD
TFDM program will achieve ISD for Build 2 to allow additional deployments of the full TFDM capabilities into the NAS	Q1 CY2022	TBD
TFDM program will achieve IOC at 5 additional sites	Q1 CY2022	TBD

*** Not formal NJIP dates - new dates dependent on ability to travel, access FAA facilities, conduct training, conduct testing and other FAA program dependencies. If dependencies are not met, the program will not meet these dates.**

Performance Based Navigation (PBN)

Next, Mr. Ladner introduced the PBN team including Mr. Juan Narvid, Mr. Aaron Wilkins, and Ms. Wendy O'Connor from the FAA and industry co-chairs Mr. Brian Townsend (APA) and Mr. Bill Whyte (RAA). Mr. Townsend said the team is focused on a refresh of the PBN NIWG. He said they are planning an August meeting, which is envisioned to be a joint meeting with NEC NIWG. He said the following are the key meeting issues and provided additional context on each: LAS Metroplex Post-Implementation, Barriers to Established on RNP (EoR), NAS NAV Strategy, iTBO – Initial Trajectory Based Operations, PBN Clarification, and VOR Minimum Operations Network (MON).

Data Communications (Data Comm)

Next, Mr. Ladner introduced the Data Comm team with Mr. Jesse Wijntjes from the FAA and industry co-chairs Mr. Chris Collings (L3Harris) and Mr. Ed Evans (Southwest Airlines). The team reviewed the following Data Comm Accomplishments:

- Data Comm services are operational at 62 airports and the first 3 En Route Centers; planning underway for deployment restart
- Business/General aviation & DoD communities addressing avionics issues and resuming En Route participation

- Localized air-to-ground interop issues are being fault isolated & addressed

Next, Mr. Collings reviewed the following 2021 Data Comm NIWG/Avionics Ad Hoc Focus Items:

- Resume En Route Center Data Comm deployment
    - Industry requesting the FAA to restart and complete the En Route Data Comm deployment as quickly and efficiently as possible.
    - Resuming deployment will build momentum across the industry to realize operational benefits.
- Complete installation of Data Comm avionics updates for retrofit and newly delivered aircraft
    - Focus on Airbus ATSU CSB7.5, Collins CMU 900 Core 16, and Boeing 757/767 Pegasus 1 Latent Message Fix
- Track progress against plan for En Route STAR in Free Text mitigation
    - Plan presented at the March 2021 NAC
- Continue to track progress against NextGen Joint Implementation Plan (NJIP) milestones
    - Progress against FAA and Industry Data Comm milestones

Mr. Collings then reviewed the following Data Comm Avionics Ad Hoc Open Actions:

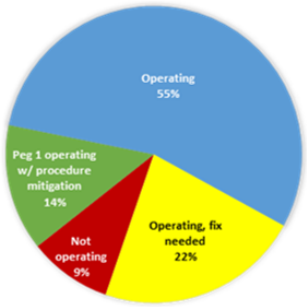
- Awaiting Airbus milestone for A220 avionics fix
- Awaiting Airbus milestone for A350 avionics fix
- Awaiting Boeing milestone for CMU900 Core 16 production cut-in for B737MAX
- Awaiting Boeing milestones for Nav Database revisions to mitigate en route STAR in free text for Pegasus II, B787, and B747 NG FMC

The team then provided an overview of avionics updates detailed in the following slide:

Data Comm Avionics Updates Fleet Status

Aircraft operating in Data Comm en route – no pending actions

Operator & Fleet Actions Complete		Status
American Airlines: A321, B777, B787		Operating en route, no action required
FedEx: B777, MD11		Operating en route, no action required
Southwest Airlines: B737		Operating en route, no action required
United: B787		Operating en route, no action required
UPS: B744, MD11		Operating en route, no action required
Avionics Action	**Operator/Fleet**	**Status**
Aircraft operating in Data Comm En Route with Crew Procedure Mitigation		
Boeing 757/767 Pegasus 1	FedEx, UPS	Aircraft operating under procedure mitigation Avionics Fix: Q3 2022
Aircraft operating in Data Comm En Route with Open Avionics Actions		
Collins CMU 900 Core 16	Alaska, American, Delta, United	Install delayed (COVID), aircraft operating
Airbus A320 ATSU CSB 7.5	Alaska, Delta, JetBlue	Fix released Dec 2020, aircraft operating, installs 50% complete
Boeing 777 AIMS 2 BP17B	United	Planned by end of 2021, aircraft operating
Boeing 747-8 ATN-203	UPS	Planned – Q4 2022, aircraft operating
Aircraft not operating in en route due to Open Avionics Actions		
Avionics Action	**Operator/Fleet**	**Status**
Collins VDR Update	Alaska, United	Install delayed (COVID), aircraft removed
Boeing 757/767 Pegasus 1	United	Pending Peg 1 Avionics Fix: Q3 2022
Airbus A220	Delta, JetBlue	Aircraft removed from en route, need fix plan
Airbus A350	Delta	Aircraft removed from en route, need fix plan



Operating, no action required | Operating fix needed | Peg 1 operating with mitigation | Not operating

In response to NAC Member Mr. Joe Landon's (Lockheed Martin) question regarding business, GA, military / DoD Data Comm use, Mr. Wijntjes said they have a methodical process put in place. He said it is absolutely important, clarifying that the more jets in the operation that can do CPDLC, the better. He said they employed some mods and enhancements in the recent ERAM release that has a feature that allows a significant number of DoD heavy lift.

NAC Member Mr. Warren Christie (JetBlue) requested issue resolution timelines for aircraft not operating in en route due to open avionics actions reported by the Data Comm Avionics Ad Hoc Group. He added that it is tough to see new aircraft without this capability. Mr. Wijntjes and Mr. Collings said they appreciated the suggestion.

Action: A NAC Member requested issue resolution timelines for aircraft not operating in en route due to open avionics actions reported by the Data Comm Avionics Ad Hoc Group

Northeast Corridor (NEC)

Next, Mr. Ladner introduced the Northeast Corridor team with Mr. Wilkins, Mr. Narvid, and Ms. O'Connor from the FAA and industry co-chairs Mr. Ralph Tamburro (Port Authority of New York and New Jersey) and Ms. Lee Brown (JetBlue).

Mr. Tamburro began by reviewing the following updates on NEC accomplishments (Opportunities):

- High-Performance Escape Route Test
    - Initial test

        - Test conducted in late March
        - Single flight, TEB-CLT
        - Requested climb performance was achieved; 26000' around GREKI (still heading Northeast)
    - Next Steps
        - Examine performance as part of the operation
- LGA PARK Visual Runway 31 (Implemented April 2021)
    - Mitigates safety concerns caused by convergent tracks of the RNAV VISUAL RWY 31 and Expressway Visual RWY 31
    - Feedback from operators and ATC has been positive
    - Currently gathering data on feasibility of public RNAV (GPS) instrument approach with multiple TF turns in an extended visual segment

Based on a comment from NAC Member Mr. Bolen regarding escape routes, Ms. Bristol said the FAA is working with facilities to have the capability as a tool in the toolbox—not just for severe weather.

Mr. Tamburro then reviewed the following NEC focus areas:

- Advancing NAC-recommended "NextGen Opportunities"
    - LGA Runway 31 instrument approach procedure, supporting data gathering and feedback for Flight Standards
    - High-performance escape routes for TAB/HPN, working with FAA System Operations and Air Traffic to look for use opportunities
- Completing milestones and operationalizing commitments
    - Interim deliverables for Time Based Flow Management (TBFM) at PHL and EWR
    - Interim deliverables for Atlantic Coast Routes (e.g., high altitude sector in Washington Center)

Ms. Brown then provided an outlook overview of 2021 commitments. With specific regard to the "Conduct GBAS evaluation / assessment at BOS" industry milestone, she indicated it was originally adjusted to "TBD" last year due to lack of resources at MassPort, related to traffic downturn during the COVID peak. When the NEC reviewed the status of the milestone with MassPort this past Spring, the response was that they did not have resources at this time to complete the study of the feasibility and cost/benefit of GBAS at BOS. Although resources might be available in another few years, which would push the milestone out, given the uncertainty, she said the NEC NIWG recommended removing the milestone.

Mr. Ladner recommended that the NAC approve removing the "Conduct GBAS evaluation / assessment at BOS" industry NJIP milestone. Mr. Childs called for a motion to approve removing the milestone, which the NAC approved.

Outcome: The NAC passed a motion to remove the "Conduct GBAS evaluation / assessment at BOS" industry NJIP milestone

Action Item Review / Other Business

Next, Mr. Childs handed off to Mr. Mims for any closing comments. Mr. Mims thanked the NAC for the excellent reports and updates. Mr. Schwab then reviewed action items and handed off to Mr. Childs.

Closing Comments and Adjourn

Mr. Childs said that he and Mr. Mims would like to thank NAC Members for their time and participation. Mr. Childs then adjourned the meeting.

Attachment 1

NAC Meeting

June 21, 2021

Opening of Meeting

Chip Childs, NAC Chairman

President & CEO, SkyWest, Inc.

PUBLIC MEETING ANNOUNCEMENT

NextGen Advisory Committee

June 21, 2021

This meeting is being held pursuant to a notice published in the Federal Register on May 27, 2021. The agenda for the meeting was announced in that notice, with details as set out in the agenda provided today. The FAA Deputy Administrator, Brad Mims, is the Designated Federal Officer responsible for compliance with the Federal Advisory Committee Act, under which this meeting is conducted.

The meeting is open to the public, and members of the public may address the NAC with the permission of the Chair. The public may submit written comments in advance of the meeting. In addition, the Chair may entertain public comment if, in his judgment, doing so will not disrupt the orderly progress of the meeting and will not be unfair to any other person.

Public Statements

Members of the Public

Chairman's Report

Chip Childs, NAC Chairman

President & CEO, SkyWest, Inc.

Motion for NAC Approval

- March 18, 2021 – NAC Meeting Summary Package Draft

Chairman's Report

Chip Childs, NAC Chairman

President & CEO, SkyWest, Inc.

FAA Report

Brad Mims, FAA Deputy Administrator

NAC Designated Federal Officer

"Unity21 made a beautiful ascent to apogee over Spaceport America, New Mexico"

Source: twitter @virgingalactic

FAA Report

Brad Mims, FAA Deputy Administrator

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Chairman's Roundtable

Chip Childs, NAC Chairman

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CVG
CINCINNATI/NORTHERN KENTUCKY
INTERNATIONAL AIRPORT

ACI
NORTH AMERICA
AIRPORTS COUNCIL
INTERNATIONAL

PORT
AUTHORITY
NY NJ
AIR LAND RAIL SEA

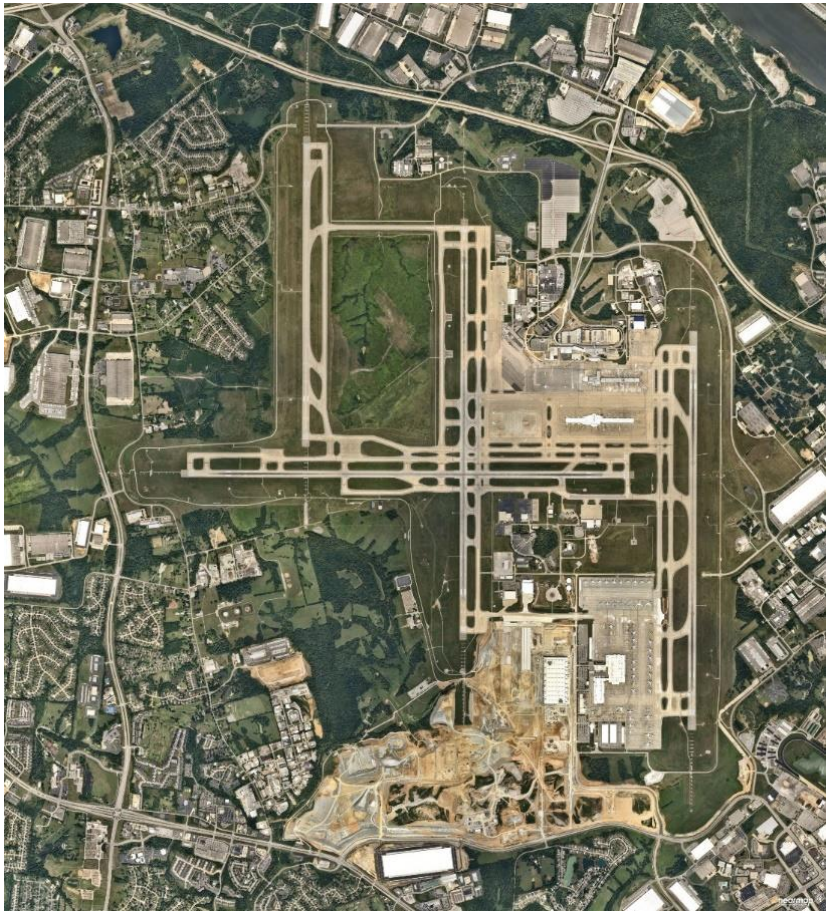
Airports and NextGen in the 2020s

NextGen Advisory Committee
June 21, 2021

CINCINNATI/NORTHERN KENTUCKY
INTERNATIONAL AIRPORT

Developments at Cincinnati/Northern Kentucky International Airport

DIVERSIFIED AIRPORT ENVIRONMENT



SIGNIFICANT AIR CARGO GROWTH AT CVG

AMAZON AIR HUB DEVELOPMENT

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INTERNATIONAL AIRPORT

NEW TECHNOLOGIES BEING INTRODUCED TO THE AIRSIDE

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DATA COMM IMPLEMENTATION TO SUPPORT GROWTH

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ACI NORTH AMERICA
AIRPORTS COUNCIL INTERNATIONAL

Airports and NextGen: The Broader U.S. Picture

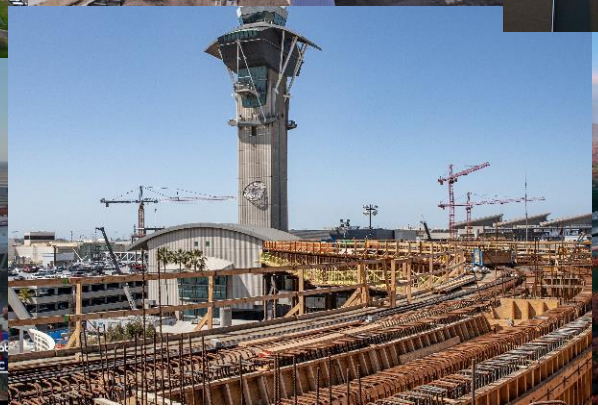
AIRPORT INFRASTRUCTURE DEVELOPMENT HAS CONTINUED DURING THE PANDEMIC (A FEW EXAMPLES)

EWR Terminal One

MCO South Terminal

ORD Global Terminal

MCI New Terminal

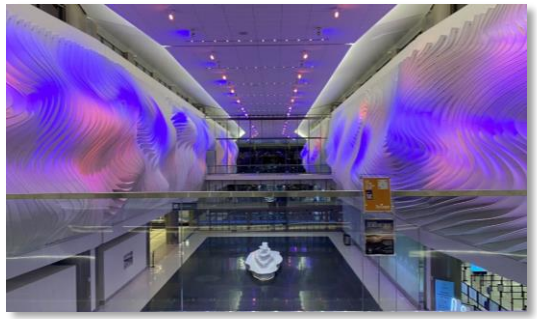


LAX LAMP Project

PIT New Terminal

MANY OTHER U.S. AIRPORTS HAVE COMPLETED OR WILL SOON COMPLETE MAJOR TERMINAL PROJECTS
(A PARTIAL LIST)

- DCA "Project Journey" terminal expansion and modernization (opened Spring 2021)
- LGA Terminals B & C (Phased opening starting in 2020)
- MSY New Terminal (Opened in 2019)
- SEA International Arrivals Facility (opening in 2021) and North Satellite Concourse Expansion (Phased opening starting in 2019)
- SLC New Terminal (Opened Fall 2020)
- SFO Harvey Milk Terminal 1 (Phased opening starting in 2019) and International Terminal Refresh

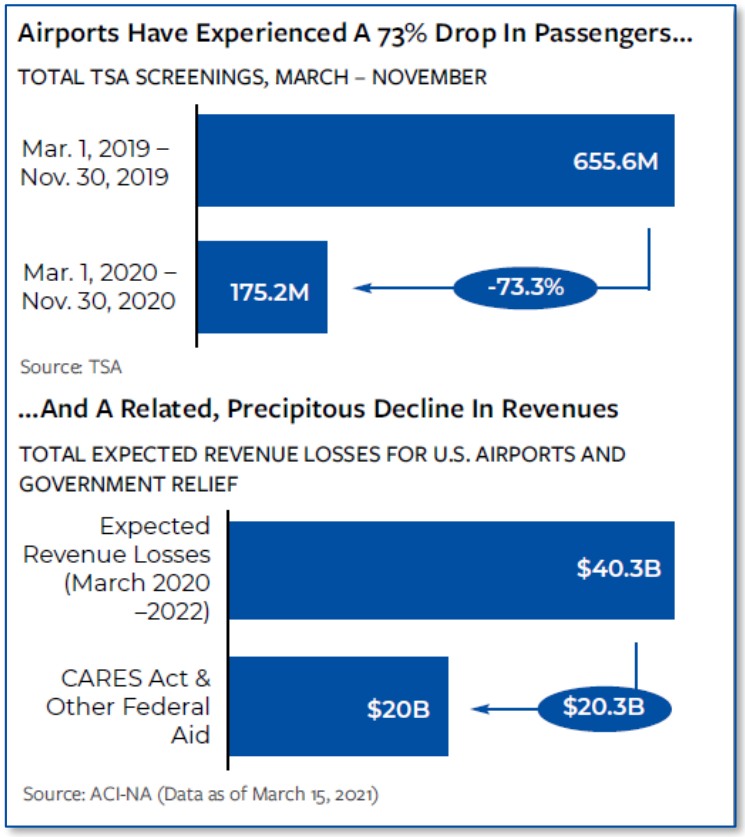


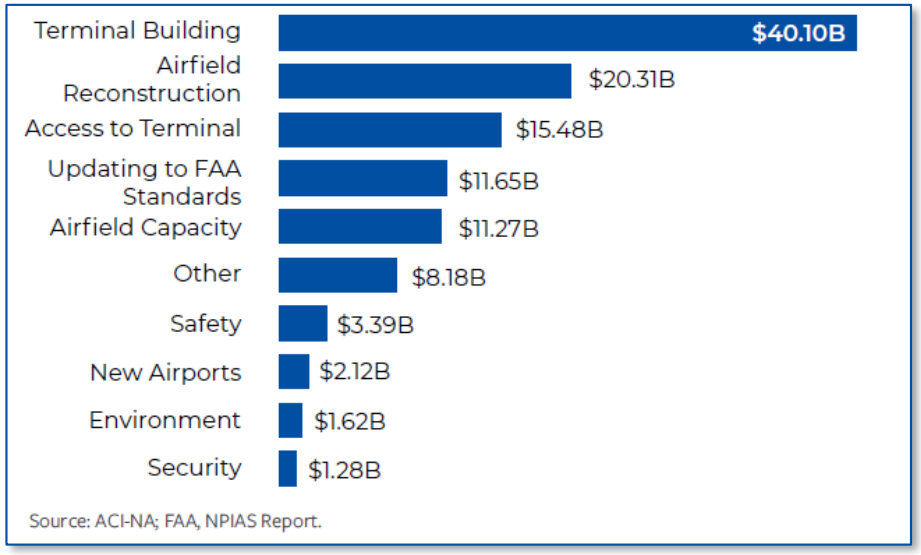
PANDEMIC IMPACTS ON U.S. AIRPORT DEVELOPMENT

- U.S. airports have reassessed capital improvement programs in light of pandemic air travel demand reductions and revenue losses.
- Many projects were delayed, deferred, or resized to reflect expected post-pandemic realities, (including several just discussed).
- However, airport capital investment needs remain strong in the U.S., much of it focusing on upgrading aging terminal and ground transportation facilities

https://airportscouncil.org/intelligence/airport-infrastructure-needs-study/

PANDEMIC IMPACTS ON U.S. AIRPORT DEVELOPMENT





Airports saw significant reductions in demand and revenues in during the pandemic…

…but still have capital needs of over $115 billion between now and 2025.

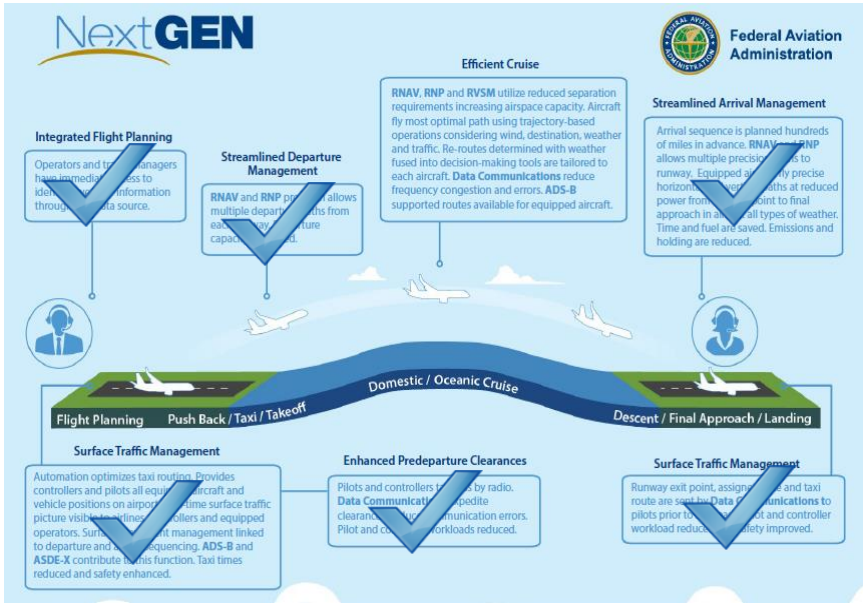
KEY OBJECTIVES OF AIRPORT INFRASTRUCTURE DEVELOPMENT

- Modernizing the air travel experience and meeting or exceeding customer service expectations
- Accommodating projected air transportation demand safely and efficiently
- Meeting community air service needs
- Improving airport and air transportation system sustainability and resiliency

These objectives need to be aligned with key stakeholders: airlines, other flight operators, the traveling public, and the community the airport serves

HOW DOES THIS RELATE TO NEXTGEN?

- Modernized terminal facilities are part of balanced aviation system development
- Ground transportation, terminal, airfield, and airspace systems need to operate in concert, with balanced capacities and efficiencies, to meet air transportation needs
- NextGen capability enhancements are vitally important to achieving this balance
- When applied well, NextGen capabilities can also address airport sustainability and resiliency objectives



NextGen Begins and Ends at Airports.

AIRPORTS AND NEXTGEN IN THE 2020S

- Enhanced surface operations via TFDM deployment, Airport Collaborative Decision Making (A-CDM), and more advanced surface management capabilities
- Enhanced efficiency/capacity through improved parallel and converging runway procedures and ATM automation
- Improved airport sustainability and community compatibility via PBN procedure refinement
- Increased use of NextGen automation capabilities and SWIM data
- Safe integration of new airspace users, particularly commercial uncrewed aircraft systems (UAS) and advanced air mobility (AAM) operators

CONTINUING CHALLENGES TO MEETING THESE GOALS

- Community acceptance particularly with respect to perceptions of aircraft noise and "metal overhead"
- Airport capability to utilize SWIM data and integrate it into airport operations and decision support systems
- Resources, including financial resources
  - Airport capital needs
  - Avionics equipage
  - Systems to support new airspace users (e.g., UTM)

Aviation stakeholders, the communities we serve, and the FAA are in this journey together.

PORT AUTHORITY NY NJ

LaGuardia Airport Redevelopment

Program Overview and Benefits to the NEC and NextGen

Huntley A. Lawrence, A.A.E.
Acting COO & Aviation Director

AIR LAND RAIL SEA

PANYNJ – BUILDING FOR THE FUTURE

- **EWR Redevelopment:**
  - Terminal One construction underway
  - Consolidated rental car/parking facility
  - AirTrain EWR Replacement
- **JFK Redevelopment:**
  - Modernized and unified Central Terminal Area
- **LGA Redevelopment**
  - First new airport in the United States in 25 years
  - New rail link – AirTrain LGA

LAGUARDIA TERMINAL B

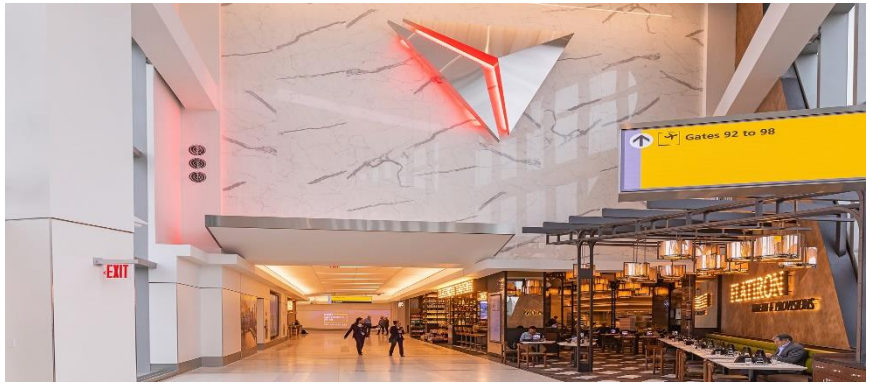
✈ Terminal B

- 35 gate-terminal, featuring dual pedestrian bridges spanning active taxi lanes
- $4 billion Public Private Partnership, led by LaGuardia Gateway partners
- Over $1.5 billion in M/WBE Contract Awards

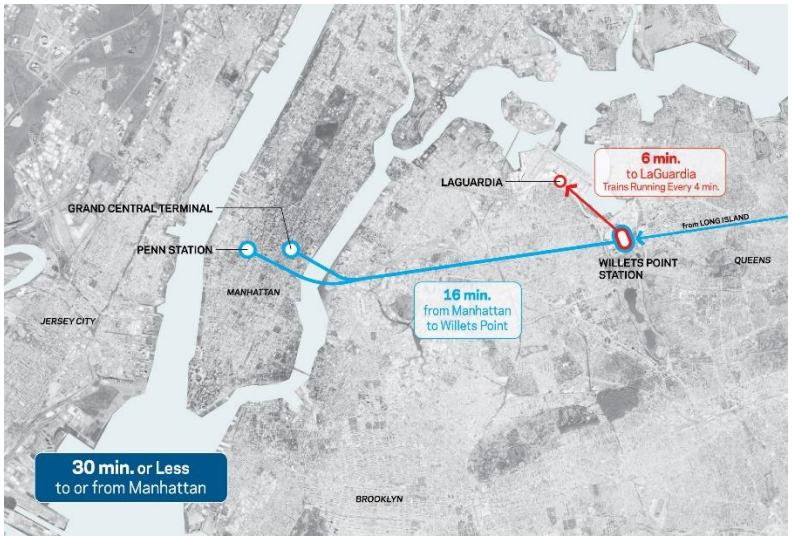
LAGUARDIA TERMINAL C

✈ Terminal C

- Four concourses; central check-in lobby
- 37 flexible gauge gates (33 with dual taxi lanes)
- $4 billion development by Delta Air Lines to replace existing terminals C&D



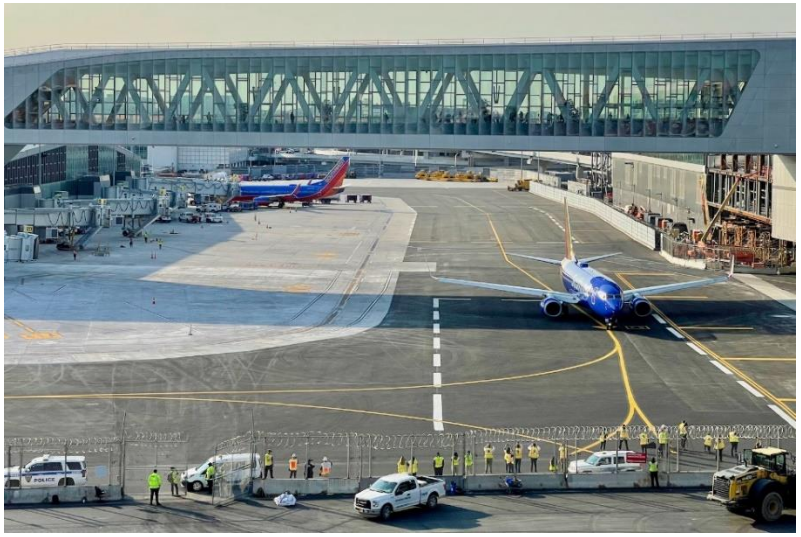
AIRTRAIN LGA



- LGA is the only major East Coast airport without a direct rail connection.
- AirTrain LGA will provide a reliable 30-minute travel time from Midtown Manhattan.
- AirTrain LGA will connect with public transportation at Willets Point, relieving congestion at LaGuardia while delivering environmental benefits.
- AirTrain LGA will not displace homes or businesses.

LAGUARDIA AIRPORT AND NEXTGEN

- Redevelopment shifts terminals to the south, allowing for increased ramp and taxi lanes.
- Taxi lane congestion is reduced with dual taxiways in most alleyways.
- Terminal B and C/D redevelopment will allow for departure metering, reducing taxi delays and aircraft emissions.
- While departure metering is a key component of the TFDM program, the surface improvements may allow the Port Authority to initiate a departure metering operation in the coming years while we wait for TFDM.
- Many of the surface chokepoints that impeded a smooth flow of traffic to and from the gates have been eliminated.



NEXT STEPS – WORKING TOGETHER

- ✈ Airport inclusion in the Collaborative Decision-Making process
- ✈ Continue to advance data-sharing capabilities in order to drive efficiency
- ✈ Investment in near- and long-term infrastructure
- ✈ Accelerate NEC recommendations
- ✈ Advance the Multiple Airport Route Separation (MARS) concept, Performance Based Navigation (PBN) development and Trajectory Based Operations (TBO) in the Northeast corridor with a ***specific*** focus on the New York operation

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Airports and NextGen in the 2020s

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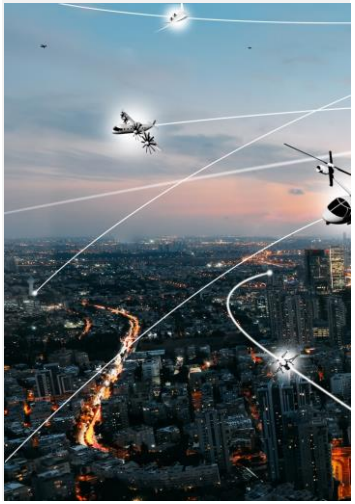
Advanced Air Mobility Update

Bob Pearce, NASA

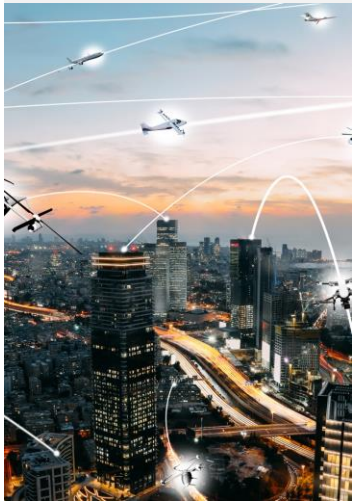
Bill Crozier, FAA

NASA Role to Address AAM Challenges

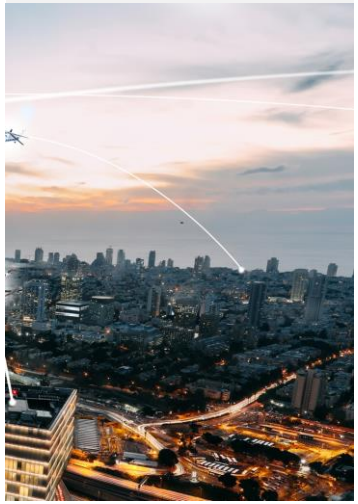
Vehicle Development and Operations



Airspace Design and Operations



Community Integration



NASA and key partners are collectively taking on the most difficult mission challenges to enable industry to flourish by 2030

- Research and Development Portfolio
- Robust Ecosystem Partnerships
- AAM National Campaign Series

NASA to deliver long-term technical solutions, architectures, and recommended requirements for the industry and regulatory communities

Federal Aviation Administration

AAM Strategic Overview

Chris Rocheleau / Bill Crozier
FAA Aviation Safety
June 21, 2021

Overview

* The FAA's regulatory framework will support industry's efforts to enable near-term AAM operations. The FAA will utilize waivers or exemptions as necessary

* Near-term AAM passenger/cargo operations to be certified under the current regulations

Focus:

- Covers the FAA's five areas of AAM (aircraft, airspace, operations, infrastructure, community)

- Based on current industry concepts and the associated assumptions surrounding AAM near-term operations

Key Assumptions

Key Assumptions

Based on current industry concepts, the FAA has made the following assumptions surrounding AAM near-term operations:

1. AAM aircraft will incorporate varying degrees of automation
2. Near-term operations will likely utilize existing airports and heliports
3. The AAM ecosystem includes all aspects of these five areas: Aircraft, airspace, operations, infrastructure, and community
4. At a minimum, AAM pilots will hold a commercial pilot certificate with an instrument rating
5. In the near term, AAM aircraft are anticipated to be predominantly electrically powered
6. The FAA may grant relief through waivers, exemptions, deviations, or other authorizations when necessary, to enable near-term operations

NAC Subcommittee (SC) Chairman's Report

John Ladner, NAC Subcommittee Chair, Alaska Airlines

21-2 (20-1 Extension):
ADS-B In Commercial Application Technologies
June 2021 – Final Report

Don Kauffman, Honeywell Aerospace

David Surridge, American Airlines

Operator Feedback

Alaska Airlines

American Airlines

Delta Air Lines

FedEx Express

JetBlue Airways

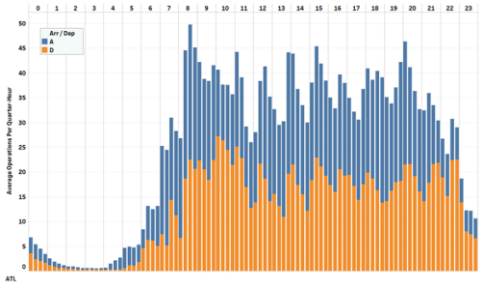
United Airlines

UPS Airlines

Regional Airline Association Members (4)

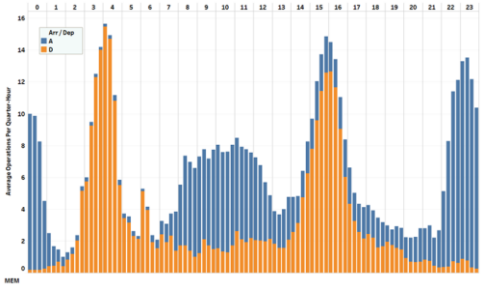
Operator Feedback

- **Operator Values that match their business models**
  - Airport Capacity (AAR)
    - Maximum runway throughput
  - Efficient Airspace
    - Reduction in CO_2
  - Schedule Reliability
    - Reduction in block variability



ATL CY2019

MEM CY2019



- **How will ADS-B In applications improve the NAS?**
  - Will this application compliment airline values?

- **What impact will be realized with having traffic information in the Flightdeck?**
  - Safety enhancements
  - Pilot/Controller enhancements

Operator Feedback Questionnaire Results

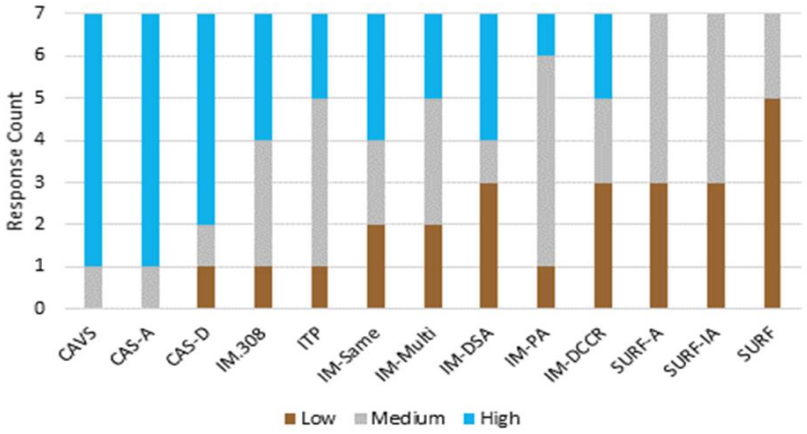
- **Questionnaire focused on What - Why - When**
  - **What** ADS-B In Application do you value?
  - **Why** does a certain ADS B In application interest you?
  - **When** does your company plan on having the majority of aircraft equipped?

- **Questionnaire then probed what barriers exist to investment**
  - Top 7 reasons

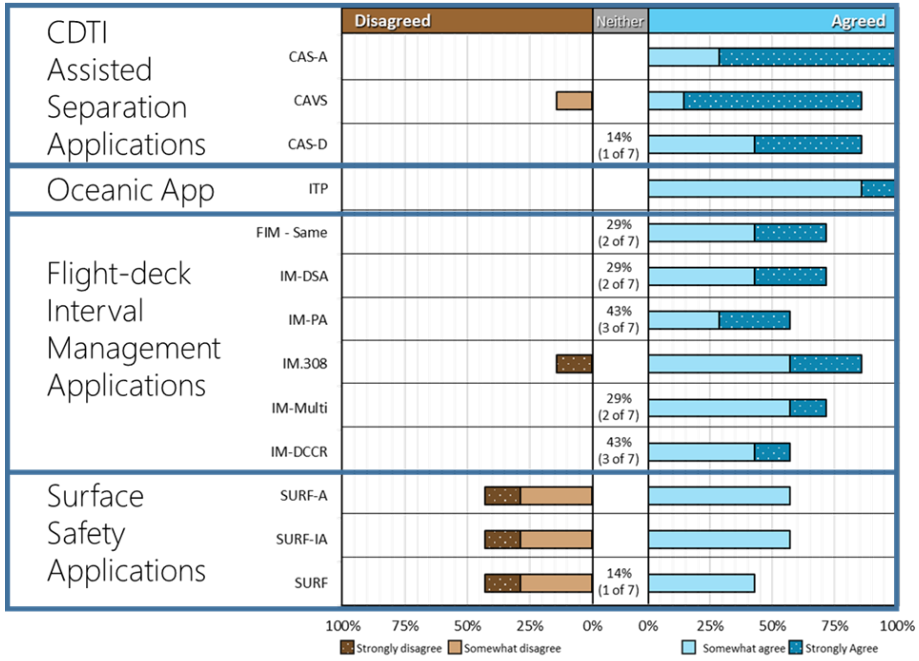
Operator ADS-B In Priorities

What

- What ADS-B In application are you interested in?



Alaska, American, Delta, FedEx Express, JetBlue, United, and UPS Priorities

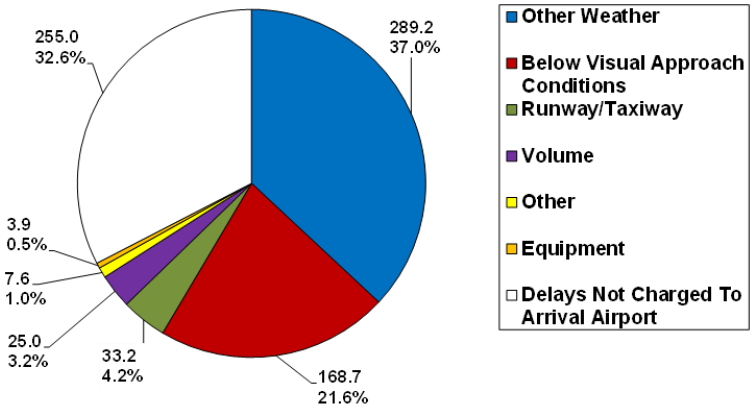


Alaska, American, Delta, FedEx Express, JetBlue, United, and UPS Level of Interest

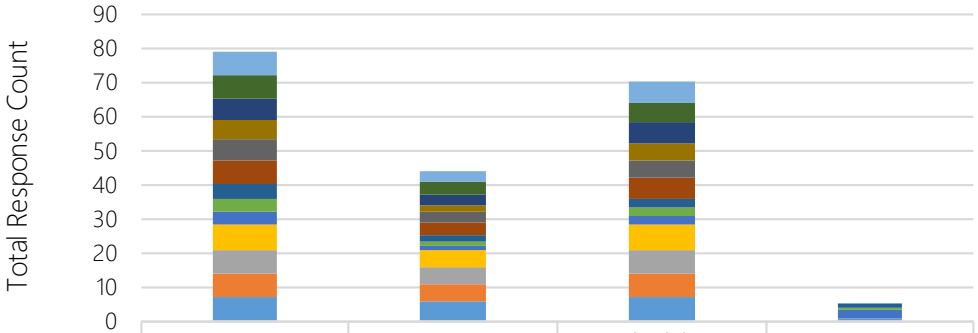
Operator ADS-B In Priorities

Why

- Why does a certain ADS-B In application interest you?



OPS Net Delay



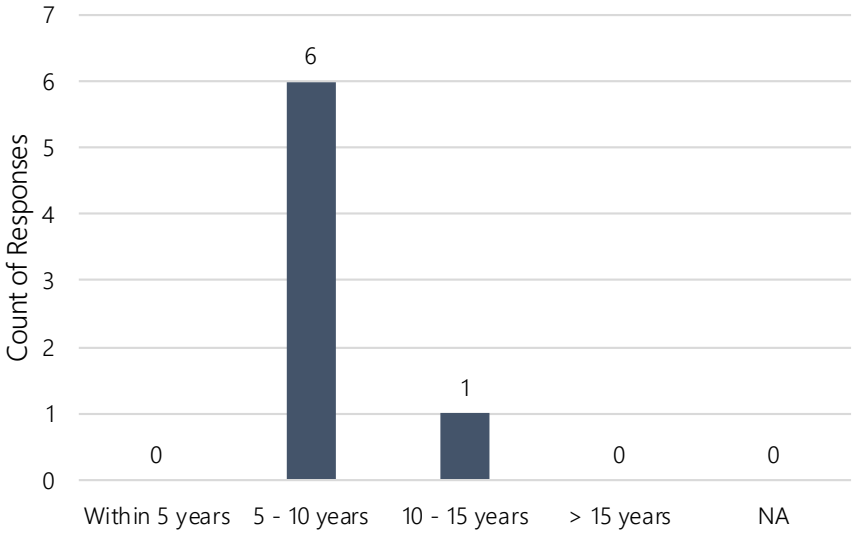
	Benefits	Low Cost	Applicability at enough locations where we operate	Other
IM-PA	7	3	6	0
IM-DSA	7	4	6	0
IM-DCCR	6	3	6	0
IM-Multi	6	2	5	0
IM.308	6	3	5	0
IM-Same	7	4	6	0
SURF-IA	4	2	3	1
SURF-A	4	1	2	1
SURF	4	1	3	2
ITP	7	5	7	0
CAS-D	7	5	7	0
CAS-A	7	5	7	0
CAVS	7	6	7	1

Alaska, American, Delta, FedEx Express, JetBlue, United, and UPS Priorities

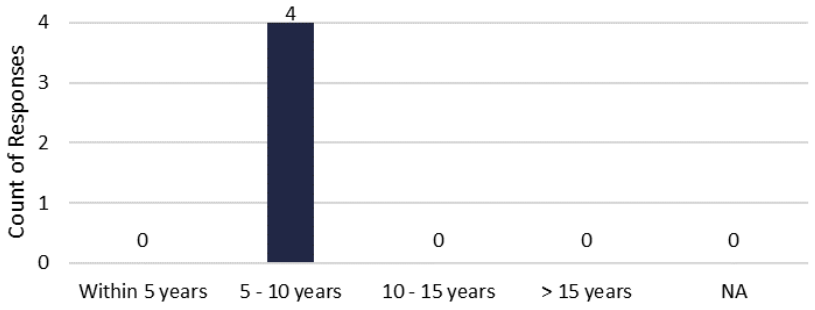
Number of Operators Likely to Equip / Investment Timeline

When

- Vast majority of airlines are interested in investing within 5 - 10 years



Alaska, American, Delta, FedEx Express, JetBlue, United, UPS

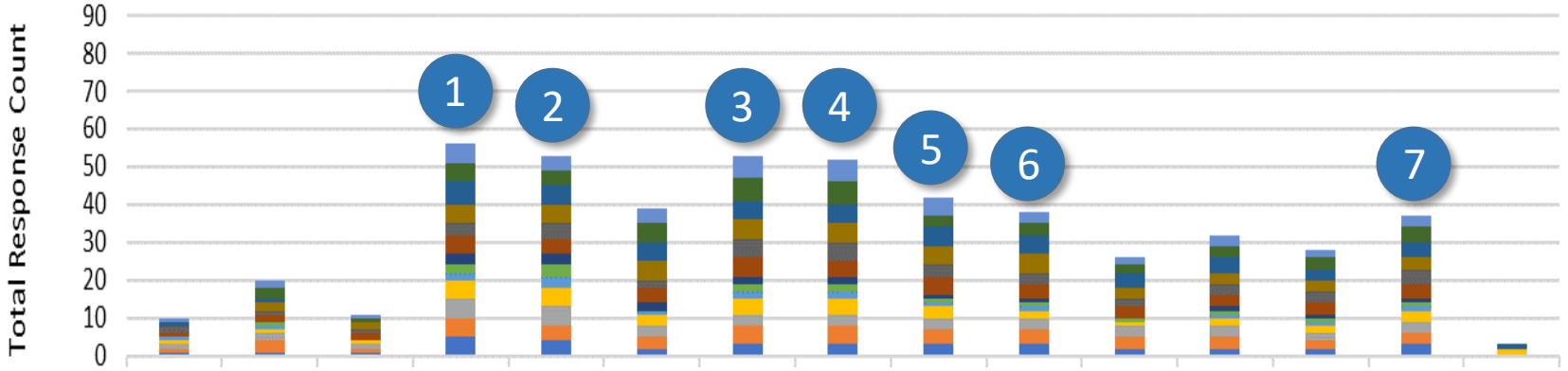


4 Regional Airlines

Operator Barriers to Investment

Top Seven Operator Barriers to Investment

1. Insufficient funds
2. Unclear FAA commitments on automation investments
3. Lack of benefits data
4. Unclear FAA commitments on necessary procedure changes
5. Lack of information on avionics costs
6. Lack of information in avionics installation requirements
7. Training costs



Aircraft & Avionics OEM Feedback

Airbus

Boeing

Collins Aerospace

Honeywell

L3Harris

General Aviation Manufacturers Association Members (3)

OEM Feedback – Timeline for Product Development

CAS-Capable Solutions

- All but two OEMs indicated they plan to have CAS-capable solutions within 5 years
- Two OEMs will have a solution in 5-10 years
- Highest operator interest

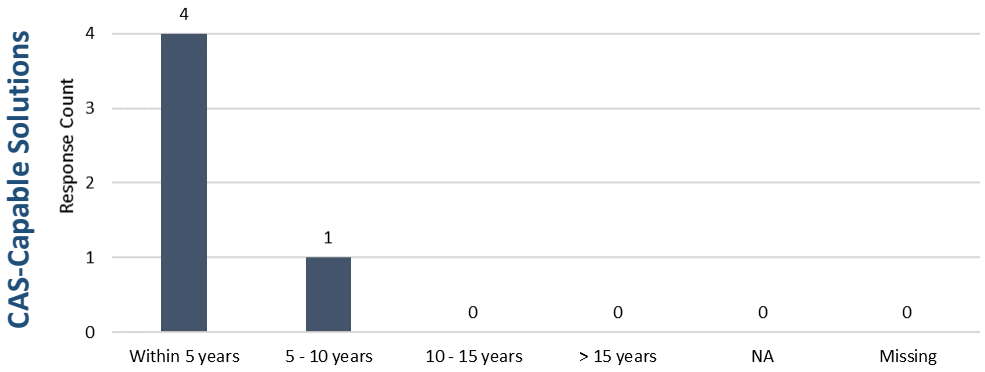


Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3Harris Responses
GAMA: 2 within 5 years, 1 in 5-10 years

FIM-Capable Solutions

- Timelines for FIM-capable solutions are typically 5 years later than CAS-capable solutions
- Avionics are more complex than CAS
- Processing the intended path of traffic-to-follow
- Continuously calculating speed commands
- Operator purchasing decisions are less certain

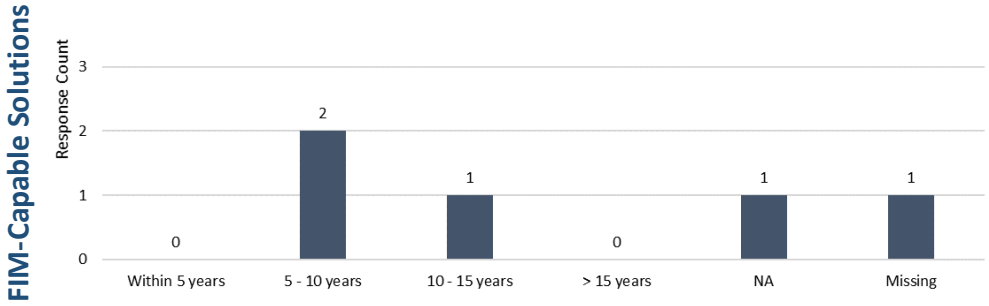


Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3Harris Responses
GAMA: 1 in 5-10 years, 1 in 10-15 years, 1 missing

OEM Feedback – Product Availability

CAS-Capable Solutions

- 5 OEMs either have or would likely offer CAS-capable software upgrade solutions in their most recent TCAS/ADS-B In avionics
- Some older avionics not upgradeable
- Additional avionics may be required, e.g., CDTI Displays

FIM-Capable Solutions

- 4 OEMs will likely offer FIM-Capable solutions in a future product offering
- Additional avionics may be required
- Some older avionics not upgradeable
- 1 OEM has no plans of offering FIM-capable solutions

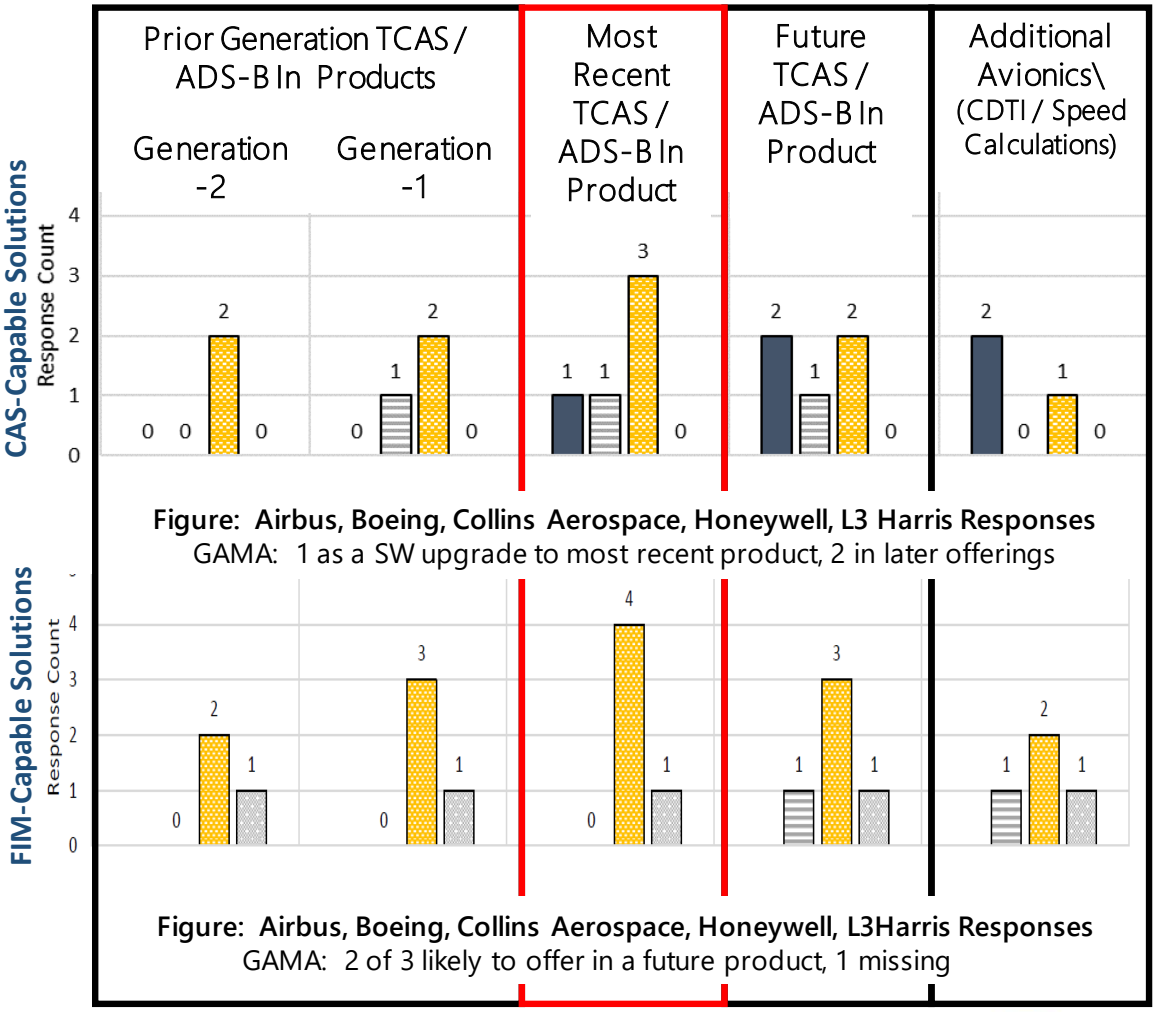


Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3 Harris Responses
GAMA: 1 as a SW upgrade to most recent product, 2 in later offerings

Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3Harris Responses
GAMA: 2 of 3 likely to offer in a future product, 1 missing

OEM Feedback – Interest in Operational Benefits Validation

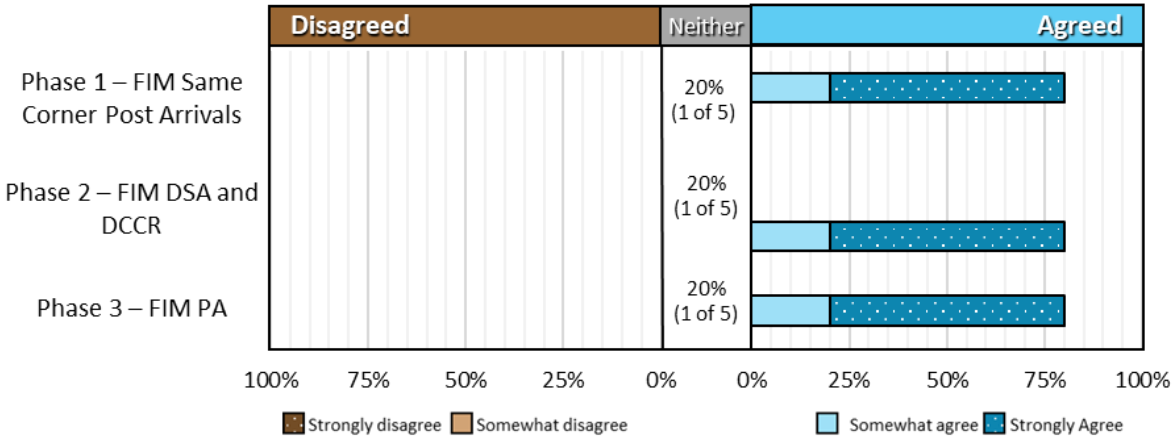


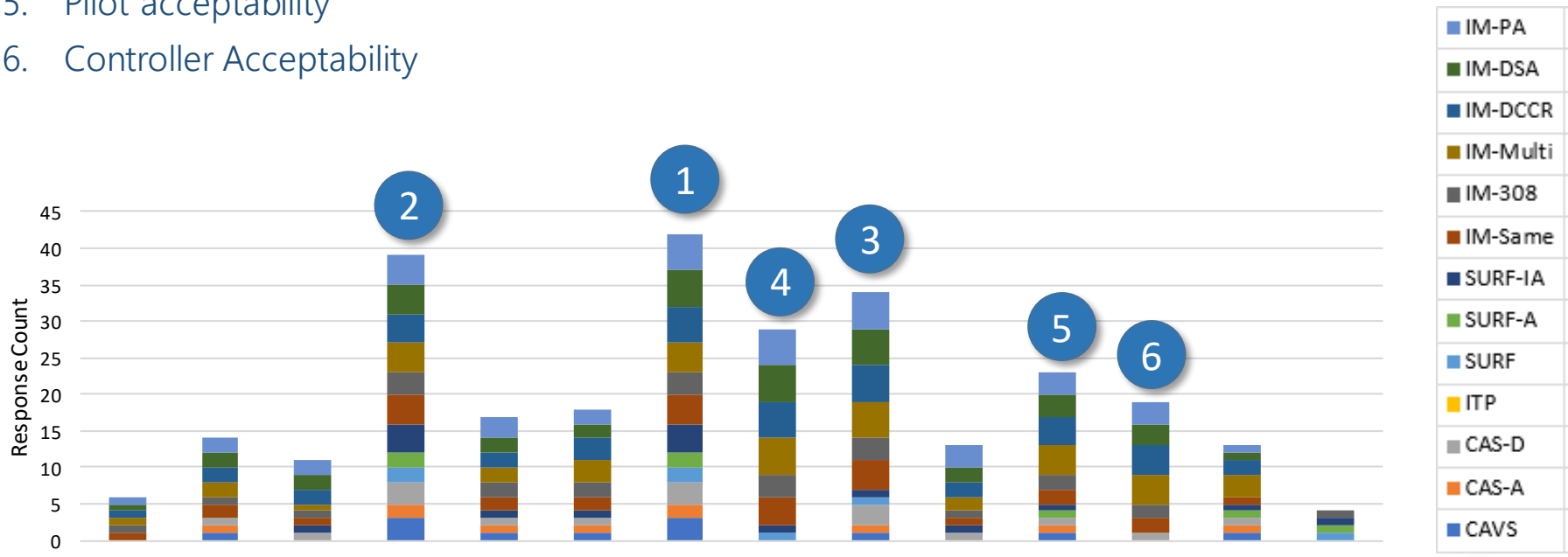
Figure: Airbus, Boeing, Collins Aerospace, Honeywell, L3 Harris Responses
GAMA: 1 of 3 Strongly Agree, 2 of 3 Neither Agreed nor Disagreed

- OEM business case will not close on just the quantity of shipsets required for the Operational Benefits Validation (OBV)
  - Risk that OBV outcome will not lead to forecasted product demand
- OEMs need to prioritize internal product development and certification funding across multiple product lines
  - Financial impact of the COVID-19 is limiting internal R&D funding

OEM Feedback – Barriers to Investment

Top Six OEM Barriers to Investment

1. Unclear interest from airline and aircraft OEM customers
2. Insufficient funds
3. Unclear FAA commitments on necessary procedure changes
4. Unclear FAA commitments on automation investments
5. Pilot acceptability
6. Controller Acceptability



Recommendations

Recommendations – FAA (1 of 2)

Formally notify Operators and OEMs when the FAA makes investment decisions or changes previously communicated investment approaches

- Operators and OEMs are unwilling to make investment decisions until they know the FAA has the infrastructure necessary to use ADS-B In applications

Recommendations – FAA (1 of 2)

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Provide opportunity to interested Operators, Pilot Associations and NATCA to discuss, develop and implement procedural changes, prior to the introduction of new ADS-B In Applications into the NAS

- Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctant to adopt the ADS-B In Applications

Recommendations – FAA (1 of 2)

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- Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctant to adop t the ADS-B In Applications

Develop safety cases that show the proposed ADS-B In Applications meet or exceed an equivalent level of safety

- Maintaining current level of safety is important to Operators, Pilot Associations and NATCA

Recommendations – FAA (1 of 2)

Formally notify Operators and OEMs when the FAA makes investment decisions or changes previously communicated investment approaches

- Operators and OEMs are unwilling to make investment decisions until they know the FAA has the infrastructure necessary to use ADS-B In applications

Provide opportunity to interested Operators, Pilot Associations and NATCA to discuss, develop and implement procedural changes, prior to the introduction of new ADS-B In Applications into the NAS

- Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctant to adopt the ADS-B In Applications

Develop safety cases that show the proposed ADS-B In Applications meet or exceed an equivalent level of safety

- Maintaining current level of safety is important to Operators, Pilot Associations and NATCA

Develop funding support programs for Operators and OEMs participating in Operational Benefits Validation field trials

- Operational Benefits Validation field trials benefit the entire industry, the costs and risks should not be fully borne by a few industry participants; Government funding support is appropriate in situations such as this

Recommendations – FAA (2 of 2)

Formalize an FAA approved concept of operations for the use of Flight-deck Interval Management applications with Time-Based Management procedures such as Time of Arrival Control (ToAC) and communicate it to Operators, OEMs, pilots and air traffic controller associations, and standards developing organizations as changes occur

- While MITRE has performed analysis of how ToAC and FIM could be implemented in the NAS, an FAA approved concept of operation for the use of these flight-deck based speed control technologies, preferably coordinated with other ANSPs world-wide, would give Operators and OEMs more confidence to move forward with their investment decisions

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Create a stepped approach for MOPS, TSOs and ACs for FIM applications, concurrent with FAA investment decisions, to advance ADS-B In Applications as they evolve

- Industry is concerned that their initial investments will be at risk to ever changing MOPS over the more than ten-year span of the FAA Investment Concept

- A two rate-Ground Delay Program (GDP)10F that does not penalize those who do not equip, is one possible solution

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- Industry is concerned that their initial investments will be at risk to ever changing MOPS over the more than ten-year span of the FAA Investment Concept

Explore, with the Operator community, methods to provide operational incentives for Operators to equip

- A two rate-Ground Delay Program (GDP) that does not penalize those who do not equip, is one possible solution

Additional Recommendations

- **The Final Report also includes recommendations for:**
  - Operators
  - Aircraft and Avionics OEMs
  - Pilot Associations
  - NATCA

Acknowledgements

- **Subject Matter Experts**
  - American Airlines
  - Blue Mountain Aero
  - FAA
  - MITRE
  - Regulus Group
  - United Airlines

- **MITRE**
  - For the administration of the on-line questionnaires, de-identification of the results, and generation of the tables and graphs contained in the Final Report

- **NAC Task 20-1 Members and Their Organizations**

Request for Approval

- A draft of the Final Report was distributed to NAC SC members for review and comment on May 19th
- The Final Report was distributed to the NAC members with the read-ahead material

1. **Task Group 20-1, ADS-B In Commercial Applications Technologies, requests NAC approval of their Final Report in response to the FAA Tasking**

2. **This is the final deliverable of Task Group 20-1; therefore, we request that Task Group 20-1 be deactivated**

Motion for NAC Approval as Advice to the FAA

- ADS-B In Commercial Application Technologies – NAC 21-2 (20-1 Extension) Report

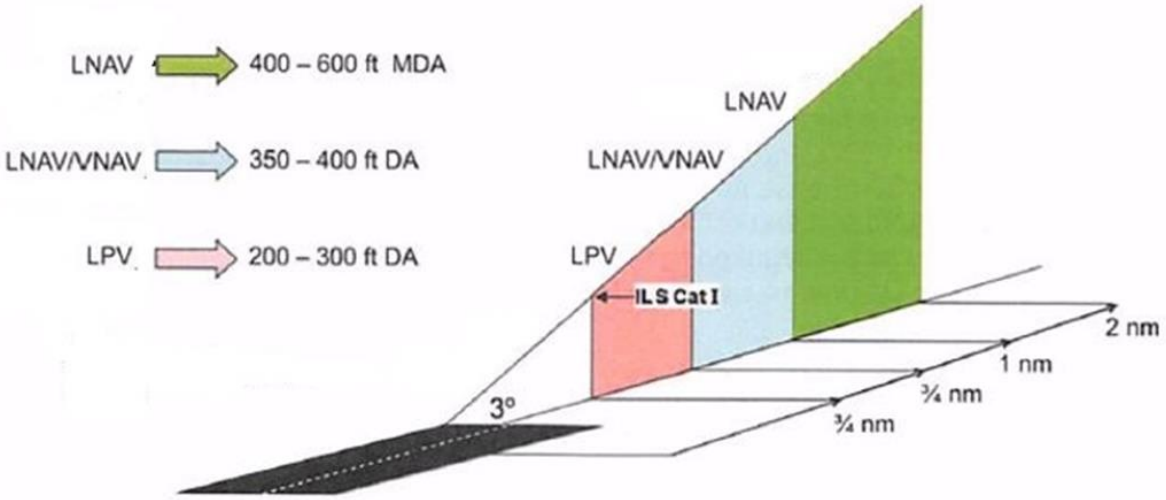
20-2: Vertical Navigation (VNAV)

Michael McDowell, Collins Aerospace

Greg Young, Delta Air Lines

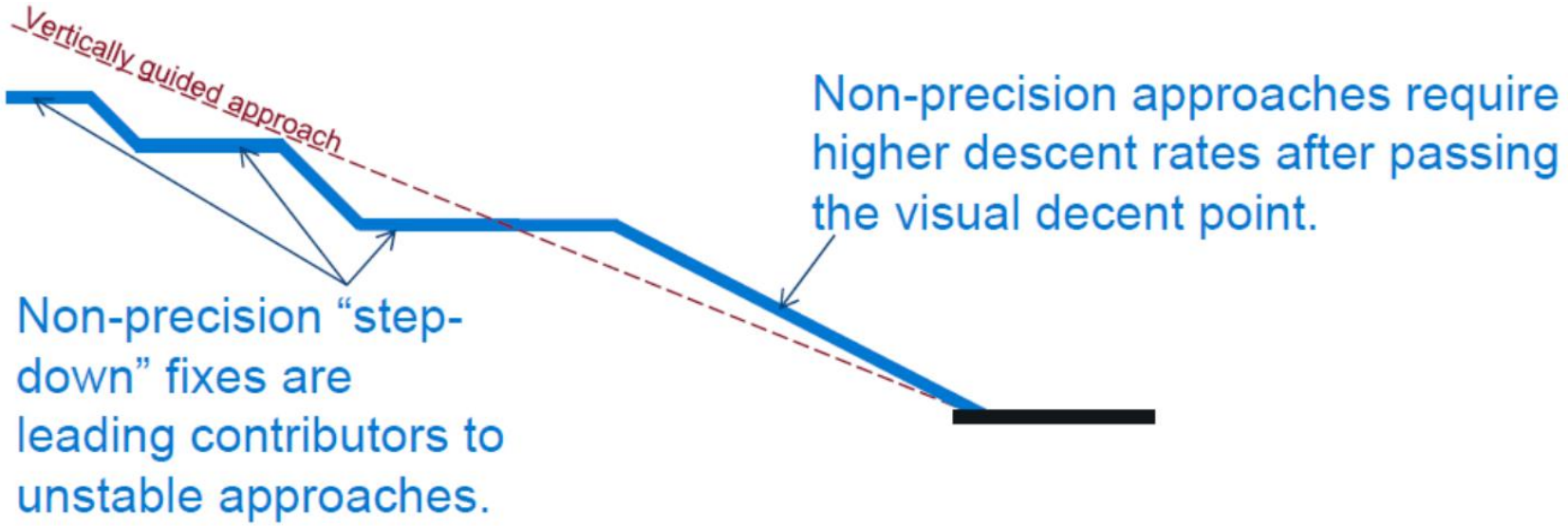
Quick Review: RNAV Approaches

- RNAV ("Area Navigation) approaches: used in NextGen b/c they are more *efficient*
- Three levels of capability (lower minimums are better):
  - "Good" = Lateral Navigation Only (LNAV or "LNAV Only")
    - No Vertical Navigation for operational credit
  - "Better" = Lateral Navigation with Vertical Navigation (LNAV/VNAV)
  - "Best" = Localizer Precision with Vertical Navigation (LPV)



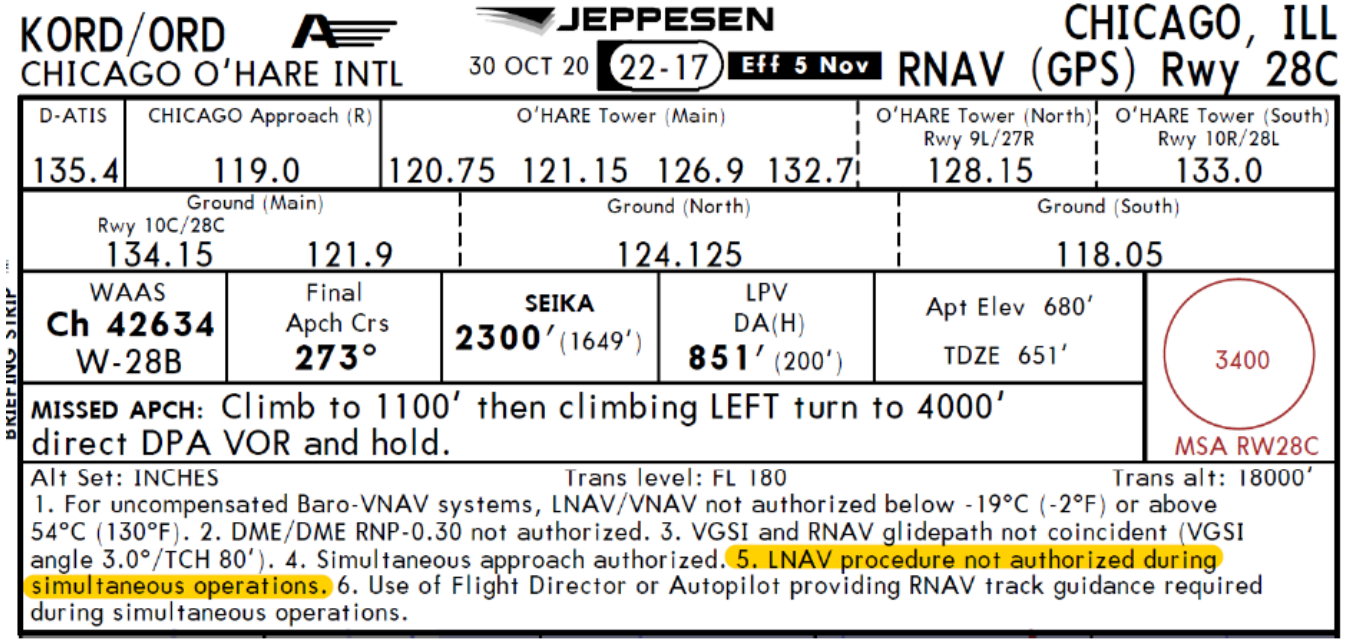
Quick Review: Why Vertical Navigation Is Good

- Calculates constant angle, or "smoothed," guidance on descents with altitude/airspeed constraints (avoids step-downs)
  - More stable (safer!)
  - More fuel efficient (power back at idle longer)
  - More accurate (compliance)



Quick Review: The Issue

- Aircraft with LNAV Only guidance are not permitted to fly RNAV approach procedures when simultaneous parallel runways are in use.
  - "Special handling" required (Read: more work for ATC)
  - Creates "friction:" increases risk, disrupts operations



KORD/ORD
CHICAGO O'HARE INTL

JEPPESEN
30 OCT 20 | 22-17 | Eff 5 Nov

CHICAGO, ILL
RNAV (GPS) Rwy 28C

D-ATIS	CHICAGO Approach (R)	O'HARE Tower (Main)	O'HARE Tower (North) Rwy 9L/27R	O'HARE Tower (South) Rwy 10R/28L
135.4	119.0	120.75 121.15 126.9 132.7	128.15	133.0

Ground (Main) Rwy 10C/28C		Ground (North)	Ground (South)
134.15	121.9	124.125	118.05

WAAS	Final Apch Crs	SEIKA	LPV DA(H)	Apt Elev 680'
Ch 42634 W-28B	273°	2300' (1649')	851' (200')	TDZE 651'

MISSED APCH: Climb to 1100' then climbing LEFT turn to 4000' direct DPA VOR and hold.

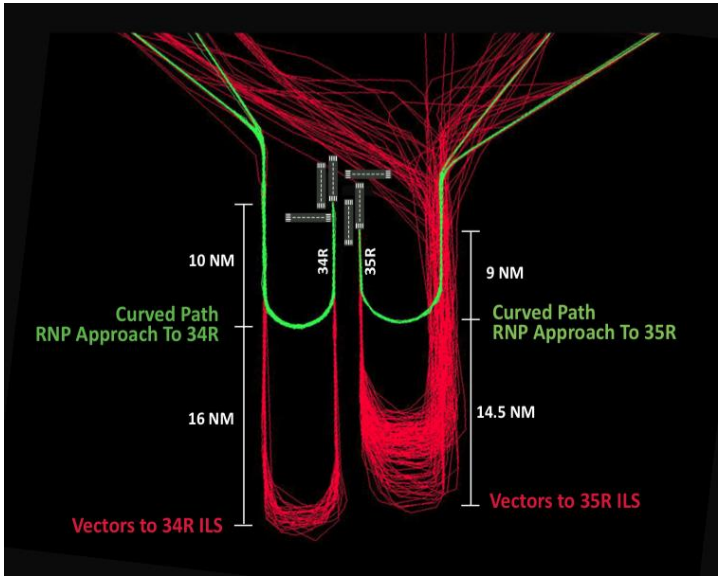
3400
MSA RW28C

Alt Set: INCHES Trans level: FL 180 Trans alt: 18000'

1. For uncompensated Baro-VNAV systems, LNAV/VNAV not authorized below -19°C (-2°F) or above 54°C (130°F). 2. DME/DME RNP-0.30 not authorized. 3. VGSI and RNAV glidepath not coincident (VGSI angle 3.0°/TCH 80'). 4. Simultaneous approach authorized. 5. LNAV procedure not authorized during simultaneous operations. 6. Use of Flight Director or Autopilot providing RNAV track guidance required during simultaneous operations.

Quick Review: Application

- RNAV is critical to unlocking NextGen benefits
  - Flexibility enables more efficient traffic patterns = time/fuel savings, greater predictability
  - Example: "Established on RNP" (EoR) configurations
    - LNAV aircraft cannot fly EoR with most other traffic (VNAV is reqd) = more track-miles, time, fuel, noise, and emissions.
    - LNAV aircraft often drag multiple VNAV aircraft behind them on these longer flight paths
  - Other implementations: Optimized descents, Multiple Airport Reduced Separation (MARS) [planned]

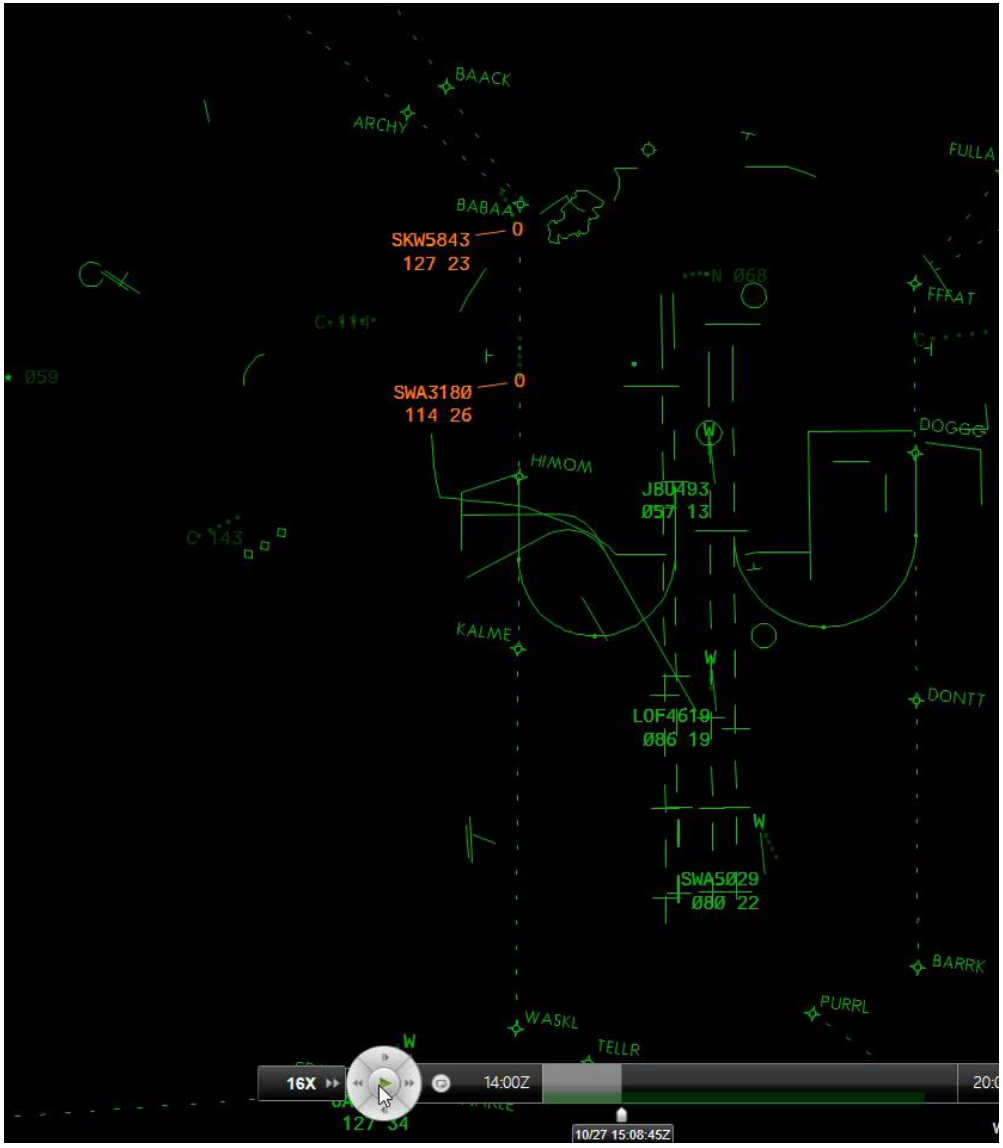


EoR in Denver
(green path is good)

This is an equipage gap…

- The VNAV working group examined this “equipage gap” in vertical guidance capability, between those aircraft with only LNAV guidance and those with LNAV/VNAV or LPV vertical guidance

DEN RNAV (RNP) Z Rwy 34R EoR Video



Tasking & Clarification

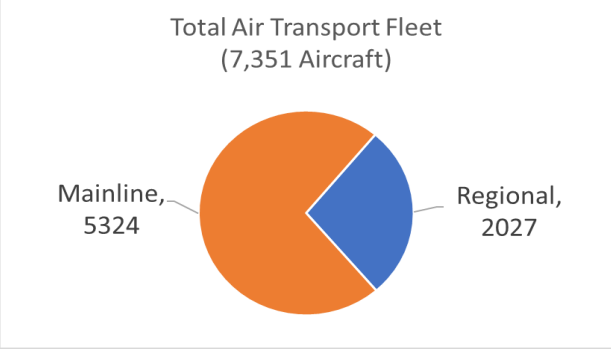
- **Original FAA Tasking Requested the Following**
  - Devise a plan to address the "equipage gap"
  - Assess the impediments to full VNAV operations
  - Make a plan to eliminate these impediments

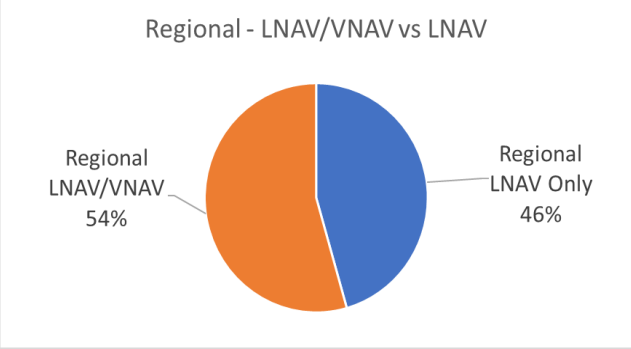
- **Clarification due to COVID-19 impact**
  - Relevance of a plan due to operational decline?
  - New impediments from this decline?

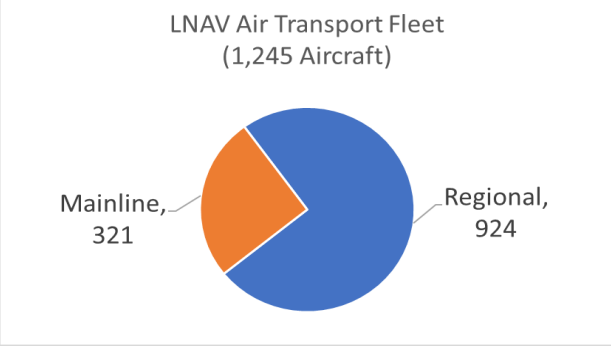
- **20-2 Vertical Navigation Updated Tasks**
  - Current Equipage Landscape
  - Affected Models / Quantities / Retirement Plans
  - Upgrade Options Available
  - Impediments to Upgrading

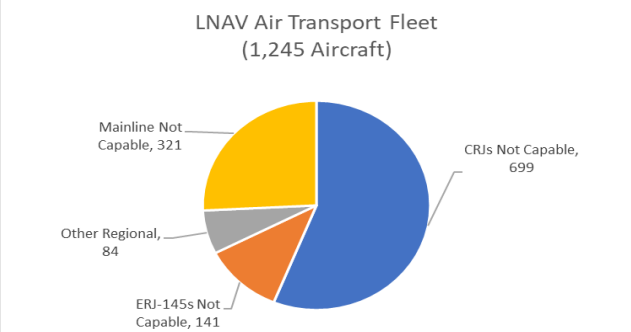
Fleet Data

- **Op Specs Authorized VNAV Capability**
  - D085 Op Spec data filtered for Part 121 aircraft
    - 1,245 aircraft (17 %) were identified as having LNAV Only capability
  - Two Findings on Regional aircraft
    - They are only 28% of total Part 121, but 74% of LNAV Only fleet
    - They are almost *eight* times more likely (46% vs 6%) to be LNAV Only equipped vs Mainline a/c









Fleet Data (cont.)

- **Survey Results**

A/C Type	*Pre-COVID LNAV-Only Fleet (Ops Specs)*	Operator Reported LNAV-Only Fleet	Operator Plans to operate>5yr	Operator Plans to Equip
CRJ	*704*	452	431	259
ERJ–135/145	*141*	113	113	0
Other	*408*	69	0	0
Total	*1253*	634	544	259

- **Conclusions**
  - Fleet size will likely remain close to present size
    - Market trends favoring smaller markets served by these a/c
    - "Retired" aircraft may not actually stay retired
      - Often acquired and returned to service by another operator
      - This is likely, considering renewed demand
  - Approximately 259 (31 %) are currently planned for upgrade

Upgrade Solutions

- **Upgrade Challenges**
  - Impact to Multiple Aircraft Systems
    - FMS, Flight Director/Autopilot, Displays
    - Control Panels and Sensors
  - Update is Aircraft Configuration dependent
  - Product Obsolescence

- **CRJ Upgrades (Collins)**
  - CRJ–200
    - Avionics Manufacturer STC for LPV is Available
    - Autopilot Coupled VNAV planned, Availability TBD
  - CRJ–700/900/1000
    - OEM Service Bulletin for Autopilot Coupled VNAV/LPV is Available

- **ERJ-135/145 Upgrades (Honeywell)**
  - Upgrade path for ERJ–145 is being developed as contracted by customers to include RNP, LPV, and VNAV capabilities
  - Will be available for ERJ–145/135 equipped with Honeywell FMS and requires dual installation
  - Upgrade availability TBD due to COVID delays

Impediments to Upgrade

- Benefits difficult to identify
  - $75K-350K per tail; highly dependent on aircraft type and current config
- Regional Airline – Network Carrier Business Relationship
  - Operating contracts complicate investment decisions
  - Length of contract, competition, aircraft ownership are all in play
- Training Device Configuration
- Availability of Upgrade Hardware: low demand, obsolescence

Final Comments

- Tasking was focused on Vertical Navigation; specifically requested assessment of impediments to full VNAV operations.

HOWEVER…

- Improving VNAV capability alone is not the only capability required to fully leverage NextGen benefits. The MCL also lists the following:
  - Capability to fly curved Radius to Fix (RF) procedure segments
  - Resilient position sources,
  - RNP alerting and reporting features, and
  - FANS 1/A over VDL Mode 2 Datacomm

Final Comments (cont.)

- To consider these requirements, executive leaders will need specific benefit data to support a successful business case favoring NextGen equipage investments.

  - More study is needed, and should examine:
    - All capabilities required to maximize NextGen benefits
    - How all capabilities work together, to include consideration that ensures safety at high density airports and reduces workload risks,
    - Operational data from current NextGen implementations, and
    - Projected data from planned implementations

Final Comments (cont.)

- The Working Group recommends that:
  - Benefits be broken down in terms of which specific equipment provides which capabilities, delivering which benefits
  - Capabilities be presented in a way which will contribute to business analysis, such as where the additional capabilities are most beneficial, where and how cost savings may be achieved, or where markets may become more accessible
  - Recommendations be shaped for decision makers who may be less familiar with NextGen development and its goals.

- Any subsequent efforts must leverage the expertise of operators, OEMs, and other stakeholders.

Comments

Motion for NAC Approval as Advice to the FAA

- Vertical Navigation (VNAV) – NAC Task 20-2 Report

Multiple Runway Operations (MRO)

Natee Wongsangpaiboon (FAA) & Raul Zamora, Jr. (FAA)

Phil Santos (FedEx) & Scott Dehart (Southwest Airlines)

Accomplishments (since March 2021 NAC)

- **FAA completed additional CWT standards conversion at 3 sites**
  - Memphis (M03/MEM) – 3/24/21
  - Indianapolis (IND/GUS) – 4/26/21
  - Chicago (C90/ORD) – 5/26/21

- **Completed/Closeout 1 FAA Milestone**
  - CWT Implementation at 7 sites

Looking Ahead

- **Additional CWT implementation/conversion**
  - A80/ATL - September 2021
  - N90/EWR - October 2021
  - D01/DEN - Jan 2022

- **Separation Standards for Closely Spaced Parallel Operations (CSPO) with High Update Rate Surveillance (HUR) - Q2CY2021**
  - Safety Risk Management (SRM) document has been developed and approved
  - On track for June, 2021 publication cycle

Surface & Data Sharing

Doug Swol (FAA) & **Ayaz Kagzi** (FAA)

Rob Goldman (Delta Air Lines) & **Steve Vail** (Mosaic ATM)

Surface & Data Sharing

- New joint commitment: FAA and industry will review current and subsequent changes of the TFDM waterfall to ensure industry alignment no later than Q1CY2022 and continue through Q4CY2022
  - Reduces programmatic risk while maximizing benefits
  - When available, seizes opportunities to fill identified needs
    - Example: Original recommendations moved NYC earlier on waterfall to replace DSP

Surface & Data Sharing (cont.)

"Enabler for TBO – Robust Information sharing"

- Steve Bradford at SWIFT 14 meeting 5/27/21

Surface & Data Sharing (cont.)

- **Data sharing = Equipage**
  - Trajectory Based Operations (TBO) integrates ATC Automation programs ("T" programs)
    - For example, TFDM, a part of TBO, requires two SWIM connections plus process and technology changes in ramp towers and operation centers to achieve full benefits
  - NASA ATD-2 and Digital Information Platform, SWIFT, CDM, etc. are helping inform industry as well as FAA
    - Industry commitment to participate in SWIFT extended through 2022
  - Need to leverage data exchange to achieve an integrated ATM system focused on throughput, efficiency and sustainability

TFDM Program Status

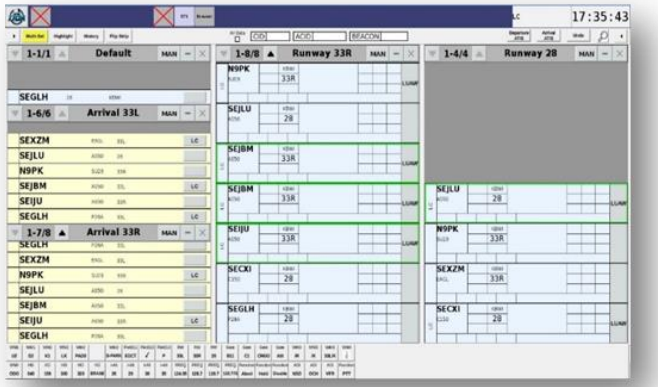
Build 1 Status (Key Site: PHX)

> **Accomplishments**

- Completed B1.2 software testing remotely leading to new 1.3 software build
- Completed first travel to WJHTC/OKC for training, security scans and upgrade of TFDM training systems

> **Planned Activities**

- Planning B1.3 operational risk reduction test at WJHTC in June-July 2021
- Travel to PHX planned for July/August to install software and update interfaces
- Formal WJHTC and PHX OT on 1.4 planned for Fall 2021



TFDM Build 1 Electronic Flight Strips Display

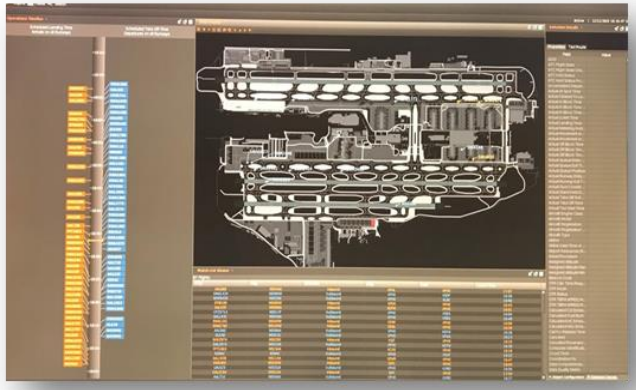
Build 2 Status (Key Site: CLT)

> **Accomplishments**

- Initiated B2.0 informal software testing remotely
  - B2.1 will be the TFDM IOC build at CLT
- Kicked off TFDM testbed activities with two industry partner (4/7, 4/21)

> **Planned Activities**

- Conduct B2.0 formal software test in September
- On ramp partners to TFDM testbed
- Finalize TFDM testbed connection to SWIM Cloud Distribution Service



TFDM Build 2 Surface Management Display

NAC Milestone Impact

SURFACE & DATA SHARING		
PRE-IMPLEMENTATION COMMITMENTS	**Old Date**	**New Date**
TFDM program will complete the operational testing for Build 1	Q2 CY2020	**Q4 CY2021***
NASA ATD-2 interim technology transfer from Phase 2: Fused IADS at CLT	Q4 CY2019	Complete
NASA ATD-2 final technology transfer from Phase 3: Terminal departure IADS at DFW/DAL	Q3 CY2020	Q4 CY2021
IMPLEMENTATION COMMITMENTS	**Old Date**	**New Date**
TFDM program will achieve key site IOC for Build 1 at PHX	Q2 CY2020	**Q2 CY2022***
TFDM program will achieve the in-service decision (ISD) for Build 1 to allow additional TFDM system deployments into the NAS	Q4 CY2020	TBD
TFDM program will achieve IOC at 3 additional sites	Q1 CY2021	TBD
TFDM program will achieve the key site IOC for Build 2 at CLT	Q4 CY2021	TBD
TFDM program will achieve ISD for Build 2 to allow additional deployments of the full TFDM capabilities into the NAS	Q1 CY2022	TBD
TFDM program will achieve IOC at 5 additional sites	Q1 CY2022	TBD

*** Not formal NJIP dates - new dates dependent on ability to travel, access FAA facilities, conduct training, conduct testing and other FAA program dependencies. If dependencies are not met, the program will not meet these dates.**

Performance Based Navigation (PBN)

Juan Narvid (FAA), Aaron Wilkins (FAA), & Wendy O'Connor (FAA)

Brian Townsend (APA) & Bill Whyte (RAA)

Status

- As we transition to a post-COVID environment, the PBN NIWG will begin to engage with the FAA for updates and discussions

- Team meeting to be scheduled for August

Key Issues

- **Key Issues for the meeting**
  - LAS Metroplex Post-Implementation
  - Barriers to Established on RNP (EoR)
  - NAS NAV Strategy
  - iTBO – Initial Trajectory Based Operations
  - PBN Clarification
  - VOR Minimum Operations Network (MON)

Activity

- **LAS Metroplex**
  - Begin the post-implementation analysis of the procedures from the operator perspectives
  - Discuss FAA benefits analysis underway

- **Barriers to EoR**
  - Advancing EoR through the 2016 NAS NAV Strategy
  - Understanding competing resources for Multiple Airport Route Separation (MARS)
  - Update on LAX EoR Section 547

- **NAS NAV Strategy**
  - Update and clarifications

Activity (cont.)

- **iTBO**
  - Discuss industry equipage plans and capabilities post COVID
  - FAA program updates
- **PBN Clarification**
  - Status update
  - FAA challenges
- **VOR MON**
  - FAA update
  - Operator feedback

Data Comm

Jesse Wijntjes (FAA)

Chris Collings (L3Harris) & **Ed Evans** (Southwest Airlines)

Data Comm Accomplishments

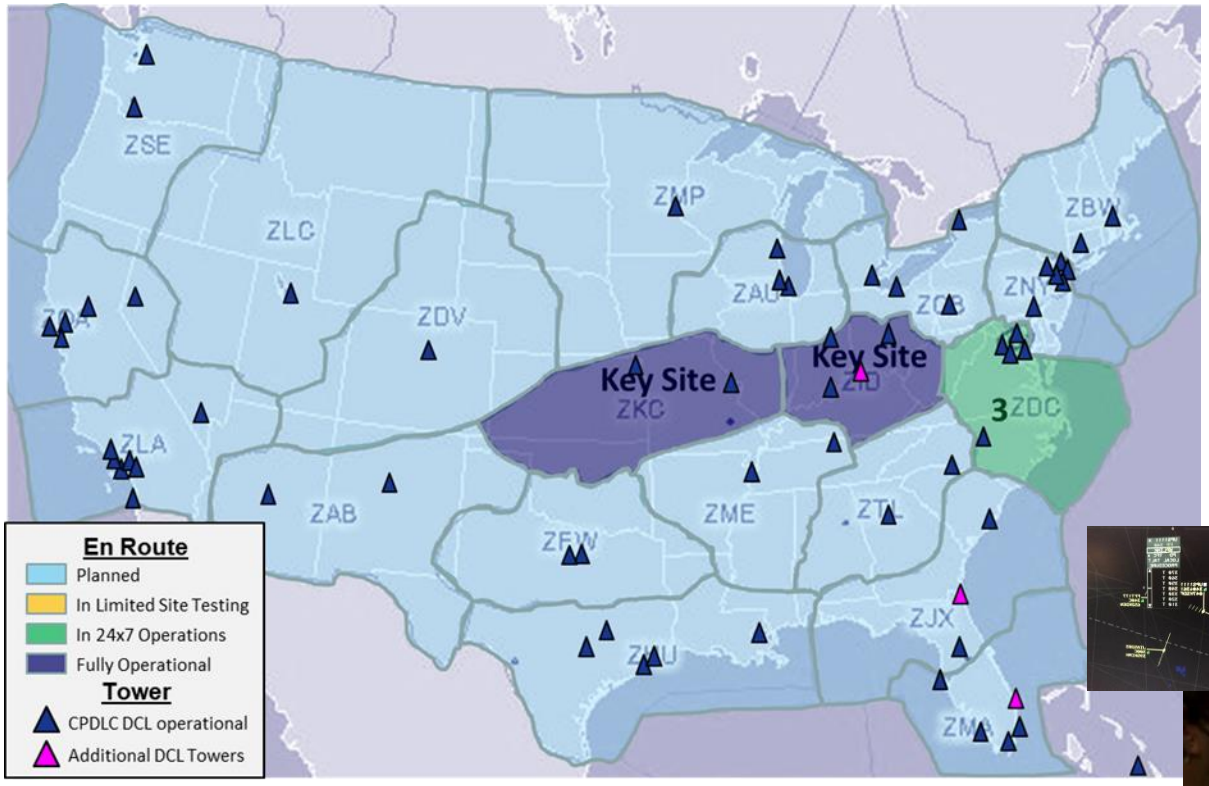
- Data Comm services are operational at 62 airports and the first 3 En Route Centers; planning underway for deployment restart

- Business/General aviation & DOD communities addressing avionics issues and resuming En Route participation

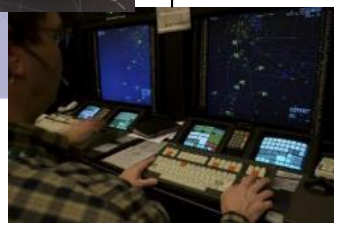
- Localized air-to-ground interop issues are being fault isolated & addressed

10,000,000th Data Comm Tower clearance successfully delivered on May 3, 2021

Data Comm Operational Status



Air-to-Ground Network



En Route

Tower

Data Comm operational at 62 Towers

CVG, PBI, & JAX approved for Tower CPDLC DCL services

Data Comm operational at 3 En Route Centers

Planning for deployment restart at remaining 17 En Route Centers

2021 Data Comm NIWG/Avionics Ad Hoc Focus Items

1. **Resume En Route Center Data Comm deployment**

   Industry requesting the FAA to restart and complete the En Route Data Comm deployment as quickly and efficiently as possible.

   Resuming deployment will build momentum across the industry to realize operational benefits.

2. **Complete installation of Data Comm avionics updates for retrofit and newly delivered aircraft**

   Focus on Airbus ATSU CSB7.5, Collins CMU 900 Core 16, and Boeing 757/767 Pegasus 1 Latent Message Fix

3. **Track progress against plan for En Route STAR in Free Text mitigation**

   Plan presented at the March 2021 NAC

4. **Continue to track progress against NextGen Joint Implementation Plan (NJIP) milestones**

   Progress against FAA and industry Data Comm milestones

Data Comm Avionics Ad Hoc Open Actions

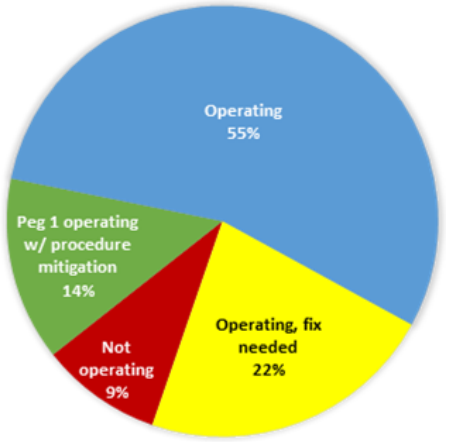
- Awaiting Airbus milestone for A220 avionics fix
- Awaiting Airbus milestone for A350 avionics fix
- Awaiting Boeing milestone for CMU900 Core 16 production cut-in for B737MAX
- Awaiting Boeing milestones for Nav Database revisions to mitigate en route STAR in free text for Pegasus II, B787, and B747 NG FMC

Data Comm Avionics Updates Fleet Status

Aircraft operating in Data Comm en route – no pending actions

Operator & Fleet Actions Complete	Status
American Airlines: A321, B777, B787	Operating en route, no action required
FedEx: B777, MD11	Operating en route, no action required
Southwest Airlines: B737	Operating en route, no action required
United: B787	Operating en route, no action required
UPS: B744, MD11	Operating en route, no action required

Avionics Action	Operator/Fleet	Status
Aircraft operating in Data Comm En Route with Crew Procedure Mitigation		
Boeing 757/767 Pegasus 1	FedEx, UPS	Aircraft operating under procedure mitigation Avionics Fix: Q3 2022
Aircraft operating in Data Comm En Route with Open Avionics Actions		
Collins CMU 900 Core 16	Alaska, American, Delta, United	Install delayed (COVID), aircraft operating
Airbus A320 ATSU CSB 7.5	Alaska, Delta, JetBlue	Fix released Dec 2020, aircraft operating, installs 50% complete
Boeing 777 AIMS 2 BP17B	United	Planned by end of 2021, aircraft operating
Boeing 747-8 ATN-203	UPS	Planned – Q4 2022, aircraft operating
Aircraft not operating in en route due to Open Avionics Actions		
Avionics Action	**Operator/Fleet**	**Status**
Collins VDR Update	Alaska, United	Install delayed (COVID), aircraft removed
Boeing 757/767 Pegasus 1	United	Pending Peg 1 Avionics Fix: Q3 2022
Airbus A220	Delta, JetBlue	Aircraft removed from en route, need fix plan
Airbus A350	Delta	Aircraft removed from en route, need fix plan



Operating, no action required | Operating fix needed | Peg 1 operating with mitigation | Not operating

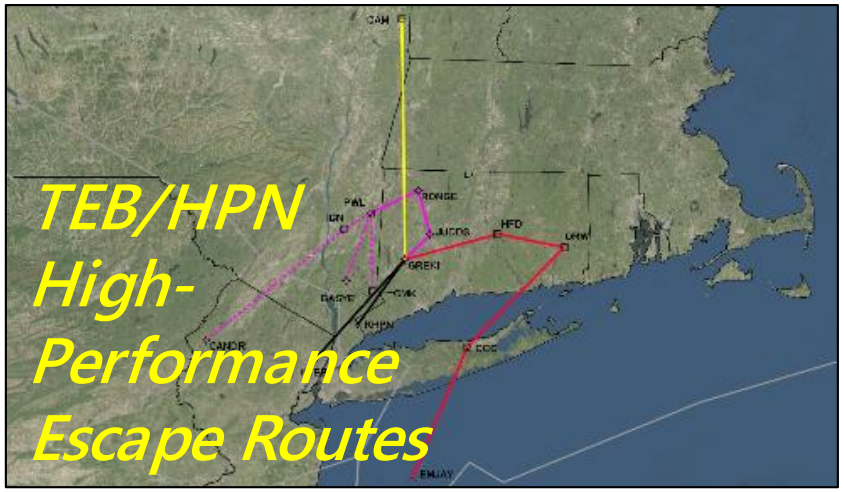
Northeast Corridor (NEC)

Aaron Wilkins (FAA), Juan Narvid (FAA), & Wendy O'Connor (FAA)

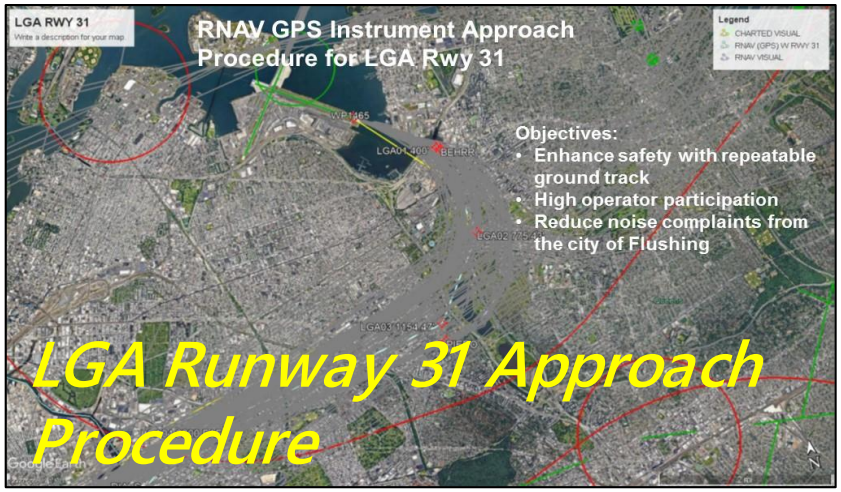
Ralph Tamburro (PANYNJ) & Lee Brown (JetBlue)

Northeast Corridor Accomplishments

- Moving forward on "Opportunities" recommendations from August 2020 NAC

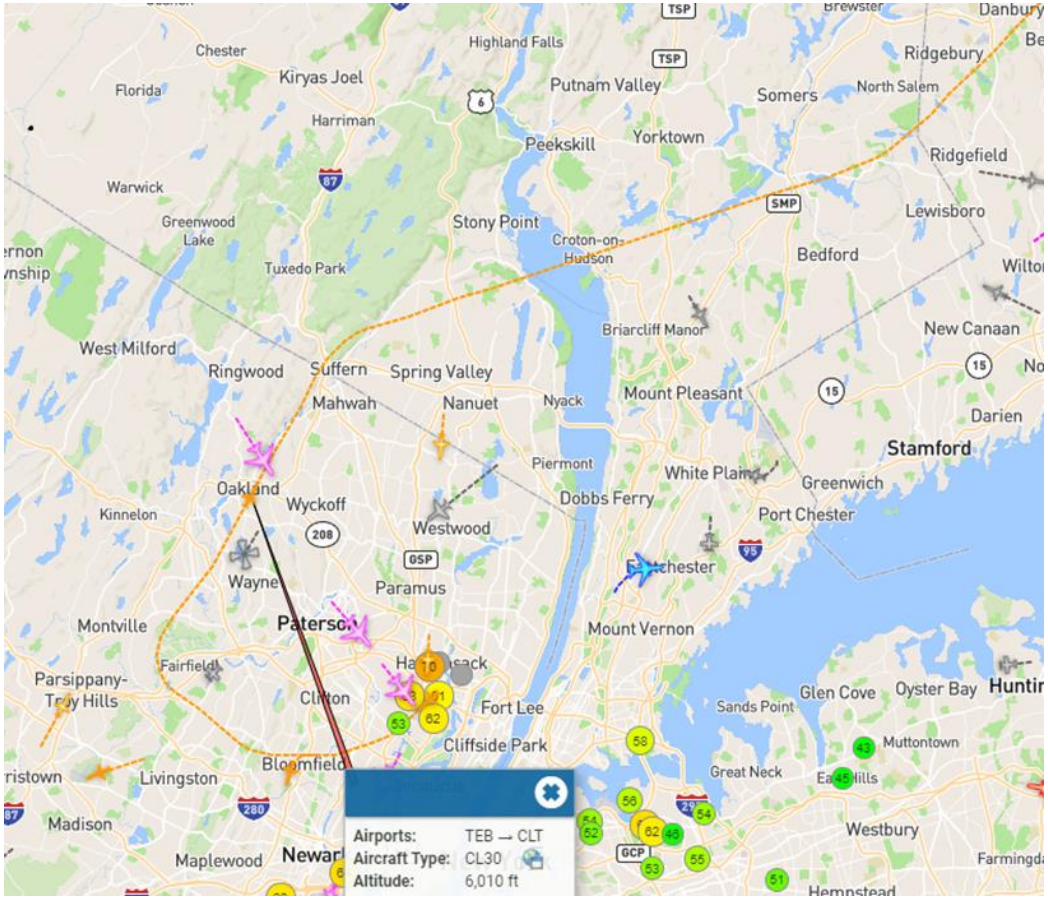


Initial test completed in March 2021



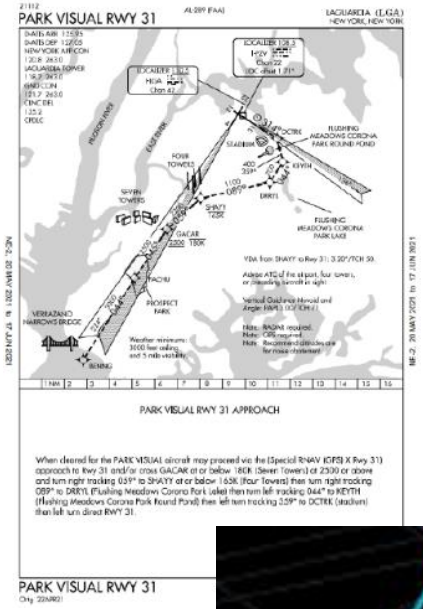
Park Visual implemented in April 2021

High-Performance Escape Route Test

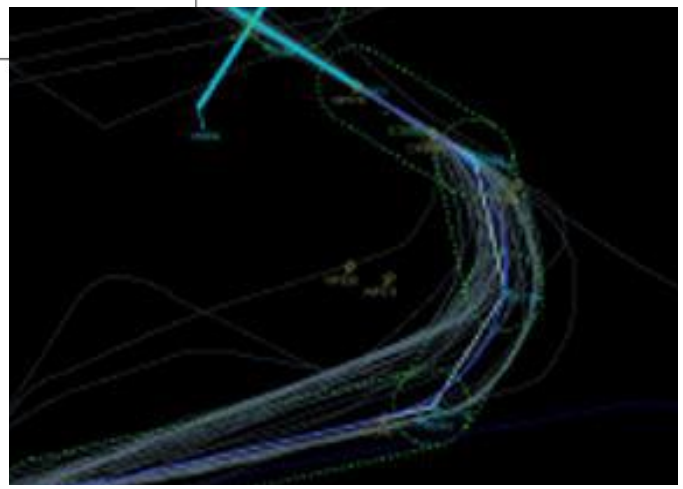


- **Initial test**
  - Test conducted in late March
  - Single flight, TEB-CLT
  - Requested climb performance was achieved; 26000' around GREKI (still heading Northeast)
- **Next Steps**
  - Examine performance as part of the operation

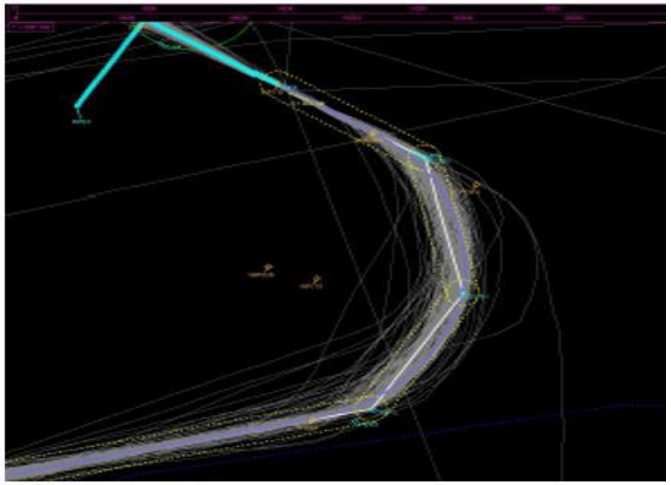
LGA PARK Visual Runway 31 (Implemented April 2021)



- Mitigates safety concerns caused by convergent tracks of the RNAV VISUAL RWY 31 and Expressway Visual RWY 31
- Feedback from operators and ATC has been positive
- Currently gathering data on feasibility of public RNAV (GPS) instrument approach with multiple TF turns in an extended visual segment



Tracks prior to PARK Visual show track disparity



Majority of PARK Visual tracks are within .30nm of designed procedure (75% are within .10nm)

Source - FAA Briefing to May 2021 NY DIM

Northeast Corridor Focus Areas

- **Advancing NAC-recommended "NextGen Opportunities"**
  - LGA Runway 31 instrument approach procedure, supporting data gathering and feedback for Flight Standards
  - High-performance escape routes for TEB/HPN, working with FAA System Operations and Air Traffic to look for use opportunities

- **Completing milestones and operationalizing commitments**
  - Interim deliverables for TBFM at PHL and EWR
  - Interim deliverables for Atlantic Coast Routes (e.g., high altitude sector in Washington Center)

Outlook for 2021 Commitments

Type	Commitment/Milestone	Aug 2020 NJIP	Mar 2021 NAC Update	Current Dates
Implementation	Improved departure management for flights destined for LGA	Q4 CY2020	TBD	TBD
Implementation*	DSP enhancements	Q2 CY2021	TBD	Q4 CY2021
Implementation*	Atlantic Coast Routes	Q4 CY2021	Q4 CY2021	TBD
Implementation*	PDRR/ABRR Enhancements	Q2 CY2021	TBD	Q4 CY2021
Implementation*	Arrival time-based metering (TBFM) for PHL and EWR	Q4 CY2021	Q4 CY2023	Q4 CY2023
Industry	GBAS evaluation at BOS	Q4 CY2021	TBD	proposed for removal
Industry	GBAS installation start at LGA	TBD	TBD	Q1 CY2023
Industry	GBAS installation start at JFK	TBD	TBD	Q1 CY2023
Industry	Evaluate multi-route TOS	Q4 CY2021	Q4 CY2021	Q4 CY2021
Industry	Additional tower space for TFDM at BOS	TBD	TBD	TBD

* Implementation and milestones are jointly shared by FAA and Industry for the NEC efforts

Motion for NAC Approval

- Approve removal of Industry milestone:

  "Conduct GBAS (Ground Based Augmentation System) evaluation/assessment at BOS"

Final Thoughts

Brad Mims, FAA Deputy Administrator

NAC Designated Federal Officer

Review of Action Items & Other Business

Greg Schwab, NAC Committee Manager, FAA

Upcoming Meetings

- **NAC SC**
  - July 7, 2021 (2:00pm – 5:00pm ET)
  - August 4, 2021 (2:00pm – 5:00pm ET)

- **NAC**
  - October 19, 2021 (1:00pm – 4:00pm ET)

Closing Comments & Adjourn

Chip Childs, NAC Chairman

President & CEO, SkyWest, Inc.

Attachment 2

NextGen Advisory Committee (NAC)
June 21, 2021 Attendance List

Last Name	First Name	Affiliation
Allen	Daniel	FedEx Express
Allen	Jackson	Airlines for America (A4A)
Andrews	Malcolm	Federal Aviation Administration
Arbuckle	Doug	Federal Aviation Administration
Armstrong	Merrill	Federal Aviation Administration
Ayelomi	Precious	Federal Aviation Administration
Baker	Mark	Aircraft Owners and Pilots Association (AOPA)
Barkowski	Justin	American Association of Airport Executives (AAAE)
Bateman	Bill	The MITRE Corporation
Bechdolt	Anne	FedEx Express
Bertapelle	Joe	Aireon, LLC
Blum	Danny	Federal Aviation Administration
Bolen	Ed	National Business Aviation Association (NBAA)
Boyle	Virginia	Federal Aviation Administration
Bristol	Teri	Federal Aviation Administration
Brown	Lee	JetBlue Airways
Brown	Steve	National Business Aviation Association (NBAA)
Bunce	Pete	General Aviation Manufacturers Association (GAMA)
Butler	Steven	Federal Aviation Administration
Buttie	Steven	Department of Defense
Carroll	Joseph	FedEx Express
Cebula	Andrew	Airlines for America (A4A)
Challan	Peter	L3Harris
Childs	Russell	SkyWest Airlines
Christiansen	Cindy	Aviation-Impacted Communities Alliance
Christie	Warren	JetBlue Airways
Clarke	Steven	National Aeronautics and Space Administration (NASA)
Cochran	Walt	Leidos
Cointin	Rebecca	Federal Aviation Administration
Collings	Chris	L3Harris
Cook	Charles	JetBlue Airways
Craven	Robert	Federal Aviation Administration
Crozier	Bill	Federal Aviation Administration
Dalton	Rick	Southwest Airlines
Dehart	Scott	Southwest Airlines

Last Name	First Name	Affiliation
DeNicuolo	Mark	Federal Aviation Administration
DePete	Joseph	Air Line Pilots Association (ALPA)
Dickson	Steve	Federal Aviation Administration
Dillman	Don	FedEx Express
Dodgen	Joey	Delta Air Lines
Donohue	Denis	Raytheon Technologies
Drew	Craig	Glidepath Aviation Consulting, LLC
Duffy	Kent	Federal Aviation Administration
Dumont	Pete	Air Traffic Control Association
Eck	Jim	L3Harris
Egentowich	John	Federal Aviation Administration
Evans	Ed	Southwest Airlines
Fanning	Eric	Aerospace Industries Association
Flynn	Robert	United Airlines
Fontaine	Paul	Federal Aviation Administration
Furleigh	Daniel	Department of Defense
Gautier	Todd	L3Harris
Goldman	Robert	Delta Air Lines
Gomez	Pamela	Federal Aviation Administration
Govender	Shereen	Southwest Airlines
Gupta	Vipul	Honeywell Aerospace
Gusky	Amy	Federal Aviation Administration
Guy	Rebecca	Federal Aviation Administration
Hendrickson	Cheryl	Public
Hennig	Jens	General Aviation Manufacturers Association (GAMA)
Hill	Fran	Leidos
Hollander	Anne	Montgomery County Quiet Skies Coalition of Maryland & Aviation-Impacted Communities Alliance
Hope	Chris	Federal Aviation Administration
Hoskins	Craig	Airbus
Ivers	Benjamin	The Boeing Company
Jackson	Catherine	Airline Dispatchers Federation
Jackson	Rachel	Raytheon Technologies
Jangelis	Steve	Air Line Pilots Association (ALPA)
Jenkins	Mara	Federal Aviation Administration
Jennings	Michael	Federal Aviation Administration
Johnson	Antionette	Federal Aviation Administration
Joly	Pascal	Airbus
Jung	Debra	BWI Roundtable
Kagzi	Ayaz	Federal Aviation Administration
Kamyab	Ahmad	Federal Aviation Administration

Last Name	First Name	Affiliation
Kasher	Alan	Southwest Airlines
Kauffman	Don	Honeywell Aerospace
Kenagy	Randy	Air Line Pilots Association (ALPA)
Knorr	Dave	Federal Aviation Administration
Kovalcik	Luanne	Leidos
Kowalewski	Debbie	Airline Dispatchers Federation
Kozica	Shawn	Federal Aviation Administration
Kushan	Mohammad	Federal Aviation Administration
Ladner	John	Alaska Airlines
Lamparello	Sandy	Federal Aviation Administration
Landon	Joe	Lockheed Martin
Lawrence	Huntley	Port Authority of New York and New Jersey (PANYNJ)
Lenfert	Winsome	Federal Aviation Administration
Leone	Gregg	The MITRE Corporation
Madera	Chico	Federal Aviation Administration
Maffei	John	Federal Aviation Administration
McClay	James	Aircraft Owners and Pilots Association (AOPA)
McCoy	Tiffany	Federal Aviation Administration
McDowell (Collins)	Michael	Collins Aerospace
McGraw	Candace	Cincinnati/Northern Kentucky International Airport
McMullin	Gary	Southwest Airlines
Merkle	Michele	Federal Aviation Administration
Mims	Bradley	Federal Aviation Administration
Mitchell	Tiffany	Federal Aviation Administration
Morse	Glenn	Public
Nadarski	Nick	Government Accountability Office (GAO)
Narvid	Juan	Federal Aviation Administration
Noonan	Kimberly	Federal Aviation Administration
O'Connor	Wendy	Federal Aviation Administration
O'Kelly	Caitlin	Federal Aviation Administration
Olson	Lee	National Aeronautics and Space Administration (NASA)
Olson	Loren	City of Minneapolis
Oswald	Chris	Airports Council International - North America (ACI-NA)
Pagliarello	Melinda	Airports Council International - North America (ACI-NA)
Payne	Jim	San Diego International Airport
Pearce	Robert	National Aeronautics and Space Administration (NASA)
Pecoraro	Ryan	The Boeing Company
Pennington	Darrell	Air Line Pilots Association (ALPA)
Perrone	Mike	Professional Aviation Safety Specialists (PASS) National
Peyton	Bret	Alaska Airlines

Last Name	First Name	Affiliation
Pierce	Brad	The National Association to Insure a Sound Controlled Environment (NOISE)
Quigley	Bryan	United Airlines
Reimold	Dorothy	Federal Aviation Administration
Renk	Ron	United Airlines
Rinaldi	Paul	National Air Traffic Control Association (NATCA)
Rocheleau	Chris	Federal Aviation Administration
Rogers	Christopher	Raytheon Technologies
Santos	Phil	FedEx Express
Schwab	Greg	Federal Aviation Administration
Scott	Antonio	Federal Aviation Administration
Sequeira	Christopher	Public
Shresta	Sanjiv	Federal Aviation Administration
Shull	Mark	Public
Silver	David	Aerospace Industries Association (AIA)
Silverman	Eric	American Airlines
Sinnett	Mike	The Boeing Company
Smith	Ryan	United Airlines
Spurio	Kip	Raytheon Technologies
Stevenson	Dawn	Evans Consulting
Stone	Kimball	American Airlines
Sullivan	James	JetBlue Airways
Sultan	Akbar	National Aeronautics and Space Administration
Sunny	De Paul	JetBlue Airways
Surridge	David	American Airlines
Sypniewski	Jessica	Federal Aviation Administration
Tamburro	Ralph	Port Authority of New York and New Jersey
Tennille	Greg	The MITRE Corporation
Thoma	Donald	Aireon, LLC
Torpey	Sean	Federal Aviation Administration
Townsend	Brian	Allied Pilots Association
Tranter	Emily	The National Association to Insure a Sound Controlled Environment (NOISE)
Vail	Steve	Mosaic ATM, Inc.
Valcich	Jeremy	American Association of Airport Executives (AAAE)
Vincent	Jeffrey	Federal Aviation Administration
Walker	Cornell	Federal Aviation Administration
Wendling	Kelle	L3Harris
White	Beth	Federal Aviation Administration
Whitley	Pamela	Federal Aviation Administration
Whyte	William	Regional Airline Association (RAA)

Last Name	First Name	Affiliation
Wijntjes	Jesse	Federal Aviation Administration
Wilkins	Aaron	Federal Aviation Administration
Williams	Heidi	National Business Aviation Association (NBAA)
Wongsangpaiboon	Natee	Federal Aviation Administration
Woods	Jeff	National Air Traffic Control Association (NATCA)
Yaplee	Darlene	Aviation-Impacted Communities Alliance (AICA) and Concerned Citizens of Palo Alto
Yates	Vaughn	Federal Aviation Administration
Young	Greg	Federal Aviation Administration
Zamora	Raul	Federal Aviation Administration

Attachment 3

June 18, 2021 NAC Public Speaker Statements

Cindy L. Christiansen, PhD
Co-founding member of the national Aviation-Impacted Communities Alliance and BOS Fair Skies

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Aviation noise is causing harm to millions of people living in homes close to airports and those far from airports who live under Next-Gen's harmfully narrow flight paths and torturously repeating operations. The NAC group knew that Next-Gen technologies would sacrifice the quality of life and health of some, but ignored that and instead made claims of efficiency, safety and the overall reduction in the number of residents exposed to aviation noise. In my opinion, that is cheating.

What can you do to make things better? Many things. Here are three, one for each of the groups represented on this Committee.

1. FAA: Don't mess-around with delays and false-promises about how you will someday update aviation noise assessment to reflect the results of the Neighborhood Environmental Survey study results. Work quickly. The persistent noise targeted on some is stealing people's joy and good-health.

2. Airlines: I don't know how many of you have promised to fix your A320-series aircrafts that whine and whistle, especially on approach, but you haven't retrofitted them with the "vortex generator" cure. You are taking too long. Do your part to reduce the torture from aviation noise that the Next-Gen technologies has exacerbated - update your aircraft.

3. Pilots: It is like your planes are yelling and screaming at people on the ground. If you do not want to come across as hostile, fly quiet. I think you know how to do this, so please think of the people on the ground who you are disturbing as you cross over us, loud, low, and dirty.

Darlene Yaplee
Co-founder of the Aviation-Impacted Communities Alliance (AICA) and Concerned Citizens of Palo Alto

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My comment is in reference to FAA Administrator Dickson's letter to the Quiet Skies Caucus dated May 10th 2021.

If the Federal Mediation and Conciliation Service (FMCS) is included in the design and implementation of policy framework and process for updating FAA's aviation noise policy, FMCS should lead the effort, not merely "assist." To achieve process and outcome independence and credibility the FMCS or another group must address the following:

- Flawed findings and assumptions must no longer be used as the basis for FAA noise policies.

- Include assessment of noise impacts for communities far from airports that experience numerous and frequent overflights.

- To bring the FAA's new noise policies into the 21st century, the Agency must seek significant input from independent, objective experts. For example, the FAA should immediately ask the National Academies of Sciences, Engineering and Medicine to provide an expert consensus report on a system of metrics (existing) and thresholds to replace reliance on the Day-Night Level (DNL) metric alone for assessing aviation noise impacts.

- The FAA should not preemptively make assumptions about potential solutions.

- Affected communities must be included and regarded as legitimate and significant stakeholders versus tokenism in the process of developing new aviation noise policies.

- The FAA needs to take quick and decisive action to update its noise policies. Lengthy studies and further delays are unacceptable given aviation noise has caused millions of complaints and increasing numbers of lawsuits.

Mark Shull
Citizen of Palo Alto, California

Hello. I'm Mark Shull from Palo Alto California.

In the five years since NextGen, 60% of arrival traffic into SFO has now concentrated over Palo Alto. Given the density of technical expertise, easy access to ADSB data streams, and projects to improve modeling and monitoring now supported by Stanford, NASA and even the FAA, this traffic is fairly well analyzed. We also benefit from additional data as SFO has begun to reach out to our more technical community as it deploys its GBAS Landing System.

Here are some observations:

1. The dramatic changes in traffic that occurred during the pandemic provided an opportunity to test the various noise annoyance metrics. What this showed is that the NA55 metric, which is the Average Number of Flights per hour Above LMax 55 dB, was the most accurate predictor of annoyance, with a very strong correlation between the number of complaints and the number of overflights.

2. Also there are two arrivals into SFO from the east, one approaches over the Bay and one flies down the Peninsula. The public has long been told that the FAA prioritized east arrivals over the bay, but in fact the breakdown between these two stayed proportional to the falloff in overall traffic. Based on inquiries by the SFO Airport Director, we understand the National Airspace Computer cannot prioritize other than for weather. This is disappointing, particularly as we anticipate the potential benefits of GLS at SFO, including a new Established on RNP bay approach.

3. With respect to its implementation of GLS, SFO is working with the general public and research community here, and we understand that United has offered additional resources for simulator and actual flight analysis. We are very frustrated however, that there appears to be little coordination between the PBN Arrival design teams and the approach design teams. This is a big problem because the arrival STAR ends just before the most populated parts of Silicon Valley, and at a location that is well known to have significant over energy problems, with a very high instance of speed brake deployment and rapid deceleration. This sub-optimal transition is also clear in the ADET BADA4 model and will fairly or unfairly affect the public's perception of GLS.

We would ask the FAA to pay attention to these issues and work proactively to improve what can be improved. The alternative is the current situation which is to be reactive only to overt political pressure, where dictated changes can be self-defeating. SFO's GBAS initiative is a clear opportunity for the FAA to showcase what is possible if the design is end-to-end and not siloed. Please take a look at this. Thank you.

Attachment 4

ADS-B In Commercial Application Technologies Ad Hoc Team

NAC Task 20-1 Final Report

To be Presented to the

NextGen Advisory Committee

June 2021

Contents

1 Executive Summary

NAC Task 20-1 requested for industry to report to the NAC regarding the interest of ADS-B In Commercial Application Technologies (referred to as ADS-B In Applications herein) for FAA understanding and future decision processes concerning funding for ADS-B In programs. An ad-hoc group comprised of Airlines, Aircraft and Avionics OEMs, and industry association representatives was formed through the NAC SC Chairman and vetted through the Department of Transportation. The Task Group met with FAA SMEs on several occasions to discuss and evaluate ADS-B In Applications and benefits. Industry was particularly interested in understanding how ADS-B In Applications might improve the National Airspace System (NAS) – with an emphasis on carbon emission reductions and improved customer satisfaction.

The Task Group focused on identifying how ADS-B In Applications address the core values with which airlines would agree. After discussing the benefits of ADS-B In Applications, discussions began on the challenges to equipage and how the FAA could assist airlines in evaluating future equipage decisions.

What Airlines Value

Airlines do share core values independent of specific marketing strategies. Reduction in delay within the NAS is a priority for all users. Part of reducing block times includes eliminating block variability when possible. Consumers value a product that includes timely flights with few to no disruptions. Focus on reduction in flight time, block variability, and system disruptions generate high value for every airline and have significant advantages in improving consumer satisfaction.

Analysis of airport metrics shows airline and customer values that drive schedules. Below are two graphs that illustrate the total number of aircraft arrivals (blue) and departures (orange) per quarter-hour coming in and out of ATL (Figure 1-1) and MEM (Figure 1-2). The Task Group explored the question – can ADS-B In Applications allow the controller to perform their duties more efficiently to better manage airline marketing strategies?

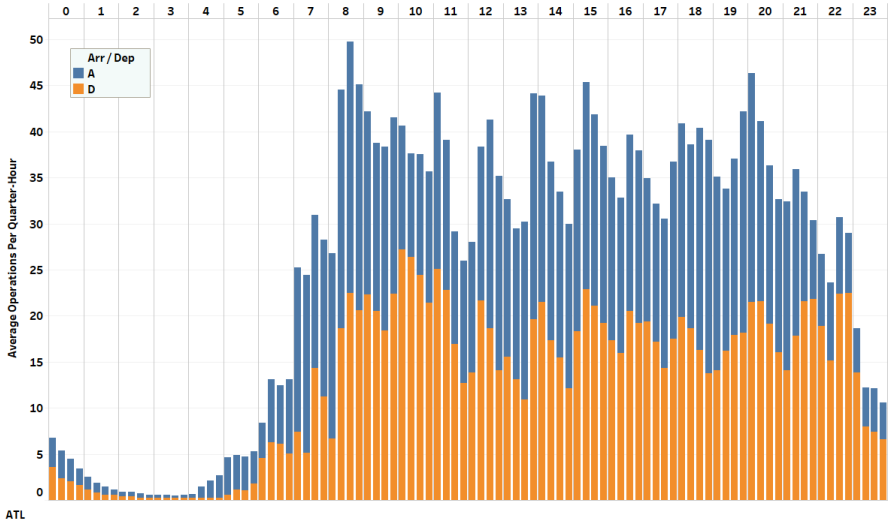


Figure 1-1: ATL CY2019 Average Operations By Local Quarter-Hour
Figure generated by the MITRE Corporation

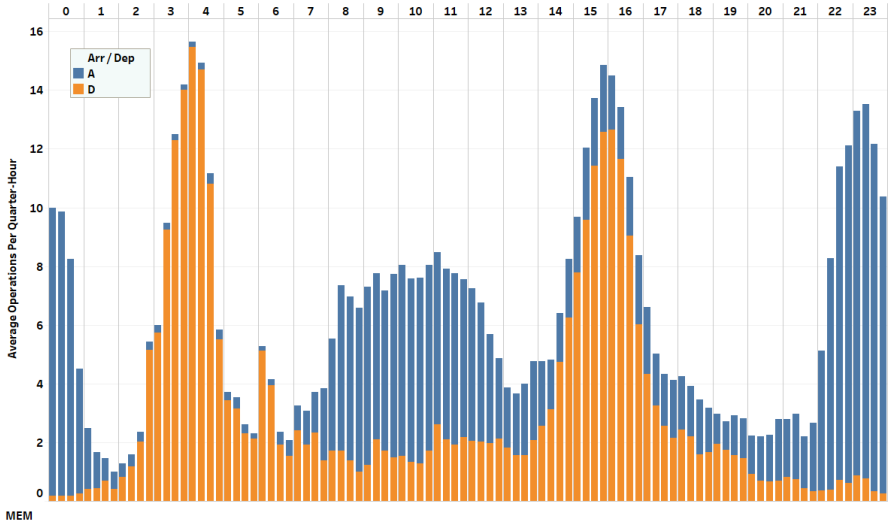


Figure 1-2: MEM CY2019 Average Operations By Local Quarter-Hour
Figure generated by the MITRE Corporation

ADS-B In Applications and How They Meet Operator Values

The Task Group spent the preponderance of time evaluating ADS-B In Application benefits of reducing delay and flight time variability due to environmental factors. The ADS-B In Applications that the Task Group considered are summarized in Appendix C.

Airline interests included a focus on terminal efficiencies created using the Cockpit Display of Traffic Information (CDTI) Assisted Separation (CAS) as it applied to reducing variability in airport arrival rates given differing ceiling and visibility conditions. Applications that allowed for runway arrival rates to be maintained when visibility dropped below traditional approach visual rules received the most interest for the airlines. CAS was widely accepted as providing a strong business case for airlines desiring to invest in ADS-B In Applications. Flight-deck Interval Management and In-Trail Procedures closely followed CAS as ADS-B In Applications that could help airline metrics.

Considering airline values of reducing delay and schedule variations caused by environmental factors, ADS-B In Applications have the ability to improve airspace efficiencies through consistent aircraft spacing performance and also provide greater pilot situational awareness. Use of these improved performance applications could be a factor in airline investment decision going forward.

Given the difficulties in approval for additional runways, improved airspace efficiencies are needed to accommodate forecasted growth. Furthermore, as efficiencies in airspace occur, carbon reductions will be realized due to reduced track miles. Improved final spacing will contribute to increased airspace efficiency.

Barriers to Investment

In conversations with the airline community represented on this task, it was clear that the impacts of COVID-19 will result in a delay on any short-term investments for all projects. Given the economic impact and rising debt of the industry, this was not a surprise to anyone in the group. Even still, industry

representatives are interested in future NextGen technologies and how those technologies will benefit their respective airline.

Long Term barriers are not as clear, and the range of reasons varies based on each airline. But central to the airline and OEM conversations were rooted in the criticality for the FAA to make the future investments allowing controllers to identify aircraft equipped with the appropriate ADS-B In Applications avionics packages and operational approvals. FAA investment decisions for ATC automation tool enhancements will be necessary for airlines and OEMs to commit to future ADS-B In equipage.

Pilots, whether they were technical pilots representing their respective airline or representing their association, saw issues regarding policy and procedures related to these new applications affecting their crews that need to be addressed. They want separations responsibilities to remain as they are in current day operations.

This report summarizes the approach and methodology that the Task Group used to arrive at their recommendations. Next, the report summarizes responses that Operators, Aircraft and Avionics OEMs, and several associations provided in response to questionnaires prepared by the Task Group. Finally, the report concludes with Section 5, Recommendations, which provides detailed recommendations for the FAA, Operators, Pilot Associations and Aircraft and Avionics OEMs, and NATCA to mitigate risks that could impact successful deployment of ADS-B In Applications. The Task Group recommendations for the FAA include:

- Formally notify Operators and OEMs when the FAA makes investment decisions or changes previously communicated investment approaches
- Provide opportunity to interested Operators, Pilot Associations and NATCA to discuss, develop and implement procedural changes, prior to the introduction of new ADS-B In Applications into the NAS
- Develop safety cases that show the proposed ADS-B In Applications meet or exceed an equivalent level of safety
- Formalize an FAA approved concept of operations for the use of Flight-deck Interval Management applications with Time-Based Management procedures such as Time of Arrival Control (ToAC)[1] and communicate it to Operators, OEMs, pilots and air traffic controller associations, and standards developing organizations as changes occur
- Create a stepped approach for MOPS, TSOs and ACs for FIM applications, concurrent with FAA investment decisions, to advance ADS-B In Applications as they evolve
- Explore, with the Operator community, methods to provide operational incentives for Operators to equip

[1] Also known as Required Time of Arrival (RTA)

2 Scope and Task Group Membership

In the August 10, 2020, letter from FAA Deputy Administrator, Daniel Elwell, the NAC was tasked with the following:

- The NAC is tasked to provide the FAA with insight from the industry on their potential application acquisitions and deployment plans, including a timeline of ADS-B In Applications pursued by the aviation community
- The NAC advice should include the following:
    - A comprehensive list of ADS-B In commercial applications that NAC members either have or intend to invest in (within the next 5-10 years)
    - A comprehensive list of ADS-B In commercial applications that are promising and a list of the NAC members tracking this list for future acquisitions

The FAA Tasking Letter is attached at Appendix A: FAA Tasking Letter.

The NAC SC chairperson developed a Task Group of Operator NAC members who had an interest and future plans to equip with ADS-B In Applications within the next 5-10 years. Based on the criteria set forth in the NAC Tasking, the NAC SC chairperson developed a list of Operator and Aircraft and Avionics OEMs to discuss ADS-B In Applications of interest and ascertain the Operators' likelihood to equip with ADSB In in the near future.

Representatives from seven mainline airlines and representatives from RAA, A4A, GAMA, two Pilot Associations, NATCA and an airport were chosen by the NAC SC Chairperson to represent industry's' interest in ADS-B In Applications. The complete membership, as well as the Subject Matter Experts (SMEs), who participated in some Task Group meetings, are listed in Appendix B: Membership.

3 Approach and Methodology

NAC Task Group 20-1 held a total of six meetings with the full Task Group membership and Subject Matter Experts (SMEs). In addition, NAC Task Group 20-1 held four meetings with subsets of the full Task Group membership and SMEs as required to delve more deeply into specific topics. The schedule was divided into three main activities, (1) ADS-B In Applications information sharing, (2) airline internal deliberations, and (3) generation, review and commenting on the final report by the Task Group members.

The first several meetings included sharing of high-level airspace needs of Operators related to ADS-B In Applications as well as information sharing from a number of SMEs regarding the practical operational impacts of each candidate application and the benefits deriving from the adoption of various applications.

With the available ADS-B In Applications information shared with the membership, Operator representatives worked within their individual organizations to arrive at their responses to the Task Group Operator questionnaire which informed the summaries and recommendations in this final report to the NAC.

In a like manner, Aircraft and Avionics OEM representatives worked within their individual companies to arrive at their responses to the Task Group OEM questionnaire which informed the summaries and recommendations in this final report to the NAC. The Pilot Associations, Regional Airline Association (RAA), and General Aviation Manufacturers Association (GAMA) worked within their individual organizations to arrive at their responses to Task Group questionnaires, which informed the summaries and recommendations in this final report to the NAC.

3.1 NAC Task Group 20-1 Informational Presentations

A number of informational presentations were made to the Task Group, both primer material which was prepared for and presented in prior forums and information prepared in direct response to members questions and discussions.

3.1.1 SME Presentations

- ADS-B In Benefits – Northeast Corridor - FAA
- Investment Approach for ATC Support of ADS-B In Applications – FAA
- ADS-B In Business Case – FAA
- ADS-B In Capabilities and Benefits Primer – FAA
    - Contained ADS-B-In Aviation Rulemaking Committee (ARC) Priority Capabilities[2]
- Airspace Benefits – MITRE
- Airline Direct Operating Cost Benefits – Regulus Group
    - Contained FAA-sponsored business case analysis from 2018 and 2020
- Use of Flight-deck Spacing Applications in a Time-Based Management Environment - MITRE
- CDTI Assisted Separation (CAS) - MITRE

[2] Summary from *A Report from the ADS-B In Aviation Rulemaking Committee to the Federal Aviation Administration*, September 30, 2011, https://www.faa.gov/nextgen/programs/adsb/media/ADSB%20In%20ARC%20Report%20with%20transmittal%20letter.pdf

- Analysis of FIM Voice Clearance Complexities - MITRE

3.1.2 Airline Presentations

- CDTI Assisted Separation – American Airlines
- IM.308/Paired Approach – Alaska Airlines
    - Alaska Airline proposed an alternative solution to improve operations on closely spaced parallel runways earlier than Dependent Staggered Approaches (DSA) as proposed in the FAA Investment Approach

3.1.3 OEM Presentations

- Surface Alerting (SURF-A) – Airbus
- NASA ATD-1 ADS-B In flight Trials – Honeywell
- ACSS Initial FIM – L3Harris
- FAA Paired Approach Flight Trials – Honeywell

3.2 Operator and OEM Discussions

The Task Group membership met frequently without SMEs in attendance to identify the major industry issues related to the investment in ADS-B In Applications. These initial Operator and OEM discussions lead to the development of detailed questionnaires that the Task Group co-leads and MITRE developed to collect candid, de-identified responses from the various groups in the Task Group membership. The following were among the significant discussions.

- What do airlines value?
- How do OEMs decide on future investments?
- Problems that exist with Trajectory Based Operations (TBO) solutions
- Need to understand the FAA's overall, future concept of operations with time based TBO and how FIM fits into that concept of operations
- Need for operational benefits validation of the Airline Direct Operating Cost Benefits models
- Concern that the FAA will require airlines to equip with TSO-compliant avionics, but the current the FAA investment road map does not show some FIM application being operational for greater than ten years in the future

3.3 Questionnaires

Questionnaires were developed with input from the Task Group and with help from MITRE to capture the individual interest in ADS-B In Applications. To provide the most accurate data to the NAC, it was decided to categorize the responses into three different groups.
Categories were based on:

- Task Group members who attended the briefings and managed questionnaire feedback
    - Airline Operators
    - OEMs
    - RAA
    - GAMA

- Trade Group members, whose member was not a Task Group member, but was briefed by the representative who attended Task Group meetings
    - Four RAA members
    - Three GAMA members
- Task Group member who represented a Pilot Association who attended Task Group meetings
    - ALPA
    - APA

If the Task Group member represented an entity that did not have a financial investment decision to be made, they participated in the review of this final report.

- A4A
- Airports representative
- NATCA

3.3.1 Operators

Eleven Operators completed the questionnaire with nine being passenger and two cargo Operators. Four of the nine passenger Operators were regional passenger airlines.

3.3.1.1 Mainline Operators

The operator questionnaire asked Operators to respond to their overall interest in ADS-B In Applications and their interest in participating in FAA Operational Benefits Validation field activities. The questionnaire asked Operators to evaluate their interest in and priority for each of thirteen ADS-B In Applications as summarized in Appendix C: Summary of ADS-B In Applications Considered by the Task Group. In addition, the Operators were asked what it is that interests their airline in each application, what they see as the benefits, concerns that they have, what contingencies they see to making an investment, and to identify barriers, which if removed, would incentivize their airline to invest in each of the applications. Furthermore, the Operators were asked their opinion on barriers that they foresee from line pilot and line controller perspectives that should be addressed for each application. Finally, Operators were asked how likely they were to invest in each of the applications if their concern, contingencies, and barriers were addressed and if they would likely include each of the applications in their first or later ADS-B In implementations for their airline.

3.3.1.2 Regional Operators

The Regional Airline Association (RAA) had a representative on Task 20-1. Four RAA members offered their respective airline position in the operator questionnaire. To ensure the validity of the responses from the RAA Operators, the RAA member of the Task Group provided copies of the SME briefings to the responding RAA members. The RAA member responses are summarized separately within Section 4.1.

3.3.2 Aircraft and Avionics OEMs

Two aircraft OEMs and three avionics OEMs were members of Task 20-1 and responded to an extensive questionnaire to assess their interest in offering the various ADS-B In Applications. The OEM questionnaire asked OEMs to respond to their overall interest in offering ADS-B In Applications and their interest in supplying equipment for FAA Operational Benefits Validation field activities. The questionnaire asked OEMs to indicate if they currently have product offerings, their level of interest in providing equipment to enable each of thirteen ADS-B In Applications and when they foresee offering equipment to enable each of the applications. In addition, the OEMs were asked what it is that interests

their company in each application, concerns that they have, what contingencies they see to making an investment in product development, and to identify barriers, which if removed, would incentivize their company to invest in product development for each of the applications. Finally, the OEMs were asked if their current product offerings could be upgraded with software-only changes for each application, or if new Traffic Alert and Collision Avoidance System (TCAS)/ADS-B In avionics would be required.

3.3.3 Associations

3.3.3.1 Pilot Associations

Two Pilot Associations were members of the Task Group. Co-leads interviewed the representatives of both Pilot Associations to solicit their feedback on the thirteen ADS-B In Applications from their association membership's perspective. In addition, the associations provided written input and comments for each of the applications.

3.3.3.2 General Aviation Manufacturers Association

The General Aviation Manufacturer Association (GAMA) had a representative on Task 20-1. The GAMA representative indicated that three GAMA members were interested in responding to the OEM questionnaire. Those GAMA members were permitted to provide responses. The GAMA member responses were included separately from Task Group OEM members in Section, 4.4, since the individual questionnaire respondents did not participate in the SME briefings and had not benefited from the SME and Task Group members discussions that led up to the generation of the questionnaire.

3.3.3.3 Airport Representative

Airport Operators were represented by one metroplex representative and provided feedback from an airport operations perspective that lead to numerous discussions on benefits from ADS-B In Applications.

4 Questionnaire and Interview Response Summaries

4.1 Operator Questionnaire Responses

Eleven Operators completed the questionnaire with nine being passenger and two cargo Operators. Four of the nine passenger Operators were regional passenger airlines. The questions focused on perceived benefits and barriers to investment to include possible concerns in operational viability. The answers were de-identified and collected by MITRE for final dissemination and review. The basic components of the questionnaire comprised of specific questions over 13 applications listed below and summarized in Appendix C: Summary of ADS-B In Applications Considered by the Task Group. The complete set of mainline operator responses is included as Appendix E: Mainline Operator Questionnaire De-identified Responses.

- CDTI Assisted Visual Separation (CAVS)
- CDTI Assisted Separation (CAS) – Approach
- CDTI Assisted Separation (CAS) – Departure
- In Trail Procedure (ITP)
- Surface (SURF)
- Surface Alerting (SURF A)
- Surface Indicating and Alerting (SURF !A)
- Flight-deck Interval Management (FIM) – Same Corner Post
- Flight-deck Interval Management (FIM) – IM .308 Approach
- Flight-deck Interval Management (FIM) – Multiple Corner Post
- Flight-deck Interval Management (FIM) – Converging / Crossing Runway – Arrival (DCCR)
- Flight-deck Interval Management (FIM) – Dependent Staggered Approaches (DSA)
- Flight-deck Interval Management (FIM) – Paired Approach

Each application is unique in its ability to bring value to the NAS. Most are believed to be capacity enhancements leading to improved runway arrival rates. Each application has its own unique benefits requiring different levels of avionics capability and investment as well as differences in the complexity of the clearances required from the controller to the pilot. Certain applications require more advanced capabilities and more complex clearances while others will need fewer complex algorithms and less complex clearances to achieve procedural compliance.

ADS-B In Applications can be grouped in four different categories. First are basic CDTI Assisted Separation applications (CAVS and CAS) that require less complex algorithms and provide the pilot with spacing and ground speed differential information of the aircraft they are following. This information can be used by the crews to make better speed adjustment decisions to maintain appropriate spacing to avoid go-arounds and lower controller workloads. The cost benefit ratio is favorable with less complexity compared to other ADS-B In Applications. FAA investment costs in controller automation as well as OEM initial development and certification costs are both lower compared to other ADS-B In Applications.

Second are more complex applications, Flight-deck Interval Management (FIM) as defined in RTCA DO-361A, Minimum Operational Performance Standards (MOPS) for FIM, that have the potential to deliver greater benefits in all meteorological conditions but have higher costs due to more complex flight avionics requirements and more complex traffic flow enhancements built into Time Based Flow Management (TBFM) and communicated to ERAM and STARS through an interface. These FIM

applications require the "following" FIM aircraft to have the intended flight path of the designated traffic to follow, "leader." This information enables the FIM aircraft to determine the continuous speed adjustments required to achieve and maintain the spacing goal assigned by the controller. Being able to improve airspace capacity will allow for more efficient use of the airspace and increase customer satisfaction through a more reliable NAS.

Third is a single ADS-B in Application, In-Trail Procedures (ITP). This application is designed for use in oceanic airspace to enable aircraft to pass through flight levels where the ITP aircraft is closer to leading or trailing aircraft than the standard oceanic separation standard. While the mainline Operators expressed interest in this application, they also had reservations about the impact of space-based ADS-B and increases in FANS/RNP4 equipage levels on the future viability of this application.

Fourth are the SURF Applications that are primarily safety enhancements during ground operations that do not require controller to pilot clearances or interactions. These applications received high interest from the Pilot Associations due to the increased safety implications during taxi, takeoff and landing from the increased situational awareness but were rated lowest by the mainline Operators.

4.1.1 Can ADS-B In Capabilities Complement Operator Strategies?

A significant part of the group discussions centered on airline marketing strategies and how ADS-B In Applications compliment those strategies. Some cargo and passenger airline route structures incorporate a hub and spoke design which depend on a bank system[3] causing peak traffic periods which put pressure on the high-density airspace. This marketing strategy is conducive to revenue yet adds risk to the operation in the form of system delay. Mitigating the effects of delay on the operation results in increased block times[4] to maintain system operational integrity.

Reducing delay and block variability within the system becomes a high value goal that lowers cost and improves customer satisfaction and business metrics. Identifying the reasons for delay and applying remedies was a priority within the group as it pertained to ADS-B In Applications.

ADS-B In Applications that address this variability obtained high interest within the questionnaire and resulted in the highest interest ratings. Furthermore, costs to Operators are minimal in comparison to other ADS-B In Applications.

4.1.2 Operator Interests in ADS-B In Applications

Operators in general, welcome ADS-B In technologies into the NAS and responded that they will likely invest in ADS-B In Applications in the future. Six out of seven mainline Operators will likely invest in at least one ADS-B In Application, as shown in Figure 4.1.2-1. Regional Operators were even more likely to invest with all four indicating that they will likely invest, as shown in Figure 4.1.2-2.

[3] A bank system is when hub Operators schedule several flight arrivals and departures within a short period of time at one of their hubs

[4] Block time is the amount of time Operators schedule for flights, which is measured from pushing back from the departure gate (off-blocks) to arriving at the destination gate (on-blocks)

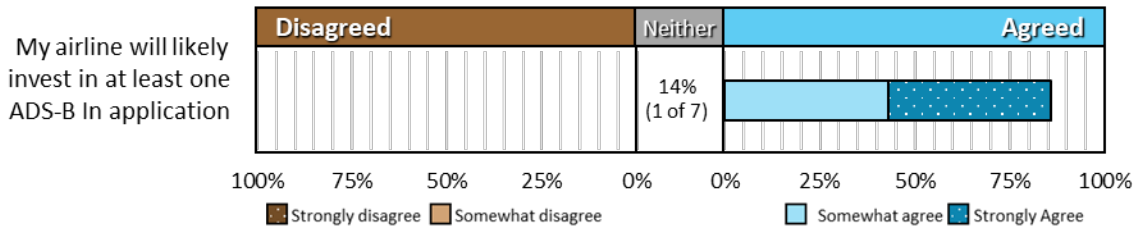


Figure 4.1.2-1: Mainline Operator responses to "If your airline decides to invest, what type of installations would you expect?" N=7[5]

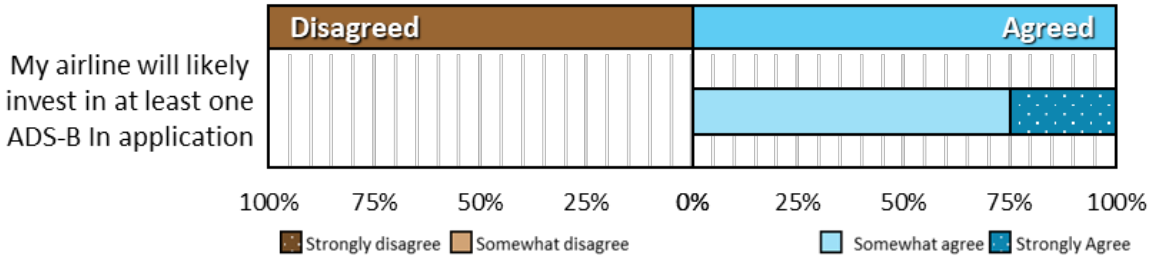


Figure 4.1.2.-2. Regional Operator responses to "My airline will likely invest in at least one ADS-B In. N=4

4.1.3 Operator Interests in Specific ADS-B In Applications

Operator interest will normally reflect their marketing strategy. An airline values the ability to have a consistent schedule that provides the most efficient time to fly to a destination. Customer satisfaction is critical to market brand and profitability. One of the largest challenges in aviation is the dynamic environment in which airlines operate. Weather patterns, maintenance failures and crew abnormalities all lead to additional expenses and degrade the customer's experience. Any product that reduces these causes in delay is highly sought after in the airline industry.

As illustrated in Figure 4.1.3-1, analysis showed an average of 168.7 hours or 21.6% of daily National Airspace System delay attributed to reduced approach visibility. When meteorological conditions meet visibility and cloud minimums, controllers will apply visual approach conditions resulting in runway rates that are maintained at or near maximum visual runway occupancy rates. When visibility and/or cloud minimums drops below visual approach conditions, airport arrival rates are adjusted based on separation standards for those minimums. This adjustment will affect arrival rates which will lead to delays in the NAS. This delay not only has implications on those flights, including follow-on delays, affected that day, but also influences the overall airline costs due the need to adjust block times to account for historical delay.

[5] The number of respondents represented in the graphs contained in this report are indicated by "N=x" at the end of the figure description. In this case N=7 indicates that there were seven respondents.

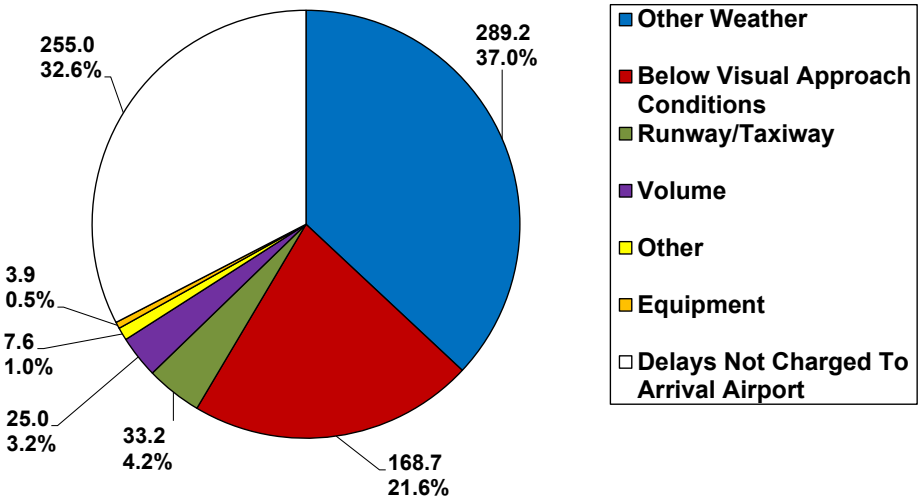


Figure 4.1.3-1: Average Daily OPSNET Delay Hours with Delays to Arrival Airports Broken Out
Figure generated by the MITRE Corporation

ADS-B In Applications can contribute to solutions for some of those issues. ADS-B In Applications that reduce variability received the most interest and reflected the values airline consistently seek. CDTI Assisted Separation (CAS) allows runway rates to be close to visual runway rates during less than visual approach conditions. Controllers also see value in this ADS-B In Application and agree that this will have a positive impact on the NAS through reduced delay.

Flight Deck Interval Management also received high scores and is believed to improve operations through the improved use of airspace by assisting both flight crews and controllers to maintain more consistent spacing and sequencing into the terminal area under all meteorological conditions. With this comes more complex avionics and traffic flow infrastructure and therefore was looked at less favorably than CDTI Assisted Separation (CAS) but still showed high interest. Contingencies on FAA delivering the necessary ATC automation platforms will be critical to success and industry will be monitoring FAA investments as a major marker to their ADS-B In investment strategy.

Mainline Operators did not rate some ADS-B Applications as high, such as the SURF applications, due to the lack of economic benefits. SURF ADS-B In Applications were discussed and do show positive safety potential. Mainline Operator rank order interest in the thirteen ADS-B Applications considered are shown in Figure 4.1.3-2 and the Regional Operators rank order of interest is shown in Figure 4.1.3-3.

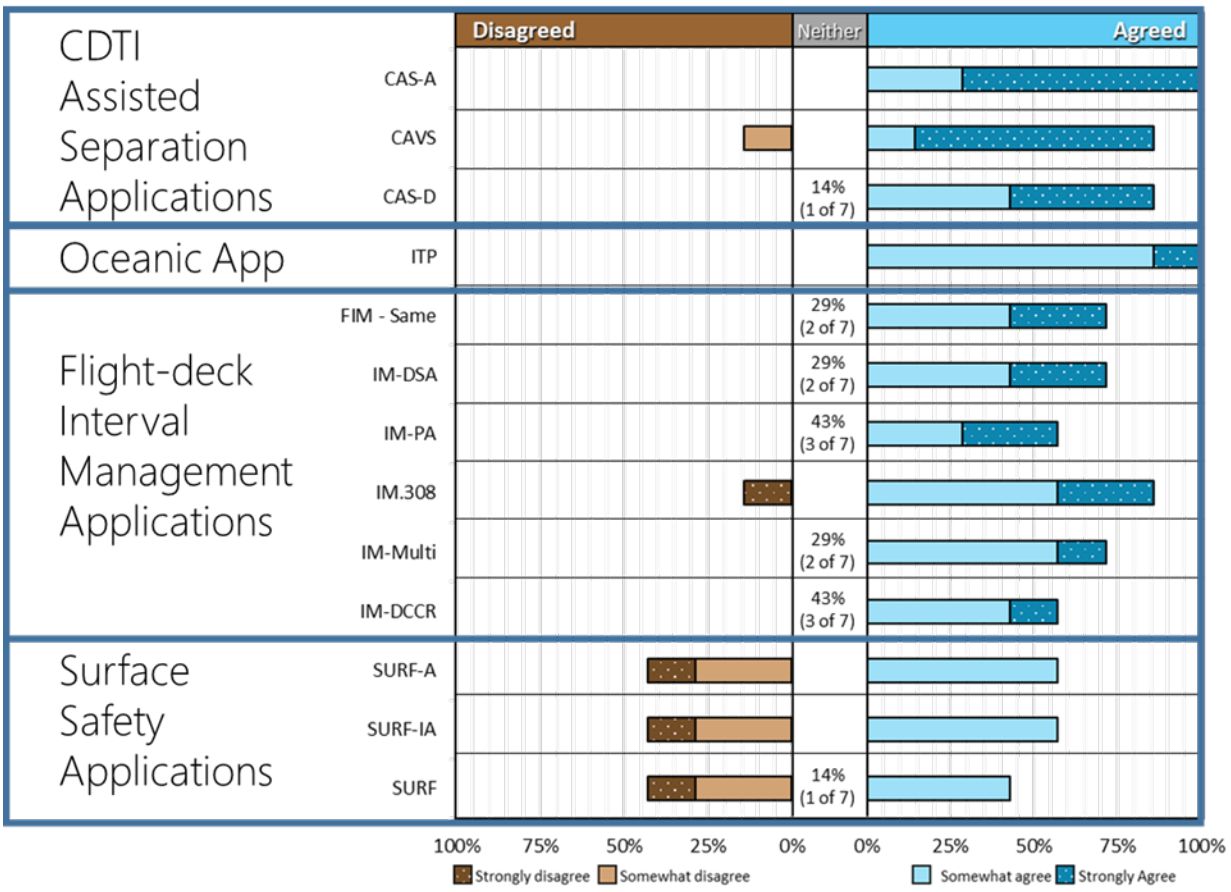


Figure 4.1.3-2: Mainline Operation Ranked Order Comparison of responses to "My airline is interested in [application]." N=7

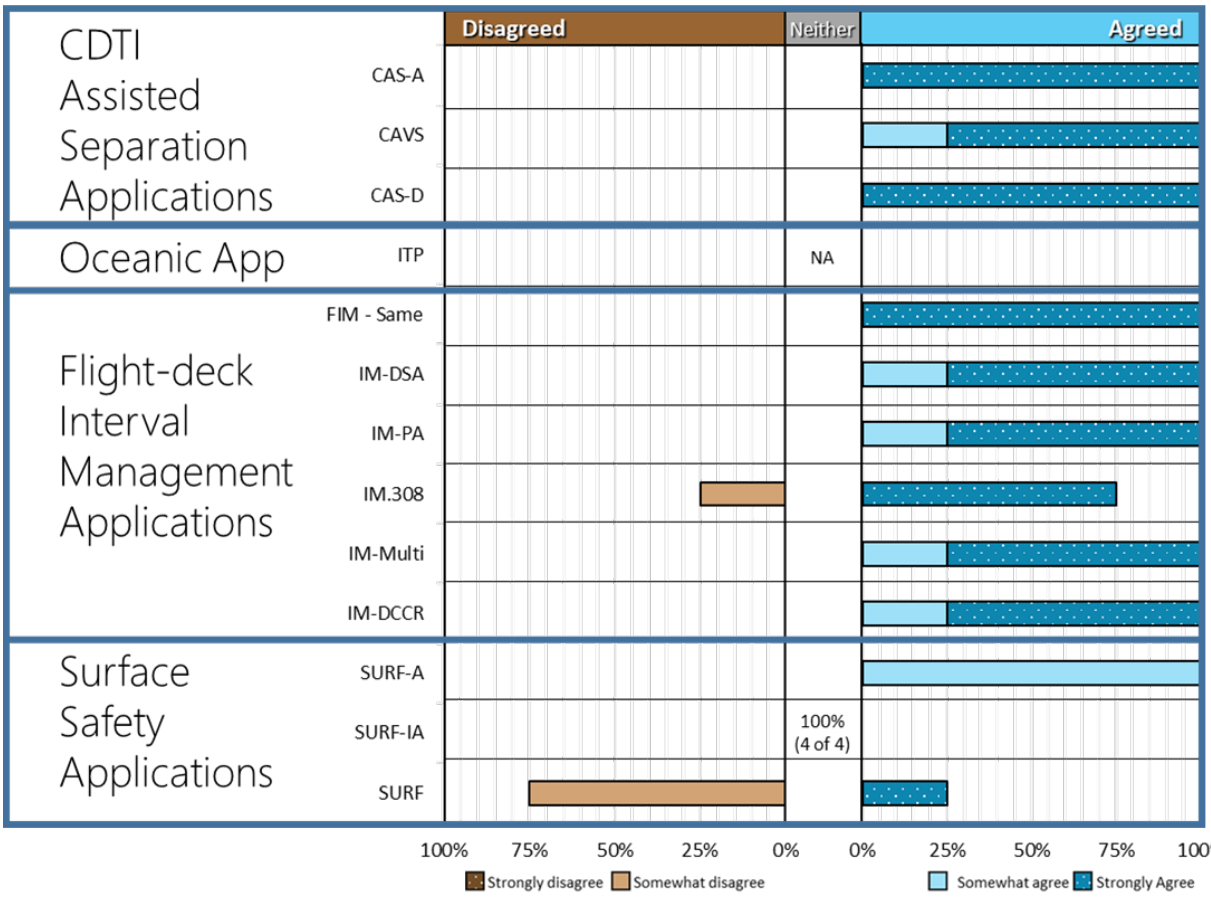


Figure 4.1.3-3. Regional Ranked Order Comparison of responses to "My airline is interested in [application]" (Note: ITP not applicable for regional carriers) – Listed in Rank Order of the Major Carrier Responses. N=4

4.1.4 Operator Interest in Participating in FAA Operational Benefits Evaluations

As shown in Figure 4.1.5-1, approximately half of the mainline Operators expressed interest in participating in the Operational Benefits Evaluation presented in Appendix D: FAA Investment Approach Presented to the Task Group. All four of the regional Operators responded that they are somewhat interested in participating in the Operational Benefits Evaluations, as shown in Figure 4.1.5-2.

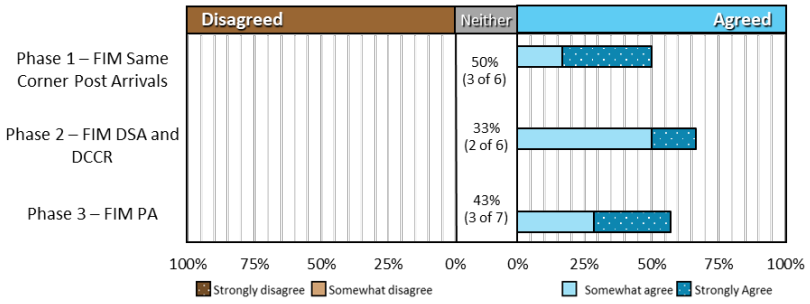


Figure 4.1.5-1. Mainline Operator Response to "My airline is interested in participating in the FAA's operational benefits validation field activities of ADS-B In." N=6

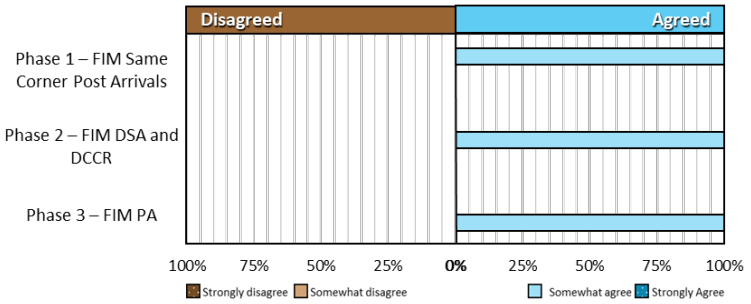


Figure 4.1.5-2. Regional Operator Responses to "My airline is interested in participating in the FAA's operational benefits validation field activities of ADS-B In." N=4

4.1.5 Operator Priority for ADS-B In Applications and Timeline for Equipage

Mainline Operators gave highest priority to terminal ADS-B In Applications that would result in more consistent runway rates, as shown in Figure 4.1.5-1. In-Trail Procedures and Flight-deck Interval Management also rated high in priorities. This was consistent with how they categorized which ADS-B In Applications they valued most. Regional operator priorities are shown in Figure 4.1.5-2. There are two main difference between mainline and regional Operator priorities. All regional Operators rated Oceanic In-Trail Procedures as low priority, due to their areas of operation.

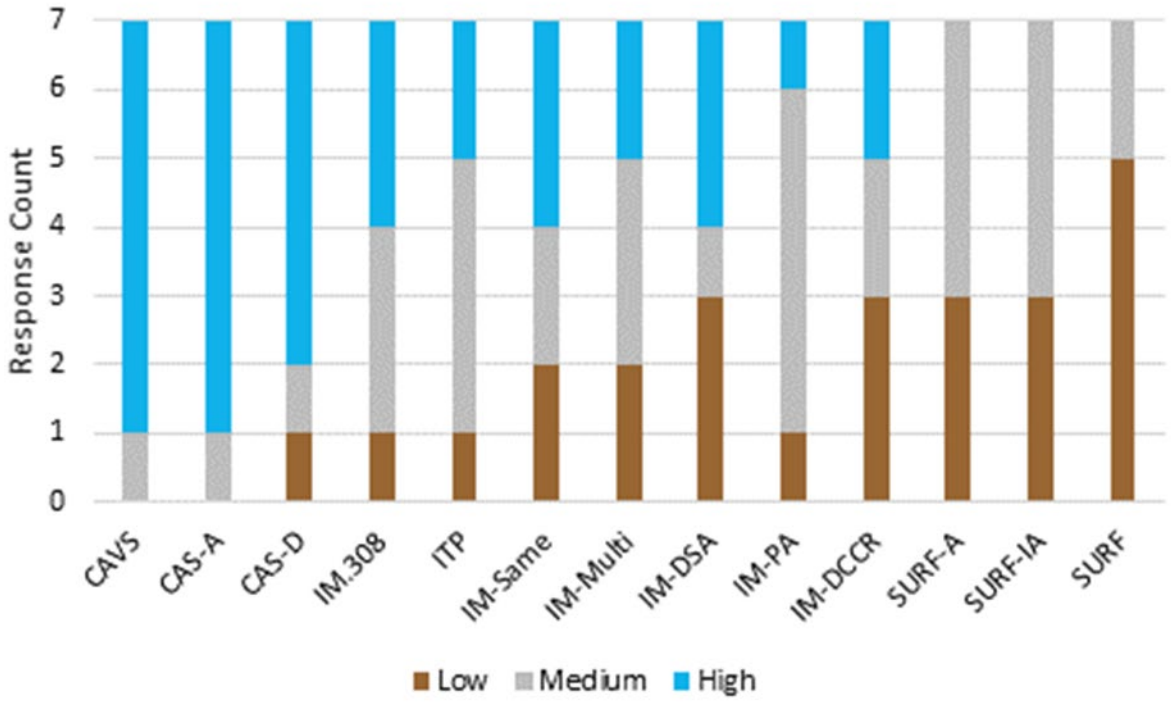


Figure 4.1.5-1: Mainline Operator Ranked Order Comparison of responses to "Rate your priority for [application] amongst the set of ADS-B In Applications." by application. N=7

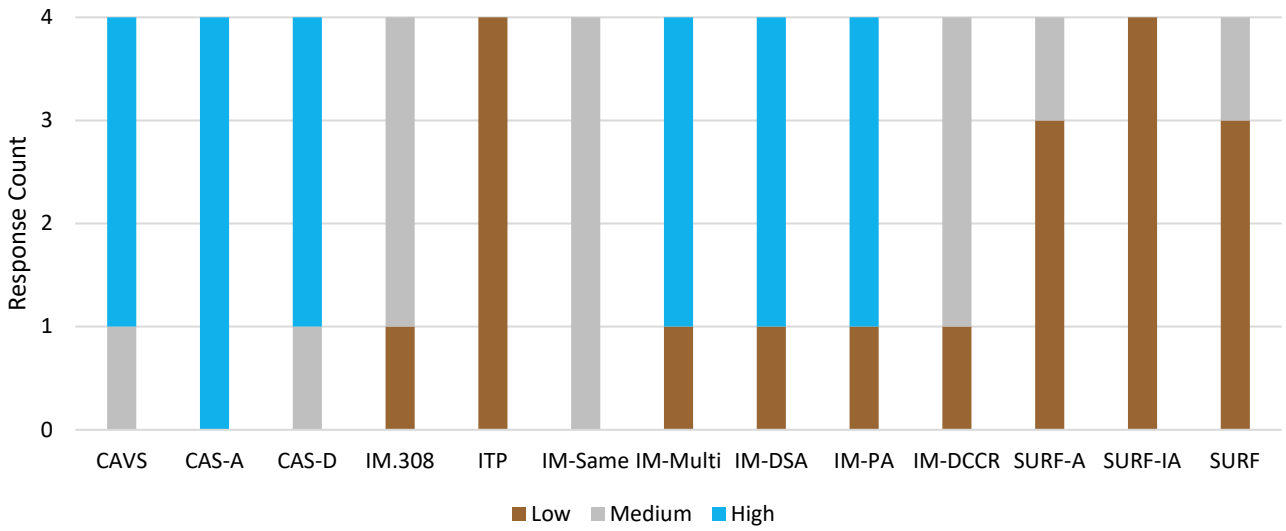


Figure 4.1.5-2. Regional Operator Ranked Order Comparison of responses to "Rate your priority for [application] amongst the set of ADS-B In applications." by application – Listed in Rank Order of the Major Carrier Responses. N=4

Investments in ADS-B In will be delayed for a few reasons. Most Operators will be recovering from losses encountered during the COVID-19 pandemic. Timelines also reflect Operators' need for the FAA to procure investments into controller automation necessary to allow for ADS-B In Applications to be performed. As shown in Figure 4.1.5-3, six mainline airlines responded that they plan to investment in ADS-B In Applications within the next 5-10 years with one airline stating 10-15 years. All four regional Operators indicated that they would likely invest in 5 – 10 years, as shown in Figure 4.1.5-4.

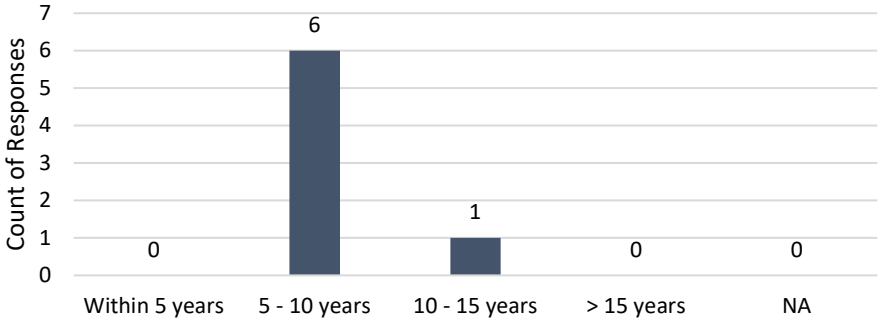


Figure 4.1.5-3: Mainline Operator responses to "If you decide to equip, in what timeframe do you expect to have the majority of the chosen fleet equipped?" N=7

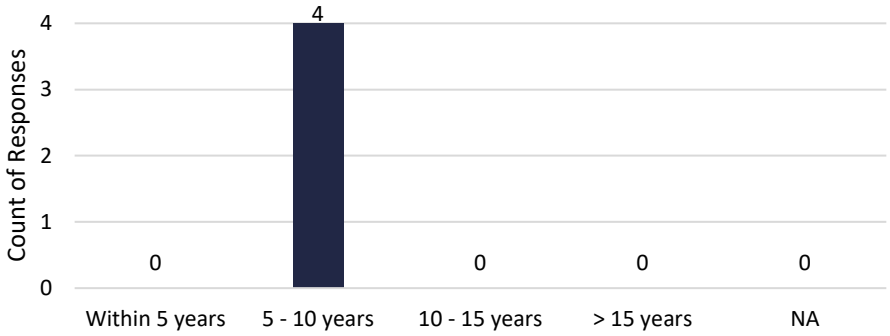


Figure 4.1.5-4. Regional Responses to "If you decide to equip, in what timeframe do you expect to have the majority of the chosen fleet equipped?" N=4

How Operators equip will vary based on each operator's philosophy in aircraft equipage. Some mainline Operators prefer forward fit options over retrofit solutions. Other mainline Operators are willing to retrofit with standalone STC avionics solutions. As shown in Figure 4.1.5-5, four out seven mainline Operators are willing to retrofit and forward fit with two willing to retrofit only. One airline will only forward fit. All four regional Operators indicated that they would likely both retrofit and forward fit, as shown in Figure 4.1.5-6.

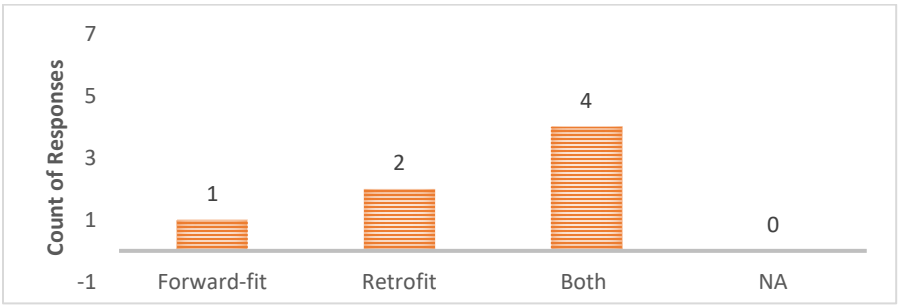


Figure 4.1.5-5: Mainline Operator responses to "If your airline decides to invest, what type of installations would you expect?" N=7

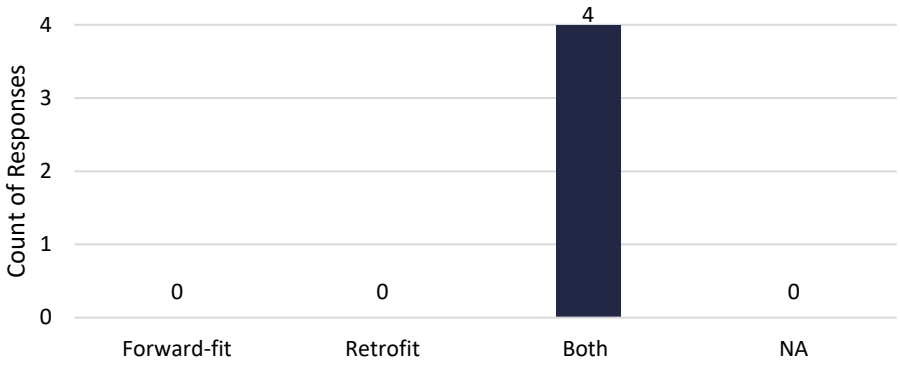


Figure 4.1.5-6. Regional Operator responses to "If your airline decides to invest, what type of installations would you expect?" N=4

4.1.6 Airline Barriers to Immediate Investment

While mainline airlines believe ADS-B In Applications have merit they also are struck with the harsh reality of the COVID-19 pandemic impact on the airline industry. Record industry losses will influence

the future investments of all technologies going forward. Large debt loads will be a barrier to future investments unless the return on investment can be established in a relatively short period. Advancing *cost efficient* applications that produce the largest benefit will become critical as the FAA continues to develop the ADS-B In road map. Operators expressed that providing a benefit for those who equip with ADS-B In Applications could have an impact on investing in ADS-B In Applications. Specifically, Operators viewed a two-rate GDP[6] system favorably in the questionnaire.

The FAA will also need to effectively communicate the intention for future investments in automation, before Operators decide to equip or make strategic investment on how to best equip. History has shown that airline and FAA investments in future technologies don't always produce the hoped-for results. Reluctance to invest in ADS-B In technologies will exist until the necessary infrastructure and controller acceptance in procedures is implemented showing FAA commitment in this technology. One approach that was discussed was to start out simple and build into more complex applications, as illustrated in a crawl, walk, run approach. The FAA Three Phased Approach, shown in Table 4.1.6-1, and presented in more detail in Appendix D: FAA Investment Approach Presented to the Task Group, appears to capture those thoughts. One airline was very clear that they do not want to make an investment in technology only to be required to reequip because the FAA has changed their direction and requirements for future applications. Making sure the avionics have growth capabilities "on wing" will be important for airline investments.

Phase 1	Same Corner Post Interval Management (IM) and ADS-B In Applications
Phase 2	Multi-Corner Post IM Dependent Staggered Approaches (DSA) IM Dependent Converging & Crossing Runways (DCCR) IM
Phase 3	Paired Approach

Table 4.1.6-1: FAA Phased Approach Table

Some of the ADS-B In Applications will require a change in procedures and how aircraft are handled compared to current operations. This will require new criteria, phraseology and in some cases, new separation standards. Uncertainties in how procedural changes will affect each workforce was ranked as a secondary concern for investment. If the procedures are not built with robust input from various labor groups, it is feared those procedures will be either ineffective or not accepted by the workforce resulting in nonuse. Early demonstrations on new ADS-B In Applications will be necessary to prove or improve the changes prior to widespread acceptance from company and labor representatives.

Company Tech Pilots and Pilot Associations were concerned with pilot workloads with the introduction of ADS-B In Applications. Pilot and controller participation will be necessary for future application development to gain acceptance from flight crews. NATCA also was concerned with exactly how these

[6] Two rate-Ground Delay Program applies when the FAA evokes a Ground Delay Program for a destination airport. Those operators who equip with ADS-B In Applications would be given shorter ground delays while those not equipped would be given ground delays comparable to delays assigned during a similar event prior to the addition of ADS-B In Applications to the NAS.

new technologies will be managed by the controller work force. New applications should be built in such a way to result in improved controller - pilot workloads and improve safety of flight. ***Acceptance by both workforces is critical to the success of this program.***

Because all ADS-B In Applications have little demonstrated use within the NAS, Operators lack confidence in projected benefits. Further demonstrations that provide actual benefits will be important for Operators to evaluate prior to investment. As the demonstrations prove benefits, barriers to future operator investments will decrease. Figure 4.1.6-1 shows the ADS-B In Applications that the mainline Operators are likely to invest in if their concerns, contingencies, and barriers were addressed. The regional Operators responses to that question are shown in Figure 4.1.6-2.

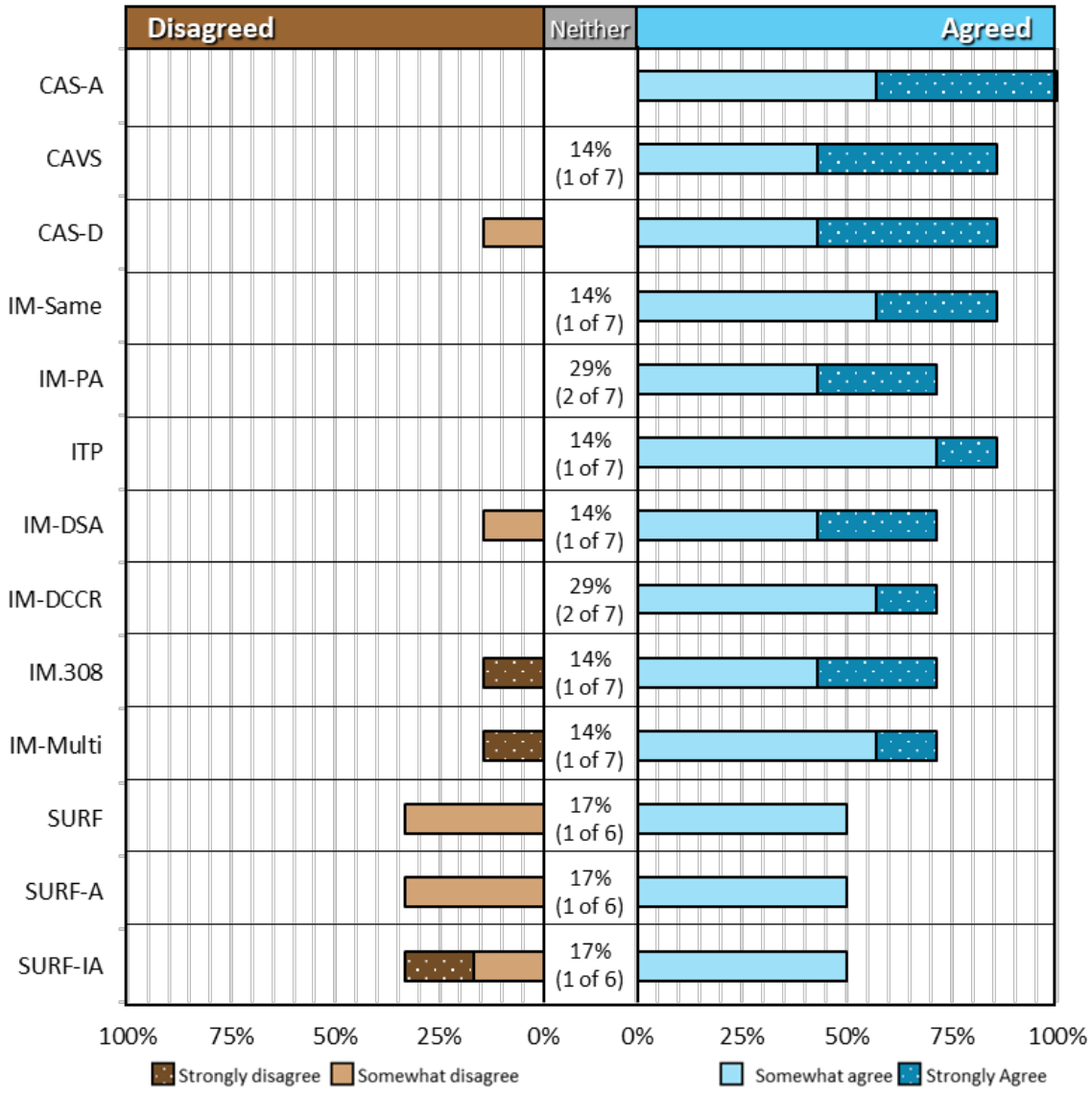


Figure 4.1.6-1: Mainline Operator Ranked Order Comparison of responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in [application]" N=7

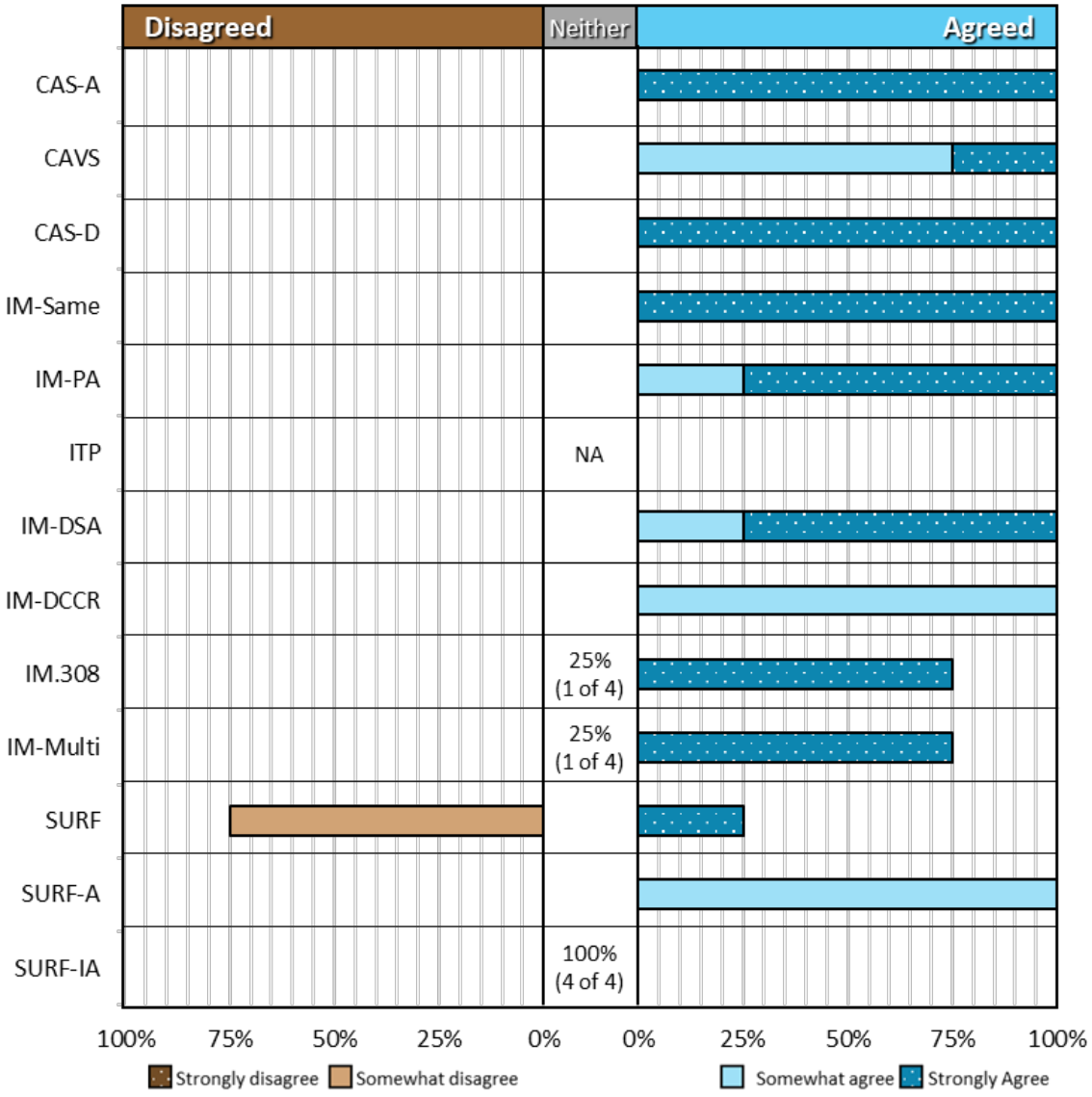


Figure 4.1.6-2. Regional Ranked Order Comparison of responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in [application]" – Listed in Rank Order of the Major Carrier Responses. N=4

4.2 Aircraft and OEM Questionnaire Responses

4.2.1 OEM Response Overview

All five OEMs responded to the OEM questionnaire, two Aircraft OEMs and three Avionics OEMs. Three General Aviation OEMs, members of the General Aviation Manufacturers Association (GAMA) also responded. Their responses are provided in Section 4.4. The questions focused on perceived benefits and barriers to investment in ADS-B In equipment development and certification. The answers were de-identified and collected by MITRE for final dissemination and review. The basic components of the questionnaire comprised of specific questions over thirteen applications as shown in Appendix F: Aircraft and Avionics OEM Questionnaire De-identified Responses. The complete set of OEM responses is included as that appendix as well.

4.2.2 OEM Interests in ADS-B In Applications

OEMs in general, welcome adding ADS-B In technologies into the NAS and responded that they will likely invest in the development and certification of ADS-B In Applications in the future. As shown in Figure 4.2.2-1, all five OEMs will likely invest in at least one ADS-B In Application. Development and certification of retrofit applications presents a number of challenges to OEMs. Most of the ADS-B In Applications require the airline to add a Cockpit Display of Traffic (CDTI) capability to their legacy fleets. Adding CDTI to existing cockpit displays requires coordination across multiple design activities which introduces significant commercial business complexities. Adding a new CDTI display device into the flight deck introduces the challenge of identifying panel space to accommodate the new display device. Development and certification of forward fit applications would follow traditional new aircraft development processes, but Aircraft OEM production rates would limit the rate of introduction of ADS-B In equipped aircraft in the NAS.

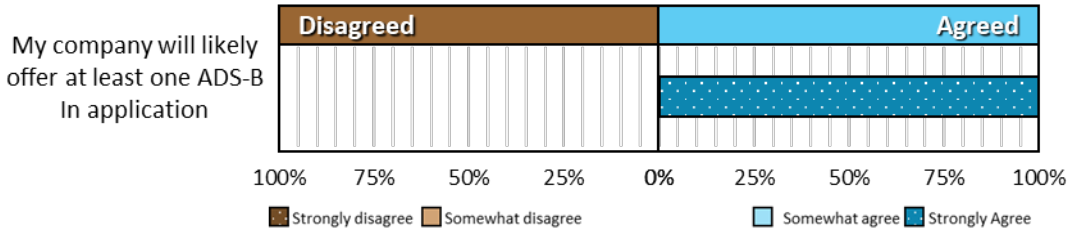


Figure 4.2.2-1: Responses to "My company will likely offer at least one ADS-B In application" N=5

4.2.3 OEM Interests in Specific ADS-B In Applications

OEM interest in new product upgrades and new product development follows demand from their airline customers balanced against their resources available to address the market demands. This includes funding and staffing availability for the development and certification of these upgrades and new products. With the significant financial downturn for OEMs as a result of the COVID-19 pandemic impacts to the aviation industry, OEMs are forced to prioritize their internally funded product development and certification efforts and make difficult decisions on which new products and services to bring to market and which to delay until a later date. Factoring into the OEM considerations is the ability to bring ADS-B In Applications to the marketplace as software upgrades to their existing avionics products, which are typically easier to develop and certify. For those ADS-B In Applications which cannot be accommodated as software upgrades to existing products, OEMs will carefully evaluate their business case for developing and certifying a new avionics hardware and software product family. Development and certification of new avionics products is significantly more costly to OEMs than software upgrades. Figure 4.2.3-1 shows OEMs interest in offering each of the thirteen ADS-B In Applications.

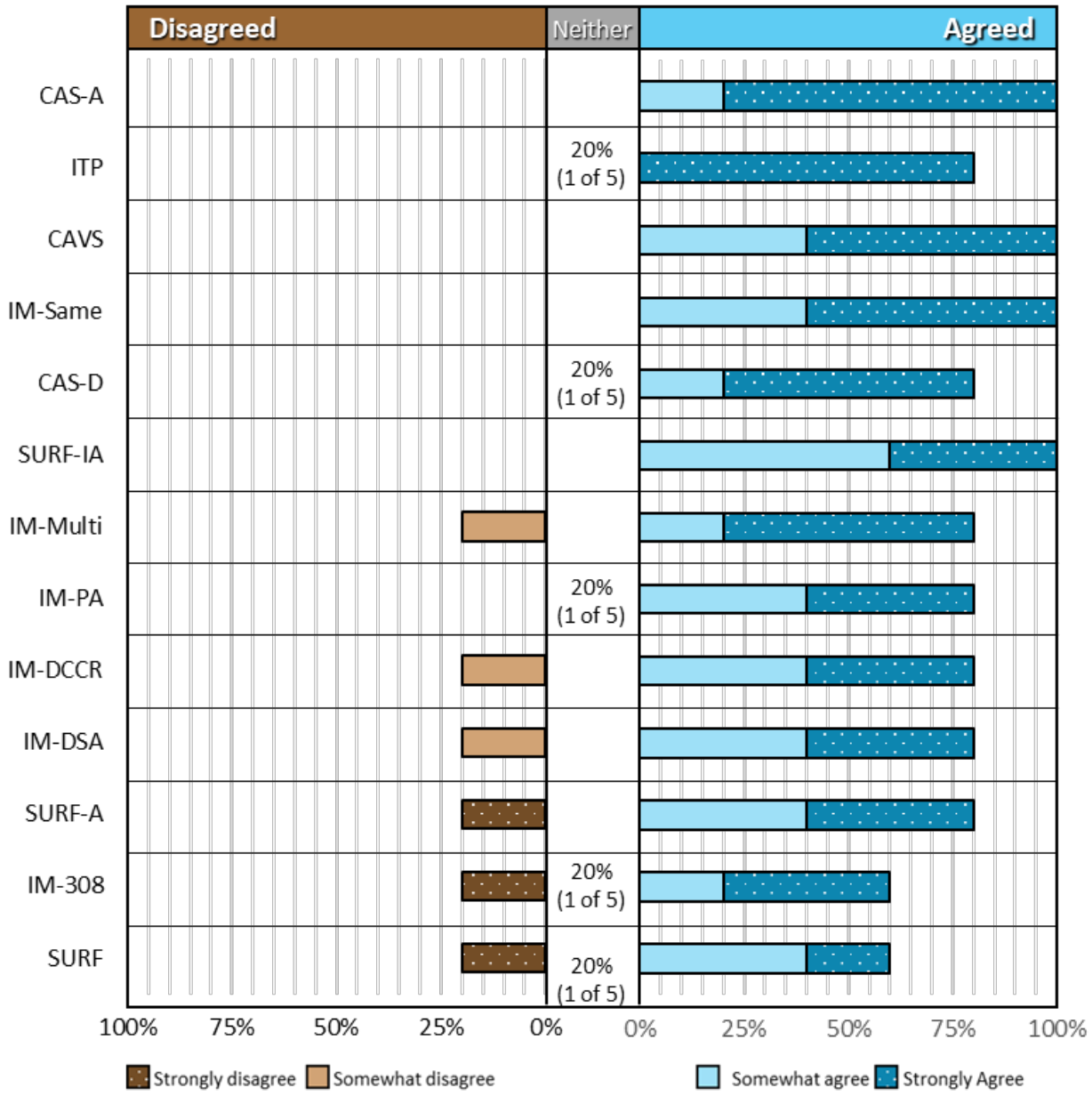


Figure 4.2.3-1: Ranked Combined Responses to "My company is interested in offering [application name]" by application. N=5

4.2.4 OEM Interest in Participating in FAA Operational Benefits Evaluations

A number of Operators indicated that one of their major barriers is the lack of benefits data from fielded systems. Clearly the FAA identified this concern and planned for Operational Benefits Validation activities in the FIM Investment Concept, as shown in Figure 4.2.4-1. A number of OEMs responded that, while interested in providing aircraft equipment to enable operational benefit evaluations, they are concerned with the amount of risk that entails. An airline participating in an operational benefits evaluation would unlikely be willing to pay the avionics product development and certification cost as well as the shipset equipment and installation costs for a small number of aircraft. Likewise, OEMs are

unlikely to commit internal funding for product development and certification of a product having uncertain demand beyond the immediate number of shipsets required for the Operational Benefits Validation, given that future demand is uncertain and several years into the future at best. The mere fact that an Operational Benefits Validation is required highlights that uncertainty. In the current economic environment as a result of the COVID-19 pandemic, OEMs are less likely to commit internal funds to products with an uncertain future. Therefore, OEMs directly, or as a pass through from a participating airline(s) would highly likely require Government assistance to mitigate the development and certification cost risk to participate in the Operational Benefits Validations.

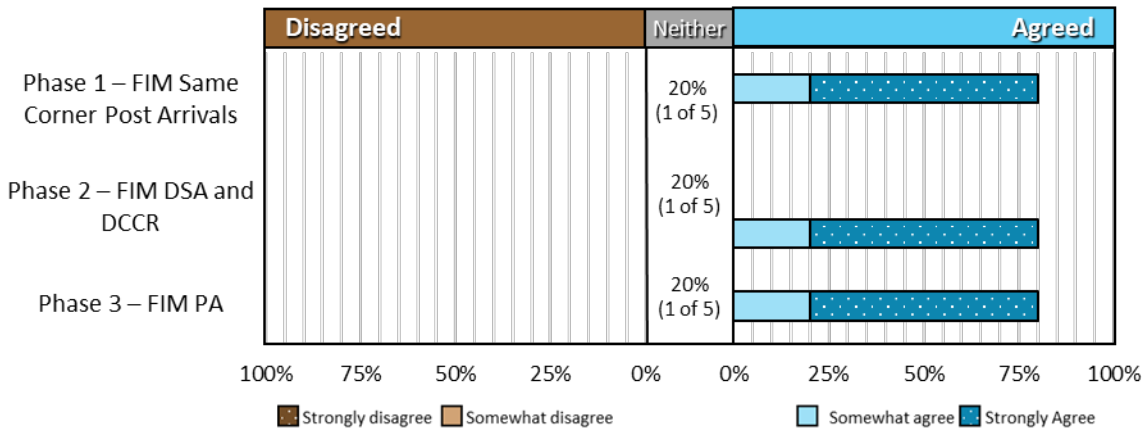


Figure 4.2.4-1: Responses to "My company is interested in participating in the FAA's operational benefits validation field activities of ADS-B In." N=5

4.2.5 Priority for ADS-B In Applications and Timeline for Equipage

The good news is that some OEMs are offering some certified ADS-B In Applications today. In addition, some OEMs have flown ADS-B In Applications in experimental flight trials which has resulted in a significant amount of engineering data to support eventual, certified product development. Each OEM has a unique road map for offering the ADS-B In Applications considered as part of this task. Some ADS-B In Applications would be available as software upgrades to existing OEM TCAS / ADS-B In avionics line replaceable units (LRUs). Other ADS-B In Applications, such as the FIM grouping of applications require avionics which can compute the flight path of the intended traffic to follow and then calculate the speed commands for the FIM aircraft to achieve and maintain the spacing goal assigned by the controller. Where this new functionality would be hosted is likely unique to each OEM. As shown in Figure 4.2.5-1, the applications which can be hosted in the existing TCAS / ADS-B In are likely to be available sooner and those requiring the functionality to process the intended flight path of the track to follow would be available much later.

Each of other OEMs was asked if each the applications was available in their current product offerings (STD), available as a software only upgrade today (A-SW), would likely be available as a software only upgrade in the future if the market demand develops (L-SW), or would not likely be available either because of hardware limitations or lack of OEM interest (NA). Given that OEMs have a number of generations of TCAS/ADS-B In avionics, OEMs were also asked these questions about their most recent product offering (Gen 0), their product that is one generation older (Gen-1) or their product that is two

generations older (Gen-2). The OEMs were also asked if their next generation TCAS/ADS-B In product would support each of the applications.

Appendix F: Aircraft and Avionics OEM Questionnaire De-identified Responses contains the OEM responses for all thirteen ADS-B In Applications but results from two significant applications are included below. The responses to the mostly highly rated application, CAS-Approach, is shown in Figure 4.2.5-1. All five OEMs indicated that CAS-approach are either standard or currently available as a software only upgrade in their current product offering or would likely be available as a software only upgrade. It should be noted that CAS-Approach would require additional avionics such as CDTI displays for some OEMs solutions.

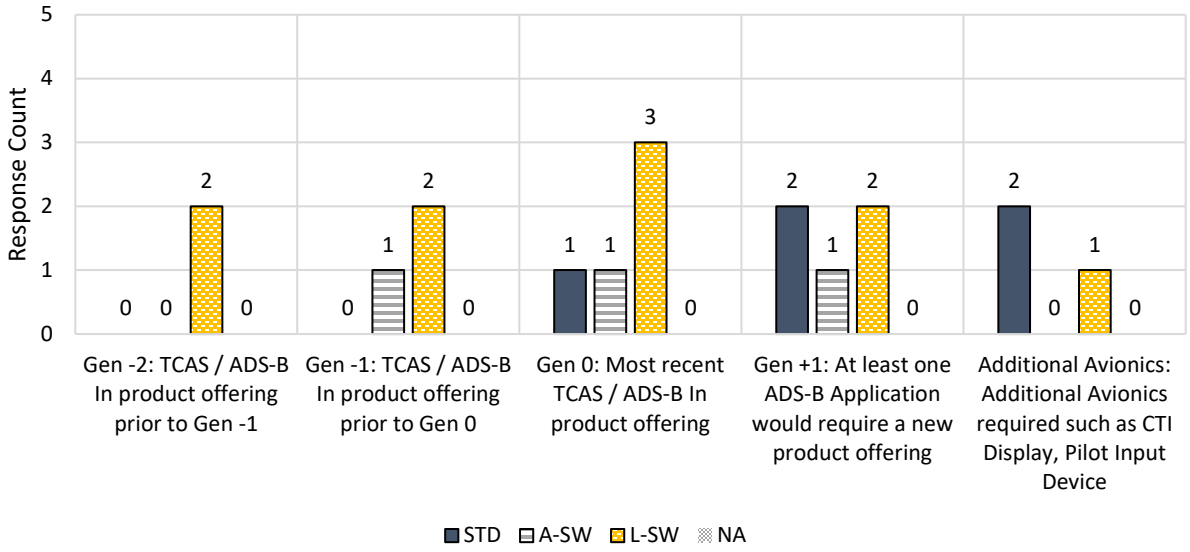


Figure 4.2.5-1. Responses to "If your company decides to offer CAS-A, how do you plan to offer the ADS-B In application avionics capabilities?" N=5

The responses to one of the highest rated FIM application, FIM-Dependent Staggered Approaches (FIM-DSA), is shown in Figure 4.2.5-2. One OEM responded that FIM-DSA would not be available in the current or future product offering. The additional avionics required, in addition to CDTI Display avionics includes the addition of functionality to process the intended path of the traffic to follow and calculate speed guidance for the FIM-DSA aircraft.

Currently available equipage costs provided to the Task Group by MITRE vary widely for each ADS-B In Application because of the implementation differences of each OEM for each aircraft model. Operators will require more detailed catalog pricing for their particular fleets to inform their investment decision making.

One concern raised in the OEM responses was incompatibility in the treatment of speed constraints between current RTCA standards for Time of Arrival Control (ToAC)[7] and Flight-deck Interval

[7] Also known as Required Time of Arrival (RTA)

Management (FIM). MITRE presented a recently prepared concept of operation for the interrelationship between ToAC and FIM procedures to the Task Group, but it has not been endorsed or approved by the FAA.

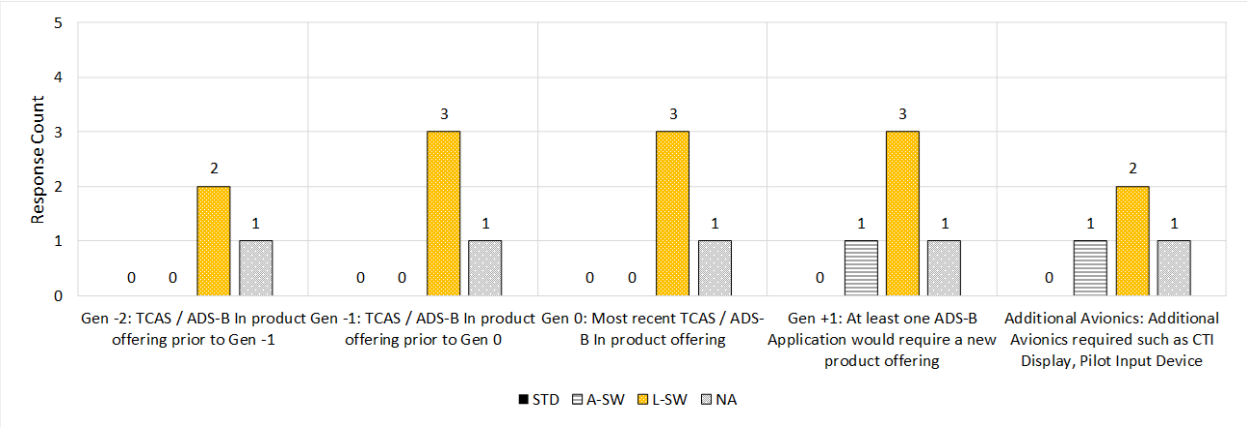
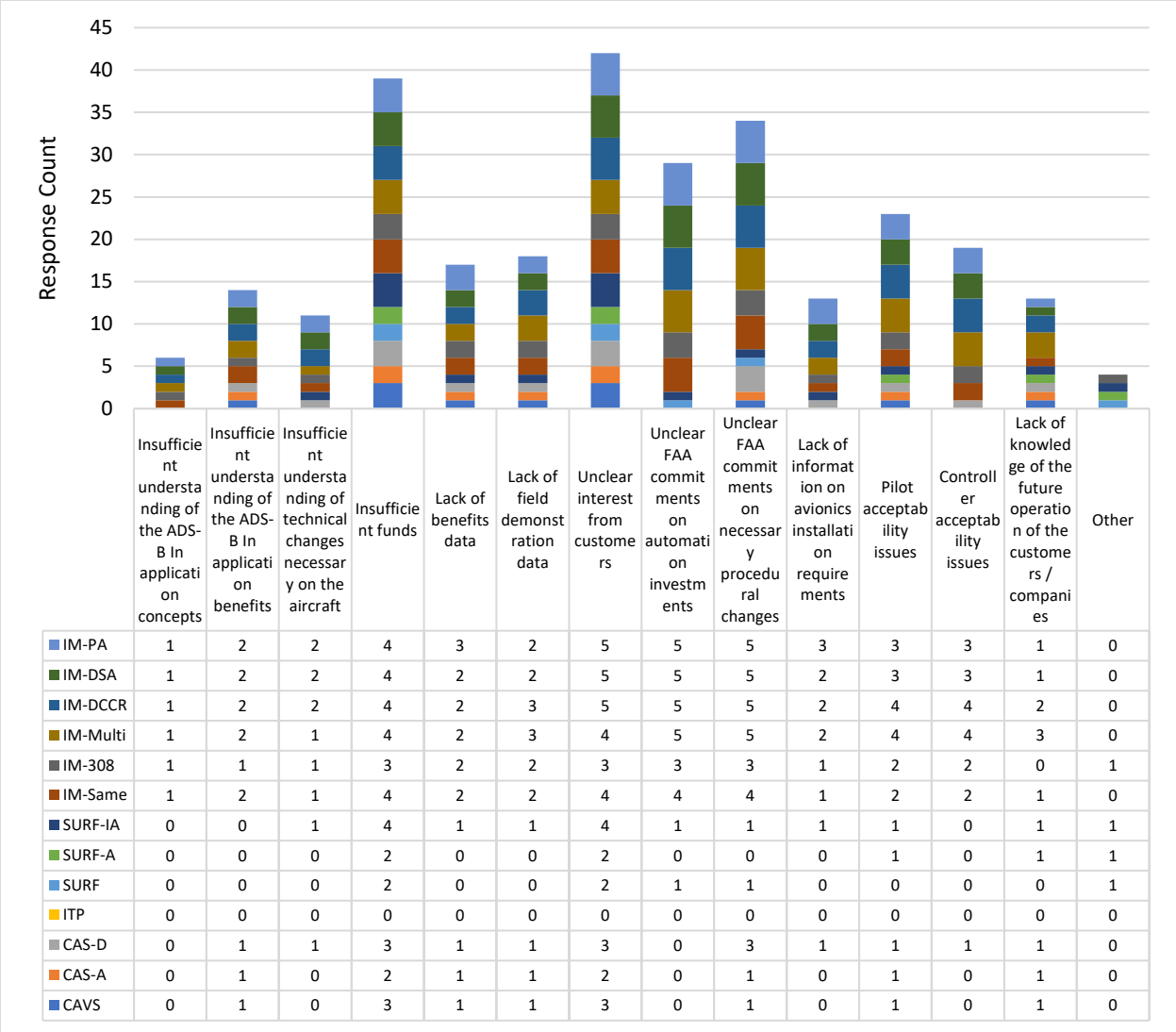


Figure 4.2.5-2. Responses to "If your company decides to offer FIM - DSA, how do you plan to offer the ADS-B In application avionics capabilities?" N=5

4.2.6 OEM Barriers to Investment

OEMs were asked to provide their primary and secondary barriers to investment in each of the ADS-B In Applications. Figure 4.2.6-1, summarizes the top OEM primary and secondary barriers to investment across all of the ADS-B In Applications, in ranked order. The highest barrier to investment is (1) unclear customer interest, followed by (2) insufficient funds for product development and certification, (3) unclear FAA commitment on the necessary procedural changes and (4) unclear FAA commitment on the necessary controller automation tools. As noted in the Operator responses, FAA commitment to the procedural changes and ground automation upgrades is also a prerequisite for Operators' investment decisions. However, FAA commitment alone would not likely be enough of an incentive for OEMs to invest in product development and certification. OEM internally funded development and certification costs must be amortized across future product sales. If there is not sufficient, initial airline interest, OEMs are unlikely to offer the ADS-B In Applications at a price the Operators would be willing to pay.



	Insufficient understanding of the ADS-B In application concepts	Insufficient understanding of the ADS-B In application benefits	Insufficient understanding of technical changes necessary on the aircraft	Insufficient funds	Lack of benefits data	Lack of field demonstration data	Unclear interest from customers	Unclear FAA commitments on automation investments	Unclear FAA commitments on necessary procedural changes	Lack of information on avionics installation requirements	Pilot acceptability issues	Controller acceptability issues	Lack of knowledge of the future operation of the customers / companies	Other
IM-PA	1	2	2	4	3	2	5	5	5	3	3	3	1	0
IM-DSA	1	2	2	4	2	2	5	5	5	2	3	3	1	0
IM-DCCR	1	2	2	4	2	3	5	5	5	2	4	4	2	0
IM-Multi	1	2	1	4	2	3	4	5	5	2	4	4	3	0
IM-308	1	1	1	3	2	2	3	3	3	1	2	2	0	1
IM-Same	1	2	1	4	2	2	4	4	4	1	2	2	1	0
SURF-IA	0	0	1	4	1	1	4	1	1	1	1	0	1	1
SURF-A	0	0	0	2	0	0	2	0	0	0	1	0	1	1
SURF	0	0	0	2	0	0	2	1	1	0	0	0	0	1
ITP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAS-D	0	1	1	3	1	1	3	0	3	1	1	1	1	0
CAS-A	0	1	0	2	1	1	2	0	1	0	1	0	1	0
CAVS	0	1	0	3	1	1	3	0	1	0	1	0	1	0

Figure 4.2.6-1: Combined Primary and Secondary Responses to "If your company is interested but not willing to commit to an investment in [application name], what barriers could be removed to incentivize your company to invest?" by application. N=5

4.3 Pilot Association Interview Responses

Since there were only two Pilot Associations represented on NAC Task 20-1 membership, the co-leads interviewed those representatives rather than preparing an on-line questionnaire for the Pilot Associations. Their feedback fell into four categories, (1) defining roles and responsibilities for safe separation of aircraft, (2) safety cases should be presented to ensure applications meet or exceed an equivalent level of safety, (3) concern about pilot workload, and (4) recognition of the increased safety offered by these ADS-B In Applications.

Most importantly, the Pilot Associations desire to ensure that use of ADS-B In Applications does not transfer separation responsibility from the air traffic controllers to the pilots. Aside from the workload issue discussed below, the Pilot Associations seem agreeable to accepting new clearance types that assign traffic to follow information, achieve-by-points, assigned spacing goals, and planned termination points. However, they view the controllers as being responsible for assuring that the clearances will

result in a safe separation of aircraft and that the controllers will continue to be responsible for monitoring safe separation and intervening when required. It is important as the FAA deploys these new ADS-B In Applications that the messaging to the pilot and air traffic control associations is very clear on this point.

Additionally, Pilot Associations desire that quantitative safety cases be presented that show that the use of the proposed applications by pilots in the NAS will not negatively impact the FAA Air Traffic Organization's (ATO) stated target level of safety for the NAS. Techniques such as collision risk analysis and the development of a quantitative basis for separation when pilots are executing ADS-B In Applications should be performed as part of application development.

Third, the Pilot Associations are concerned about the complexity of some of the clearance types associated with the FIM applications and the associated workload during the critical arrival and approach phases of flight. Even though MITRE conducted a number of data gathering exercises with line pilots and line controller to assess their ability to deliver, copy and execute clearances of varying complexity, early Operational Benefits Validations[8] should be conducted to validate the laboratory findings in a field environment.

Finally, the Pilot Associations recognize that ADS-B In Applications as important advances in safety. The Cockpit Display of Traffic Information (CDTI) is viewed as important tool to give pilots better situational awareness. The Pilots Associations were highly supportive of SURF applications and the level of situational awareness they bring for the flight crews during taxi operations, whereas the mainline Operators rated the SURF applications the lowest. The pilots associations believe that the SURF applications would contribute to increased safety on the runways and intersecting taxiways.

4.4 General Aviation Manufacturer Association Questionnaire Responses

The General Aviation Manufacturers Association (GAMA) had one representative on NAC Task 20-1. As the OEM questionnaire was developing, the GAMA representative requested that individual GAMA members be permitted to respond to the questionnaire rather than GAMA completing one questionnaire response to cover the GAMA membership. Three General Aviation OEMs, members of the General Aviation Manufacturers Association (GAMA) responded.

Since the responding GAMA members had not been party to the SME presentations, discussions and deliberations leading up to the questionnaire, the co-leads decided to include the GAMA members de-identified responses in the final report but separate them from the responses of the five Aircraft and Avionics OEMS who regularly participated in the Task Group meetings.

The remainder of this section summarizes the similarities and differences from the three responding GAMA members In contrast to the OEM responses included in Section 4.2.

Like the Task Group OEM members, the GAMA members welcome adding ADS-B In technologies into the NAS and responded that they will likely invest in the development and certification of ADS-B In

[8] Operational Benefits Validation (OBV) involves at least one operator operating certified equipment in revenue service for one year in at least one NAS location to validate the benefits of the application. An OBV would involve (1) any new pilot-controller phraseology that may be required, (2) Operational Approval, as required by Flight Standards for the operator's use of the equipment, and (3) the necessary, operational controller automation changes at the NAS location(s) where the operation(s) are being performed.

Applications in the future. All three GAMA members who responded will likely invest in at least one ADS-B In Application, as shown in Figure 4.4-1.

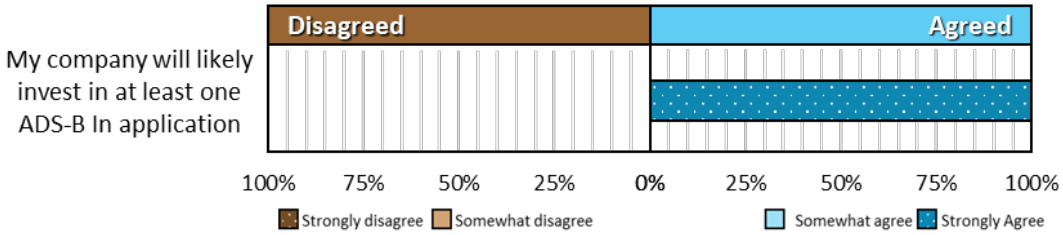


Figure 4.4-1. GAMA Responses to "My company will likely offer at least one ADS-B In application." N=3

As shown in Figure 4.4-2, the GAMA members did have slight differences in their interest in ADS-B In Applications compared to the Task Group OEM members shown in Figure 4.2.3-1. GAMA interest is higher for the SURF applications and lower for ITP and IM-Same Corner Post.

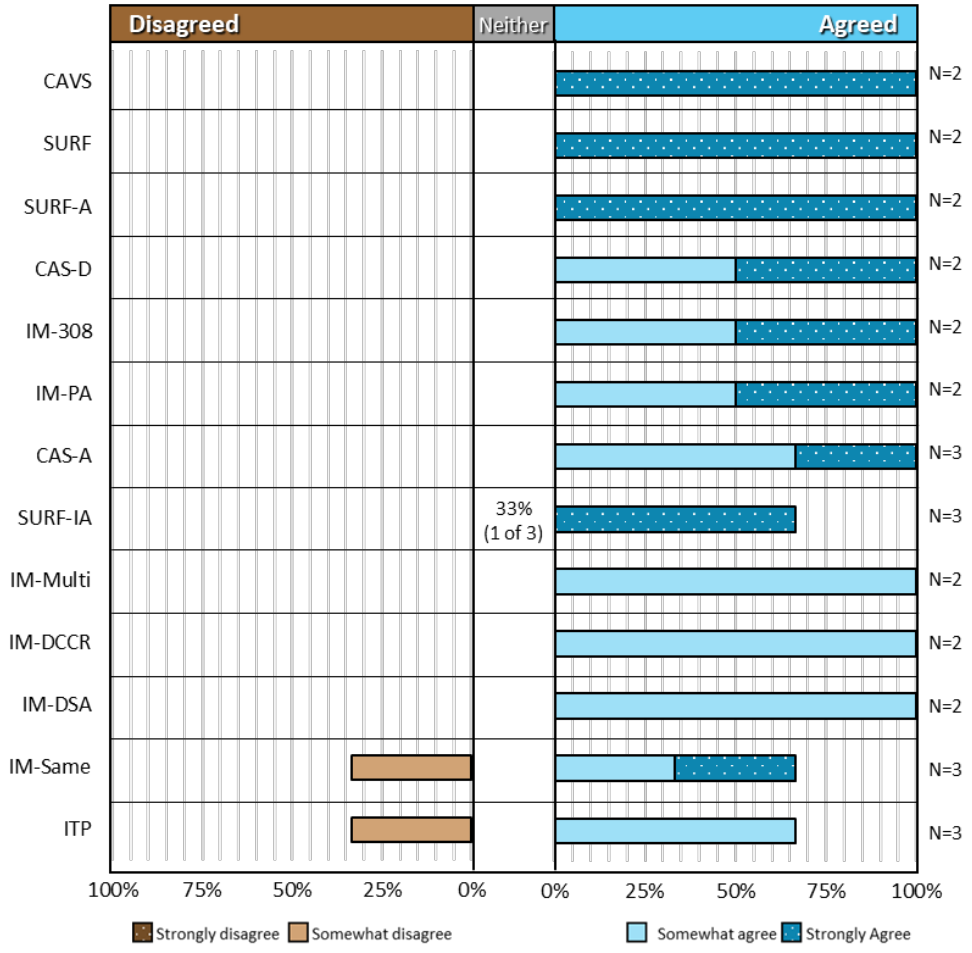


Figure 4.4-2. GAMA Ranked Combined Responses to "My company is interested in offering [application name]" by application – Ranked within GA Responses. N=3

Only one GAMA member expressed interest in participating in FAA Operational Benefits Validations as shown in Figure 4.4-3.

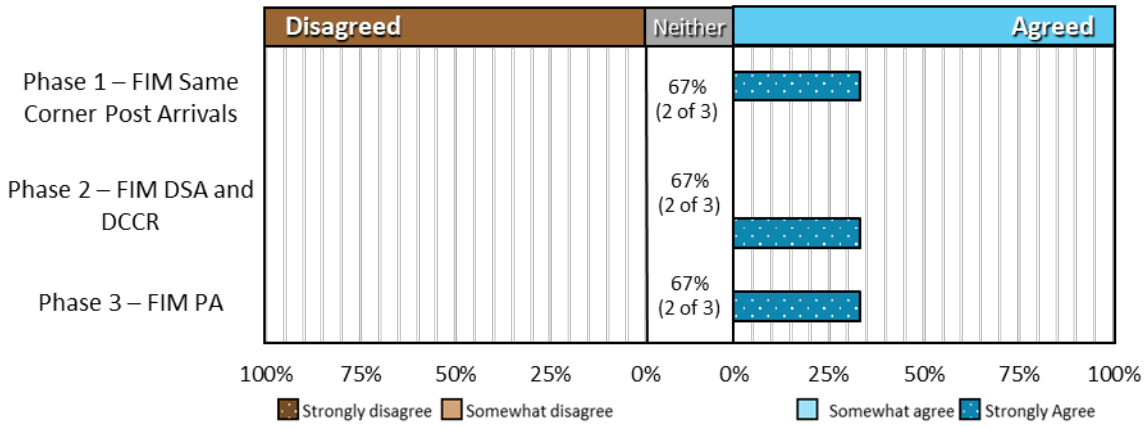


Figure 4.4-3 GAMA Responses to "My company is interested in participating in the FAA's operational benefits validation field activities of ADS-B In" N=3

5 Recommendations

Based on the questionnaire responses and Task Group discussions, Task Group 20-1, ADS-B In Applications, recommends that the FAA, Operators, OEMs, Pilot Associations, and NATCA take the following actions.

5.1 FAA

- Formally notify Operators and OEMs when the FAA makes investment decisions or changes previously communicated investment approaches
    - Operators and OEMs are unwilling to make investment decisions until they know the FAA has the infrastructure necessary to use ADS B In applications (reference Sections 4.1.6, 4.2.6)
- Provide opportunity to interested Operators, Pilot Associations and NATCA to discuss, develop and implement procedural changes, prior to the introduction of new ADS-B In applications into the NAS (reference Sections 4.1.6, 4.3)
    - Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctance to adopt the ADS-B In Applications.
- Develop safety cases that show the proposed ADS-B In Applications meet or exceed an equivalent level of safety (reference Section 4.3)
    - Maintaining current level of safety is important to Operators, Pilot Associations and NATCA
- Develop funding support programs for Operators and OEMs participating in Operational Benefits Validation[9] field trials (reference Sections 3.2, 4.2.4)
    - Operational Benefits Validation field trials benefit the entire industry, the costs and risks should not be fully borne by a few industry participants; Government funding support is appropriate in situations such as this.
- Formalize an FAA approved concept of operations for the use of Flight-deck Interval Management applications with Time-Based Management procedures such as Time of Arrival Control (ToAC)[10] and communicate it to Operators, OEMs, pilots and air traffic controller associations, and standards developing organizations as changes occur (reference Sections 3.1.1, 3.2, 4.2.5)
    - While, MITRE has performed analysis of how ToAC and FIM could be implemented in the NAS, an FAA approved concept of operation for the use of these flight-deck based speed control technologies, preferably coordinated with other ANSPs world-wide, would give Operators and OEMs more confidence to move forward with their investment decisions.

[9] Operational Benefits Validation (OBV) involves at least one operator operating certified equipment in revenue service for one year in at least one NAS location to validate the benefits of the application. An OBV would involve (1) any new pilot-controller phraseology that may be required, (2) Operational Approval, as required by Flight Standards for the operator's use of the equipment, and (3) the necessary, operational controller automation changes at the NAS location(s) where the operation(s) are being performed.

[10] Also known as Required Time of Arrival (RTA)

- Create a stepped approach for MOPS, TSOs and ACs for FIM applications, concurrent with FAA investment decisions, to advance ADS-B In Applications as they evolve (reference Section 4.1.6)
    - Industry is concerned that their initial investments will be at risk to ever changing MOPS over the more than ten-year span of the FAA Investment Concept.
- Explore, with the operator community, methods to provide operational incentives for Operators to equip (reference Section 4.1.6)
    - A two rate-Ground Delay Program (GDP)[11] that does not penalize those who do not equip, is one possible solution

5.2 Operators

- Provide ADS-B In Applications equipage summaries/plans to the FAA on a regular basis, at least annually, through the NAC. The pending tasking for the continued Minimum Capabilities List efforts should be considered as a method for sharing these updates
    - Awareness of Operators' equipage plans are important for the FAA and other industry stakeholders to inform their decision-making (reference Section 4.1.5)
- Continue to participate in FAA, Pilot Associations, and NATCA discussions to develop and implement procedural changes, prior to the introduction of new ADS B In applications in the NAS (reference Sections 4.1.6, 4.3)
    - Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctance to adopt the ADS-B In Applications.

5.3 OEMs

- Provide more detailed catalog pricing information to Operators for retrofit service bulletin or STC solutions and forward fit production option solutions (reference Section 4.2.5)
    - Operators require more detailed catalog pricing information to inform their investment decisions

5.4 Pilot Associations

- Continue to participate in FAA, Operator, and NATCA discussions to develop and implement procedural changes, prior to the introduction of new ADS B In applications in the NAS (reference Sections 4.1.6, 4.3)
    - Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctance to adopt the ADS-B In Applications.

[11] Two rate-Ground Delay Program applies when the FAA evokes a Ground Delay Program for a destination airport. Those operators who equip with ADS-B In Applications would be given shorter ground delays while those not equipped would be given ground delays comparable to delays assigned during a similar event prior to the addition of ADS-B In Applications to the NAS.

5.5 National Air Traffic Control Association

- Continue to participate in FAA, Operator, and Pilot Associations discussions to develop and implement procedural changes, prior to the introduction of new ADS B In applications in the NAS (reference Sections 4.1.6, 4.3)
    - Interested parties should have an active role in the discussions to minimize line pilot and line controller reluctance to adopt the ADS-B In Applications.

6 Acknowledgements

The co-leads and members of NAC Task 20-1 would like to thank MITRE for preparing the online questionnaires used to solicit the members' responses and the comprehensive reports containing tables and graphs documenting their collective, de-identified responses.

Appendix A: FAA Tasking Letter

U.S. Department of Transportation
Federal Aviation Administration

Office of the Deputy Administrator

800 Independence Ave., SW.
Washington, DC 20591

August 10, 2020

Mr. Russell "Chip" Childs
President and Chief Executive Officer
SkyWest, Inc.
444 South River Road
St. George, UT 84790

Dear Mr. Childs:

The Federal Aviation Administration (FAA) requests the NextGen Advisory Committee (NAC) to provide advice on two important topics: ADS-B In commercial application technologies and Vertical Navigation (VNAV). The FAA is also providing an extension of tasking 19-2, FAA Reauthorization Act of 2018, Section 547.

The first task involves potential ADS-B In commercial application technologies. Through discussions with the NAC, the FAA has become aware that several large air carriers and cargo carriers have begun to invest in ADS-B In applications.

The FAA requests further definition and advice from the NAC on ADS-B In commercial application technologies; in the form of the following task:

Task 20-1: ADS-B In Commercial Application Technologies

The NAC is tasked to provide the FAA with insight from the industry on their potential application acquisitions and deployment plans, including a timeline of ADS-B In commercial application technologies pursued by the aviation community.

The NAC advice should include the following:

- A comprehensive list of ADS-B In commercial applications that NAC members either have or intend to invest in (within the next 5-10 years).
- A comprehensive list of ADS-B In commercial applications that are promising and a list of the NAC members tracking this list for future acquisitions.

Scope:

- FAA will provide the SMEs.
- MITRE may be used as a trusted clearing house for data (considered sensitive in nature to the operators).
- Complete work and provide a final recommendation report no later than the Spring 2021 NAC meeting.

Task 20-2: Vertical Navigation (VNAV)

The NAC is tasked to provide the FAA an industry plan to address the existing equipage gap that prevents the full use of Required Navigation Performance (RNP) approaches for parallel operations. Currently, simultaneous operations cannot be used effectively by operators or air traffic control without a high participation rate. This change will allow the FAA to move forward and unlock larger safety and efficiency benefits associated with initiatives such as, Performance Based Navigation (PBN) paths to final approach, and Established on RNP (EoR).

The NAC advice should include the following:

- A comprehensive assessment of mainline and regional airline impediments to equipage for full VNAV operations.
- Achieve consensus on a plan to eliminate impediments to equipage for VNAV operations.
- Where complete consensus cannot be achieved, identify those operators or industry organizations which cannot come to consensus agreement and provide a minority opinion on any objections.

Scope:

- FAA will provide the SMEs.
- MITRE may be used as a trusted clearing house for data (considered sensitive in nature to the operators).
- Include other stakeholder organizations to include relevant manufacturers and pilot unions.
- Complete work and provide a final recommendation report no later than the Fall 2020 NAC meeting.

Task 20-3 (Task 19-2 Extension): FAA Reauthorization Act of 2018, Section 547

The NAC is asked to continue its efforts with providing advice to the FAA in accordance with FAA Reauthorization Act of 2018, Section 547. This tasking was originally issued prior to the emergence of the COVID-19 pandemic and its resulting economic impact on the aviation community. The FAA is cognizant of the need for the NAC members to remain focused on restarting industry operations as an essential part of the national recovery. This tasking is **extended through Spring 2021** to ensure the FAA is able to fulfill the congressional request contained in Section 547.

The NAC advice should include the following:

- A short list of recommended candidate airports and applications (airport, aircraft capability, and concept) for the pilot program
- For airports, while the legislation points to providing preferential basis at airports with Ground Delay Programs, the FAA seeks a recommendation from industry if this is appropriate or if other airports are preferred and why
- Describe potential and targeted benefits of most value to industry.

Scope:

- FAA will provide the NAC team an update on current and near-term forecast of NAS operations.
- FAA will provide the NAC team an update of current FAA/NAC initiatives that might be considered in fulfillment of any part of Section 547 requirements.

If you have questions, please contact Greg Schwab, NextGen Stakeholder Collaboration Division Manager, at Gregory.schwab@faa.gov.

Sincerely,

Daniel K. Elwell
Deputy Administrator

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Appendix B: Membership

ORGANIZATION	LAST NAME	FIRST NAME	TITLE/POSITION	EMAIL ADDRESS	NOTES
UPS Airlines	Bonds	Jonathan	Chief Pilot	jbonds@ups.com	
JetBlue Airways	Brown	Lee	Manager, Strategic Airspace Programs	Lee.Brown2@jetblue.com	
A4A	Cebula	Andy	Vice President, NextGen & New Entrants	acebula@airlines.org	
ALPA	Hahn	Edward	Senior Engineer, Air Traffic Management & Technology	Ed.hahn@alpa.org	
Alaska Airlines	Harrison	Paul	Technical Pilot for Surveillance	Paul.harrison@alaskaair.com	
GAMA	Hennig	Jens	Vice President, Operations	jhennig@gama.aero	
Airbus Americas	Joly	Pascal	Senior Director, Flight Safety & Technical Affairs	pascal.joly@airbus.com	
Honeywell Aerospace	Kauffman	Don	Senior Research & Development Manager, CNS/ATM Systems	don.kauffman@honeywell.com	**Co-Lead**
Collins Aerospace	McDowell	Michael	Technical Marketing Manager, Commerical Avionics	michael.mcdowell@collins.com	
L3 Harris	Morast	Cam	Senior Program Manager, ACSS	Cam.morast@L3Harris.com	
United Airlines	Renk	Ron	Chief Technical Pilot	ron.renk@united.com	
American Airlines	Surridge	David	Senior Manager, Airspace & Aircraft Modernization	david.surridge@aa.com	**Co-Lead**
APA	Townsend	Brian	Safety Representative	btownsend@alliedpilots.org	
FedEx Express	Tree	Jon	Technical Pilot, Flight Technical & Regulatory Compliance	jonathan.tree@fedex.com	
RAA	Whyte	Bill	Vice President, Aviation Operations & Technical Services	whyte@raa.org	
ALPA	Willey	Douglas	Chairman, Air Traffic Services Group	Douglas.Willey@alpa.org	
NATCA	Woods	Jeff	Representative, National PMO	jwoods@natca.org; pmo@natca.net	
Delta Air Lines	Young	Gregory	Chief Technical Pilot, Airspace & Industry Affairs	Gregory.S.Young@delta.com	
NATCA	Zarick	Thomas	Representative, ADS-B In	im@natca.net	
Boeing	Shafaat	Taji	Senior Engineer	taji.shafaat@boeing.com	

Subject Matter Experts and Invited Participants

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FAA	Bagstad	Brian	brian.bagstad@faa.gov
MITRE	Bone	Randy	bone@mitre.org;
United Airlines	Flynn	Robert	robert.c.flynn@united.com
Regulus Group	Howell	Dan	dhowell@regulus-group.com
American Airlines	Guthrie	Roddy	Roddy.Guthrie@aa.com
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Blue Mountain Aero	Jones	Ken	Kenneth.M.Jones@bluemountainaero.com
FAA	Marks	James	James.Marks@faa.gov
FAA	O'Connor	Wendy	wendy.l.o'connor@faa.gov
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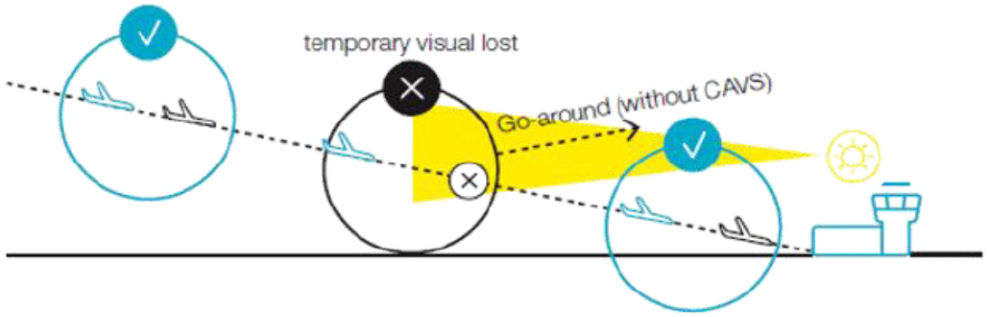
FAA	Rodriguez	Alex	alejandro.rodriguez@faa.gov
MITRE	Weitz	Dr. Lesley	lweitz@mitre.org;
FAA	Yates	Vaughn	Vaughn.Yates@faa.gov

Appendix C: Summary of ADS-B In Applications Considered by the Task Group

The one-page summaries per ADS-B In Application contained in this appendix were created by the Task Group for the benefit of Task Group to facilitate discussions and deliberations within their respective organizations. These summaries drew upon material presented to the Task Group by SMEs, Operators, and OEMs.

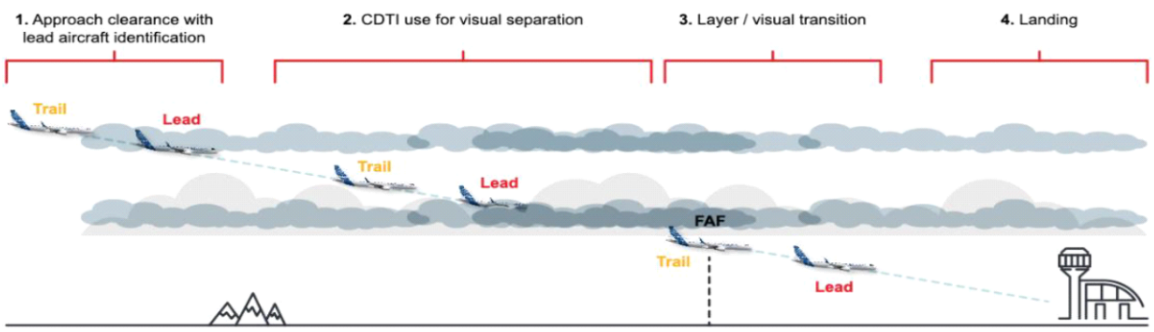
CDTI-Assisted Visual Separation (CAVS)



- Conducted in VMC, CAVS assists the flight crew in maintaining visual separation from ADS-B Out-equipped aircraft,. CAVS Benefits Report
- Once the traffic is visually acquired, and visual separation is approved by ATC, pilot may maintain visual separation using the CDTI even if visual contact is lost in legal VMC conditions
- Pilot uses traffic ground speed, ground speed differential and traffic distance on CDTI to determine speed adjustments to maintain visual separation.
    - Equipage:
        - Traffic ADS-B Out equipped
        - CAVS aircraft [E]TSO-C195b or –C195c compliant avionics
    - FAA operational approval is required

1

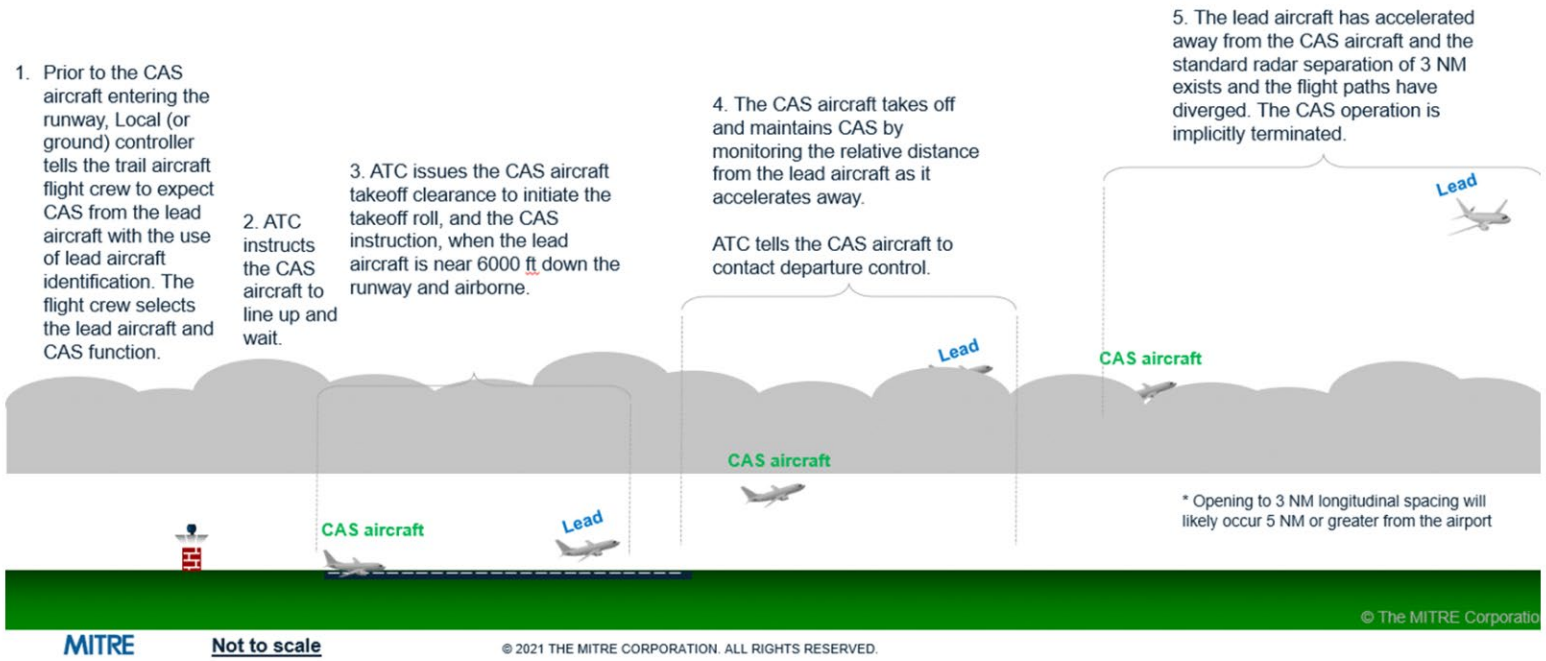
CDTI-Assisted Separation (CAS) - Approach



- CAS may be conducted in IMC, visual separation procedures can be initiated without first visually acquiring traffic-to-follow
- ATC and pilot use traffic Flight ID to identify the traffic on the CDTI
- Pilot uses traffic ground speed, ground speed differential and traffic distance on CDTI to determine speed adjustments to maintain visual separation.
    - Equipage:
        - Traffic ADS-B Out equipped
        - CAVS aircraft [E]TSO-C195b or –C195c compliant avionics
    - FAA Operational Approval will be required

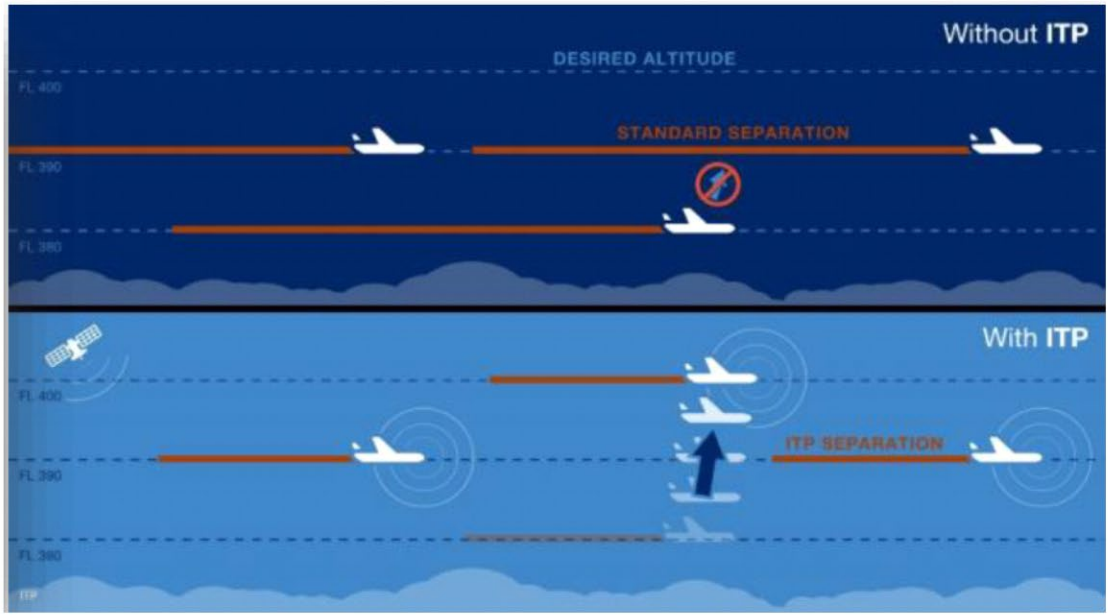
2

CDTI-Assisted Separation (CAS) - Departure



- CAS may be conducted in IMC
  - Equipage:
    - Traffic must be ADS-B Out equipped
    - CAVS aircraft must have [E]TSO-C195b or –C195c compliant avionics
  - FAA Operational Approval will be required

Oceanic In-Trail Procedures (ITP)



- Enables pilot requested climb or descent with less than standard separation
- Requires ATC approval
- Avionics determines if separation distances and relative speeds meet the initiation criteria for procedure

ITP Benefits Report

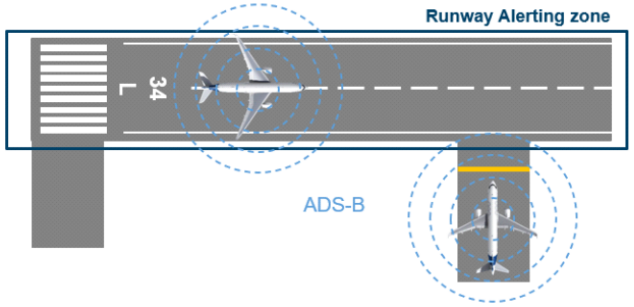
- Equipage
  - [E]TSO-C195a or later plus CPDLC for ownship
  - Reference aircraft must be ADS-B Out equipped (FANS not required)
- FAA Operational Approval is required (see AC 90-114B)
  - All US Oceanic Centers will accept ITP requests
  - Is there something else industry needs the FAA to do?

Surface (SURF)

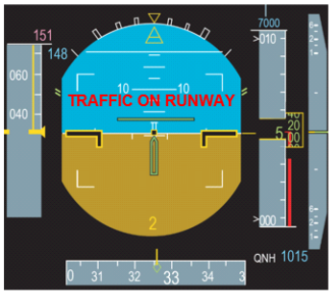
- SURF = Situational awareness of traffic on the airport surface

- Equipage
  - [E]TSO-C195a or later (SURF)

Surface Alerting (SURF-A)



Sept 2020 Airbus Runway Safety Enhancement functions summary



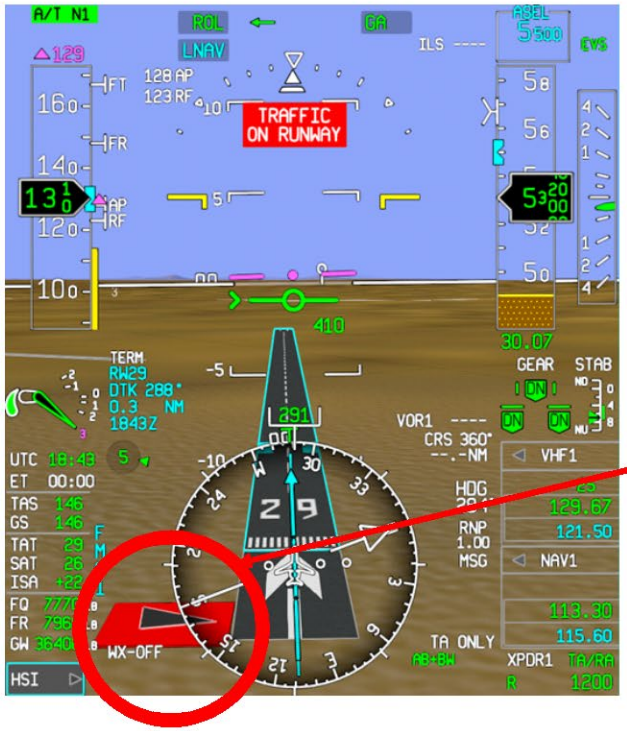
TRAFFIC ON RUNWAY

- SURF-A = Aural Alerting of surface traffic intruding on ownship path on runways
- Message on PFD
- No visual indication of the intrude location

Airbus SURF-A Video

- Equipage
  - No [E]TSO for SURF-A is currently planned

Surface Indicating and Alerting (SURF-IA)

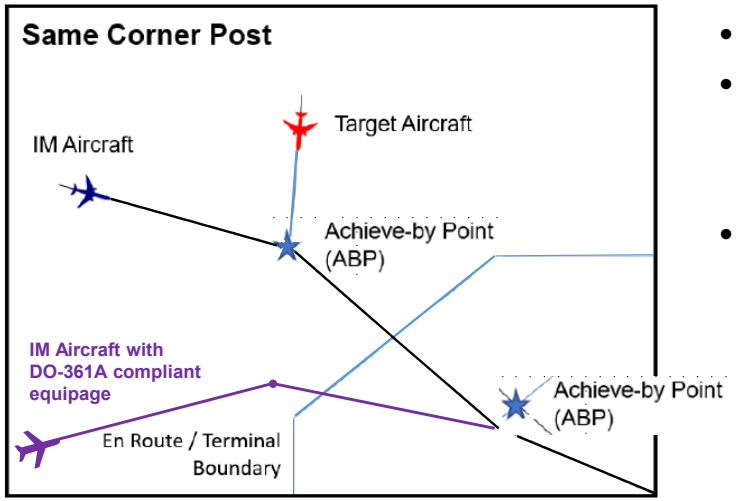


- SURF-IA = Visual Indication and Aural altering
- Provides runway incursion alerts based upon ADS-B data.
  - *Traffic on final*
  - *Traffic on runway*

Example of traffic intruding into Runway Alerting Zone

- Equipage
  - No [E]TSO for SURF-IA is currently planned

Flight-deck-based Interval Management (FIM) – Same Merge Point (Corner Post) Arrivals

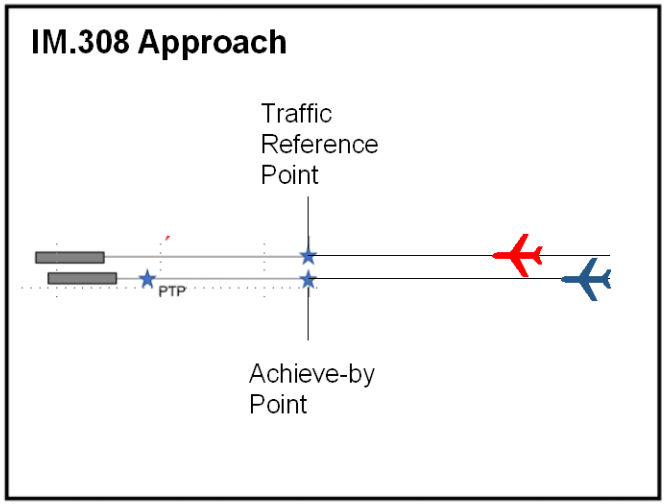


- FIM operation initiated in the En Route sector
- Enables optimal merging and spacing of arrival streams to the En Route / Terminal Boundary
- Planned Termination Point at En Route / Terminal Boundary or potentially on Final (FAA plans uncertain)

- Equipage
  1. Either ACSS-like non-DO-361A compliant avionics
     - Target and IM aircraft must be on Direct-To paths to the Achieve-by Point
     - Merging streams must form an angle less than 90^0
  2. Or DO-361A compliant avionics
     - Can perform FIM with dual corner post arrivals, e.g. DEN, ATL, IAH
     - Not limited to Direct To paths
- FAA Operational Approval will be required

1

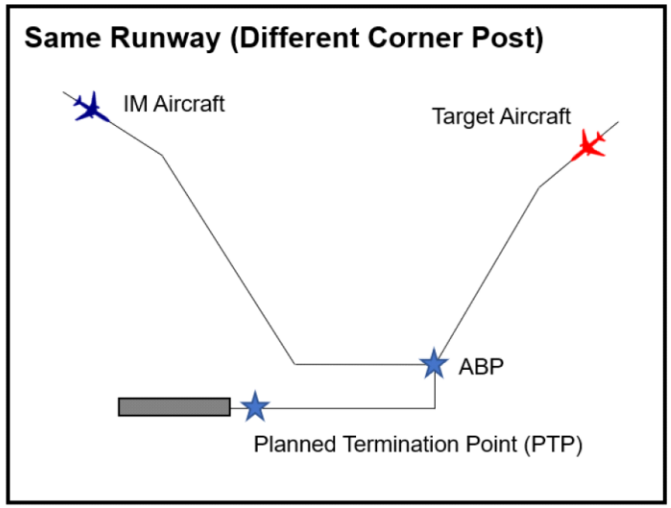
IM.308 Approach – Airline Proposal



- Airline proposed predecessor to DO-361A-compliant DSA, although with greater spacing, in accordance with JO7110.308
- Enables continued use of CSPO in IMC conditions
- Requires ground automation changes to inform controller of equipage and approval to do the operation
- Controller procedures
  - JO7110.308 (not equivalent to Paired Approach as defined in DO-361A)

- Equipage
  1. Either ACSS-like non-DO-361A compliant avionics (untested)
  2. Or DO-361A compliant avionics
- FAA Operational Approval will be required

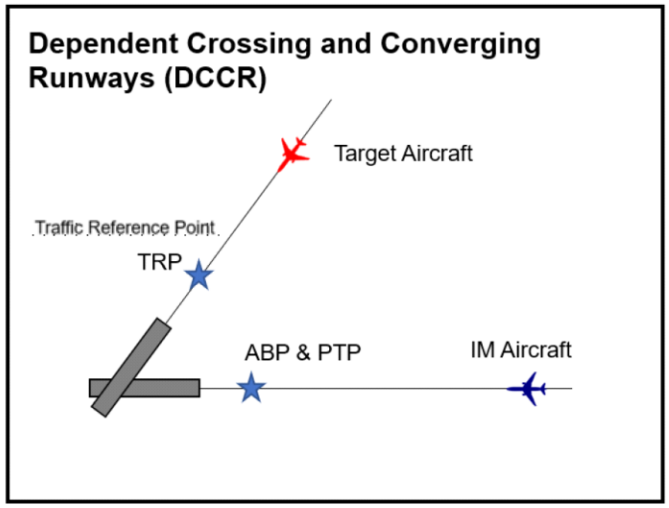
Flight-deck-based Interval Management (FIM) – Multiple Corner Posts Arrivals



- FIM operation initiated in the En Route sector
- Continues into TRACON to Final
- Achieve by Point (ABP) inside TRACON
- Enables optimal runway arrival rates by delivering aircraft to the FAF with final spacing accuracy of ± 10 sec

- Equipage
  - DO-361A compliant avionics
- FAA Operational Approval will be required

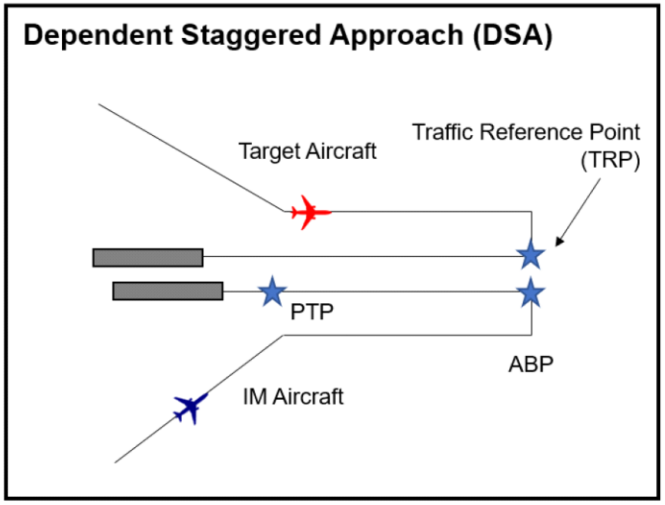
Converging/Crossing Runways (DCCR) Arrivals



- FIM operation initiated in the En Route sector or inside TRACON
- ABP inside TRACON
- Enables optimal runway arrival rates by delivering aircraft to the FAF with final spacing accuracy of ± 10 sec

- Equipage
  - DO-361A compliant avionics
- FAA Operational Approval will be required

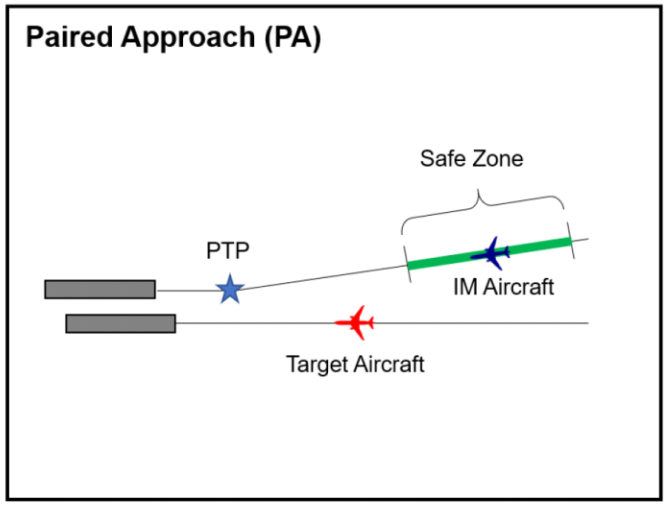
Dependent Staggered Approaches (DSA)



- FIM operation initiated on STAR arrivals
- Continues into TRACON
- Achieve By Point (ABP) on Final
- Controller procedures
  - JO7110.308 or similar
- Enables optimal runway arrival rates by delivering aircraft to the FAF with final spacing accuracy of ± 10 sec

- Equipage
  - DO-361A compliant avionics
- FAA Operational Approval will be required

Paired Approach (PA)



- Closer spacing than IM.308 resulting in incremental improvement in arrival rates
- Enables optimal runway arrival rates by delivering aircraft to the FAF with final spacing accuracy of ± 7 sec
- Controller procedures
  - JO7110.xxx

- Equipage
  - DO-361A compliant avionics
- FAA Operational Approval will be required

Appendix D: FAA Investment Approach Presented to the Task Group

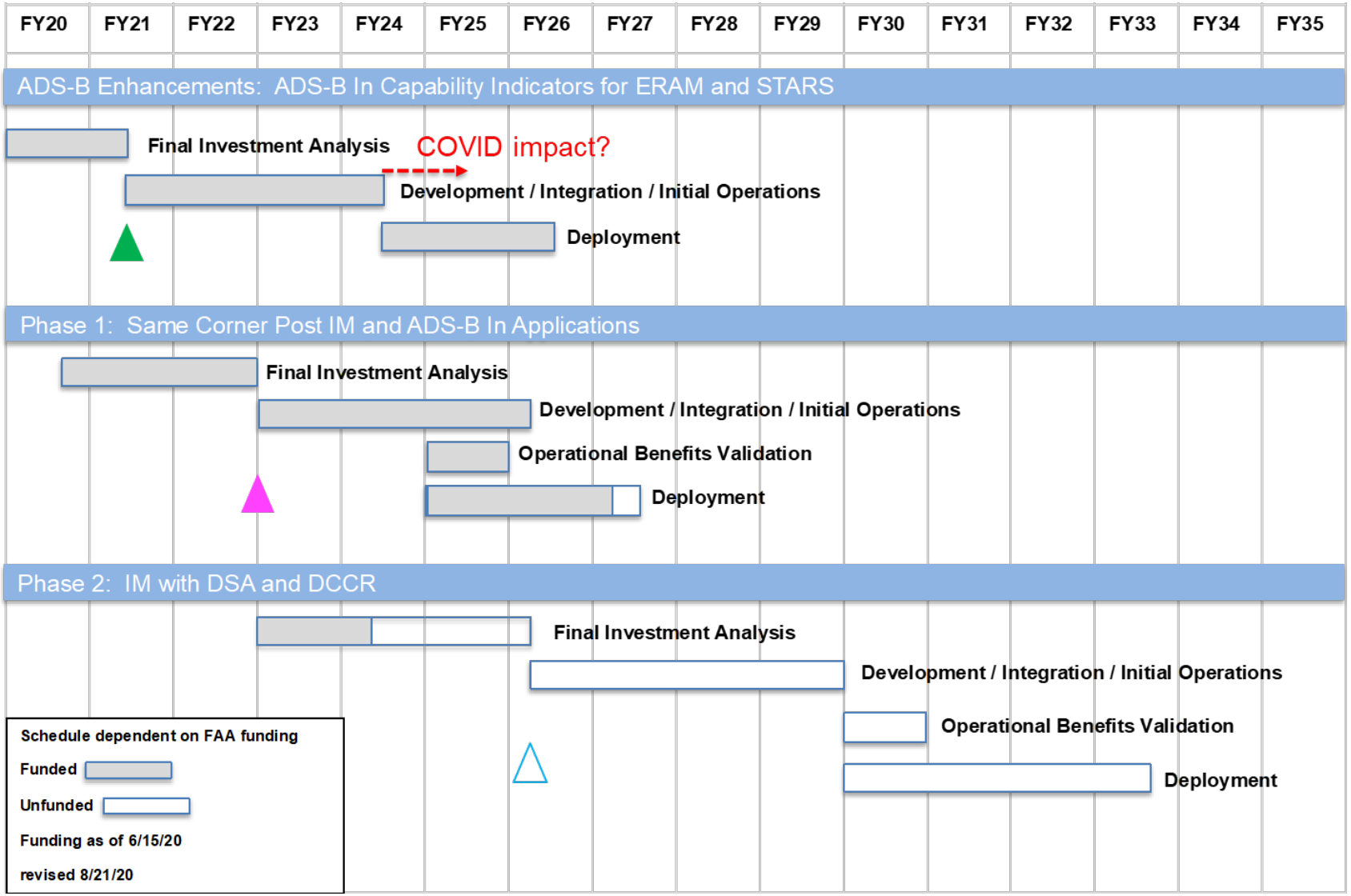
Investment Approach for ATC Support of ADS-B In Applications

- **In May 2019, the FAA's Joint Resource Council approved the strategy for a phased investment approach for Interval Management**

Phase 1	Same Corner Post Interval Management (IM) and ADS-B In Applications
Phase 2	IM with Dependent Staggered Approach (DSA) and Dependent Converging & Crossing Runways (DCCR)
Phase 3	Paired Approach

- **A phased approach is more affordable for the FAA (lower per year costs), even though overall lifecycle cost is higher**
  - Phase 1 introduces simpler IM operations first, reducing implementation risk and allowing the Agency to gain confidence before investing in more complex operations
  - Phase 2 allows for the implementation of the majority of IM operations

Phased Investment Approach (Dates tentative/dependent on Phase 1 FID)



Appendix E: Mainline Operator Questionnaire De-identified Responses

Primary Questions

Q1. My airline will likely invest in at least one ADS-B In Application

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	14%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	3	43%
N	7	
% Agreement	6	86%
% Disagreement	0	0%

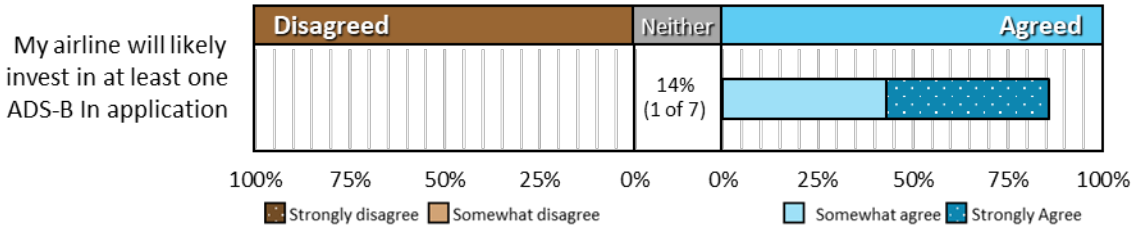


Figure 1-1. Responses to "My airline will likely invest in at least one ADS-B In Application."

Q1.a. If your airline decides to invest, what type of installations would you expect?

Forward-fit	1	14%
Retrofit	2	29%
Both	4	57%
NA	0	0%
N	7	

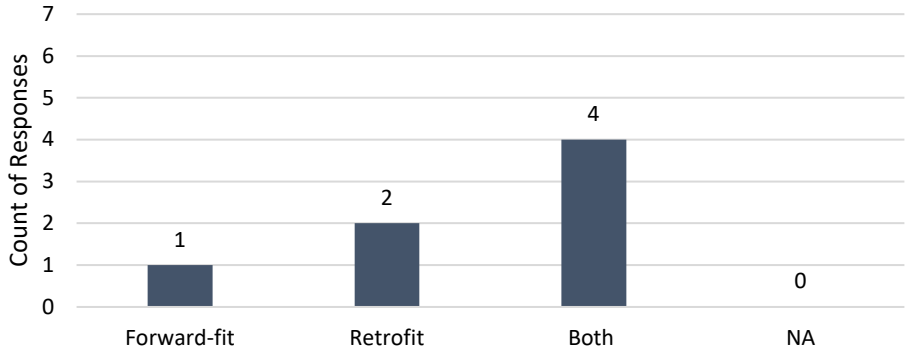


Figure 1-2. Responses to "If your airline decides to invest, what type of installations would you expect?"

Q1.b. If your airline decides to invest, how do you plan to implement the ADS-B In applications in your fleet?

Phased	4	57%
All at once	0	0%
Unknown	3	43%
NA	0	0%
N	7	

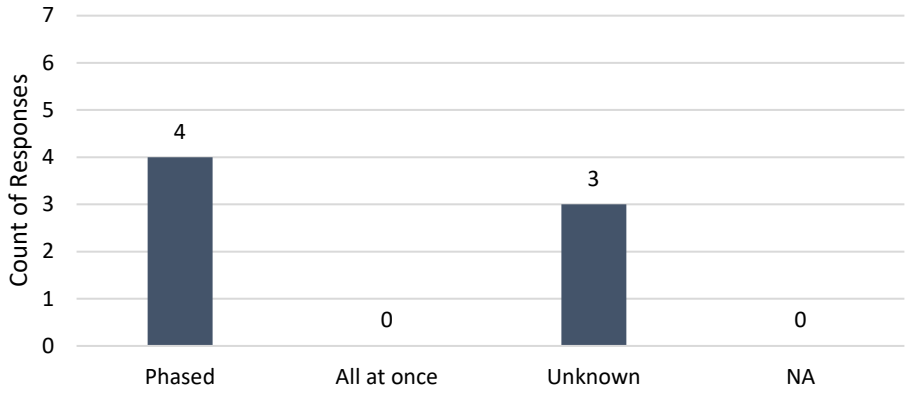


Figure 1-3. Responses to "If your airline decides to invest, how do you plan to implement the ADS-B In applications in your fleet?"

Q 1.c. If you decide to equip, in what timeframe do you expect to have the majority of the chosen fleet equipped?

Within 5 years	0	0%
5 - 10 years	6	86%
10 - 15 years	1	14%
> 15 years	0	0%
NA	0	0%
N	7	0%

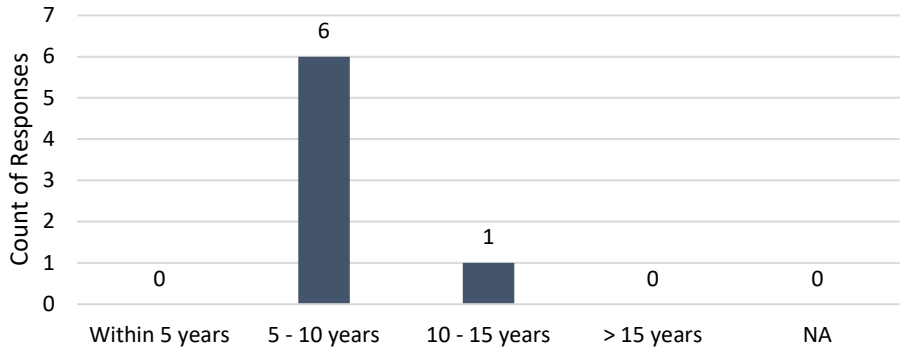


Figure 1-4. Response to "If you decide to equip, in what timeframe do you expect to have the majority of the chosen fleet equipped?"

Q2. My airline is interested in participating in the FAA's operational benefits validation field activities of ADS-B In

Strongly Disagree	0	0%	0	0%	0	0%
Disagree	0	0%	0	0%	0	0%
Somewhat Disagree	0	0%	0	0%	0	0%
Neither	3	50%	2	33%	3	43%
Somewhat Agree	1	17%	3	50%	2	29%
Agree	0	0%	0	0%	0	0%
Strongly Agree	2	33%	1	17%	2	29%
N	6		6		7	
% Agreement	3	50%	4	67%	4	57%
% Disagreement	0	0%	0	0%	0	0%

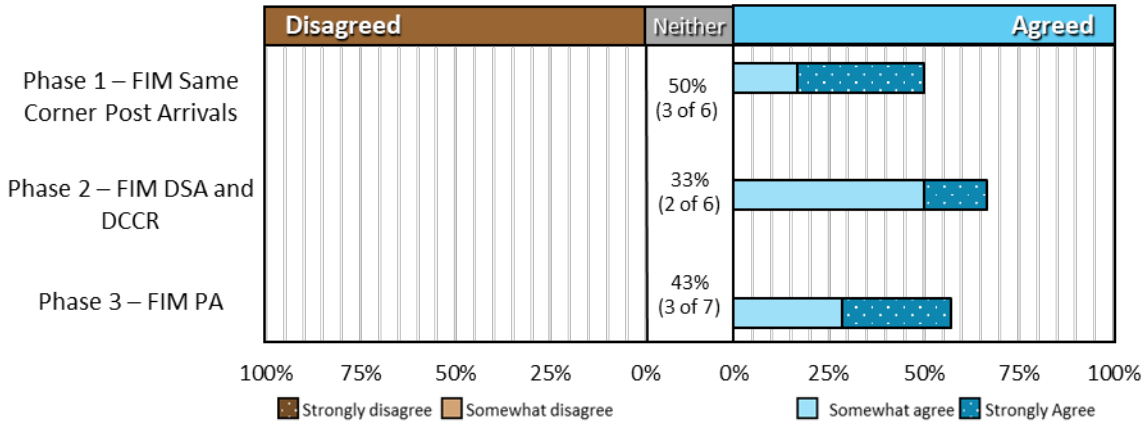


Figure 1-5. Response to "My airline is interested in participating in the FAA's operational benefits validation field activities of ADS-B In"

Between Application Comparisons

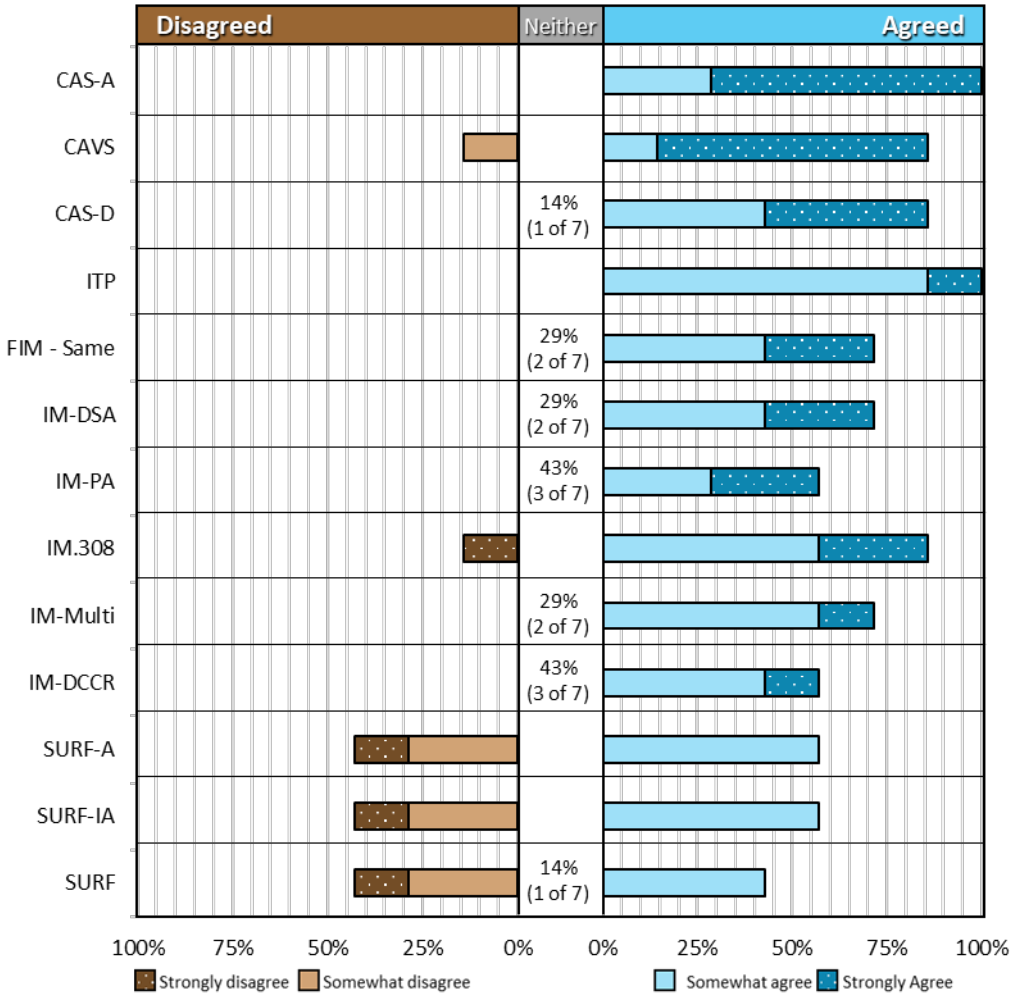


Figure 2-1. Ranked Order Comparison of Responses to "My airline is interested in [application]" by application.

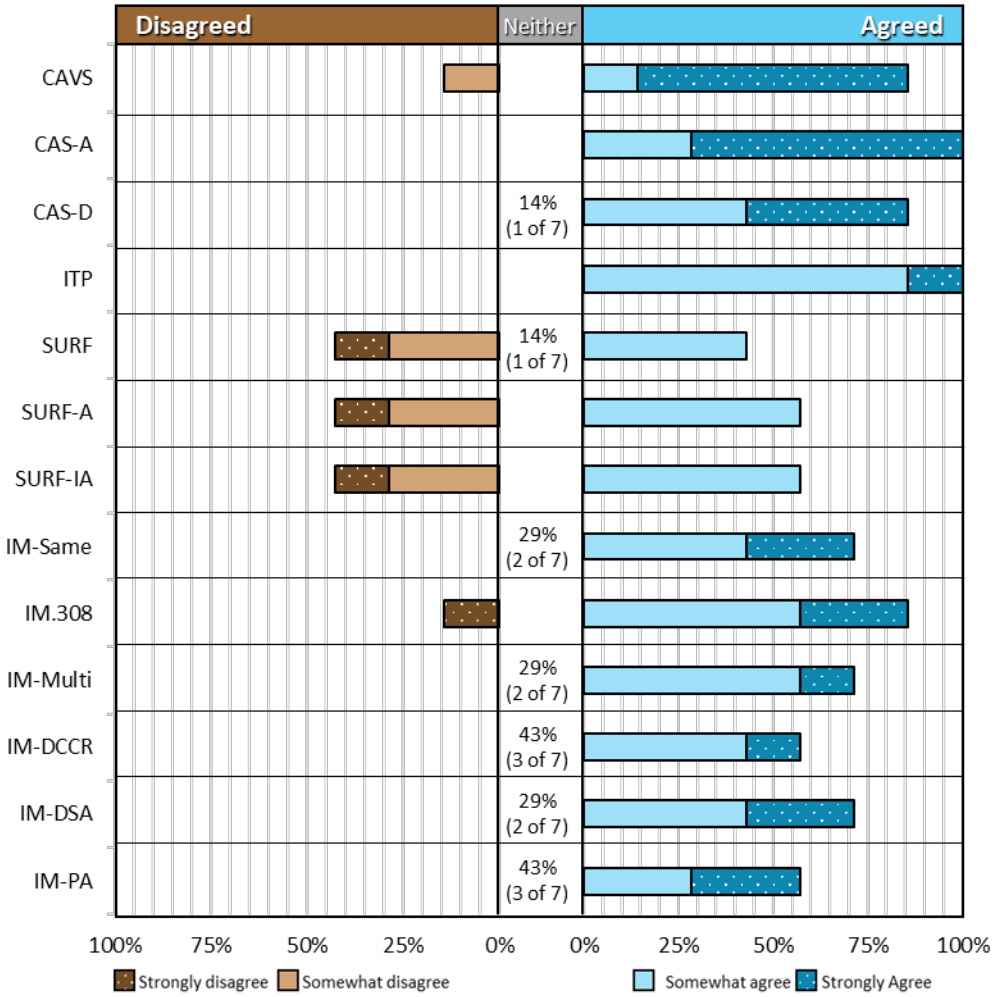
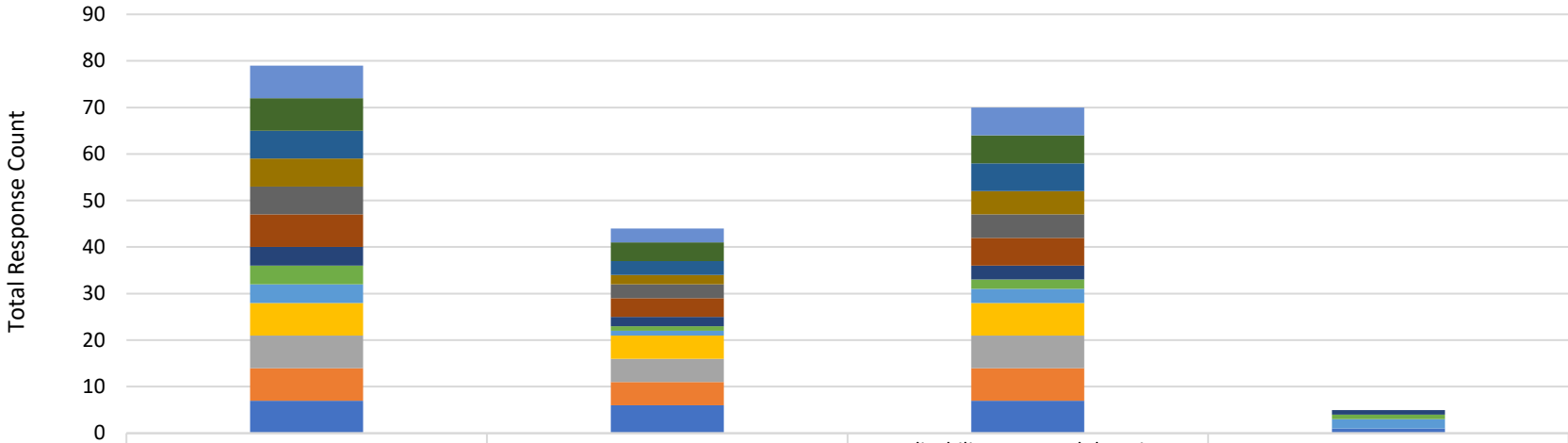
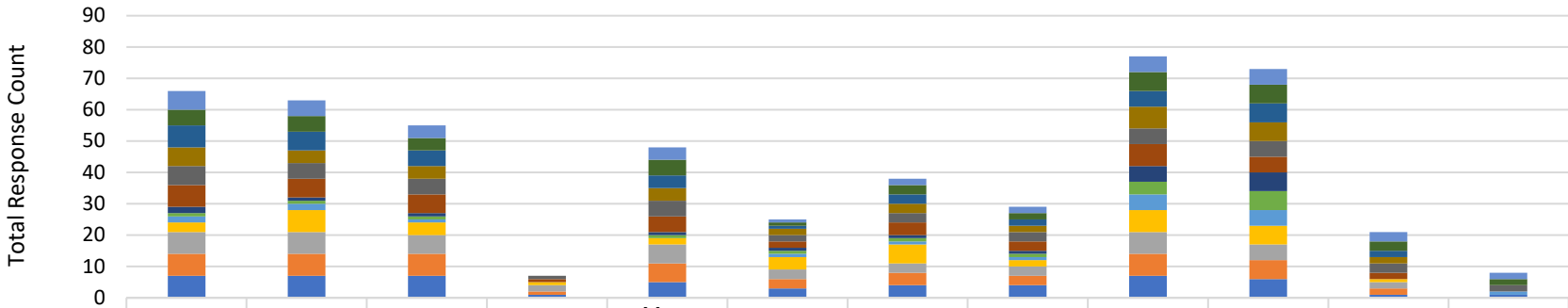


Figure 2-2. Comparison of responses to "My airline is interested in [application]" by application.



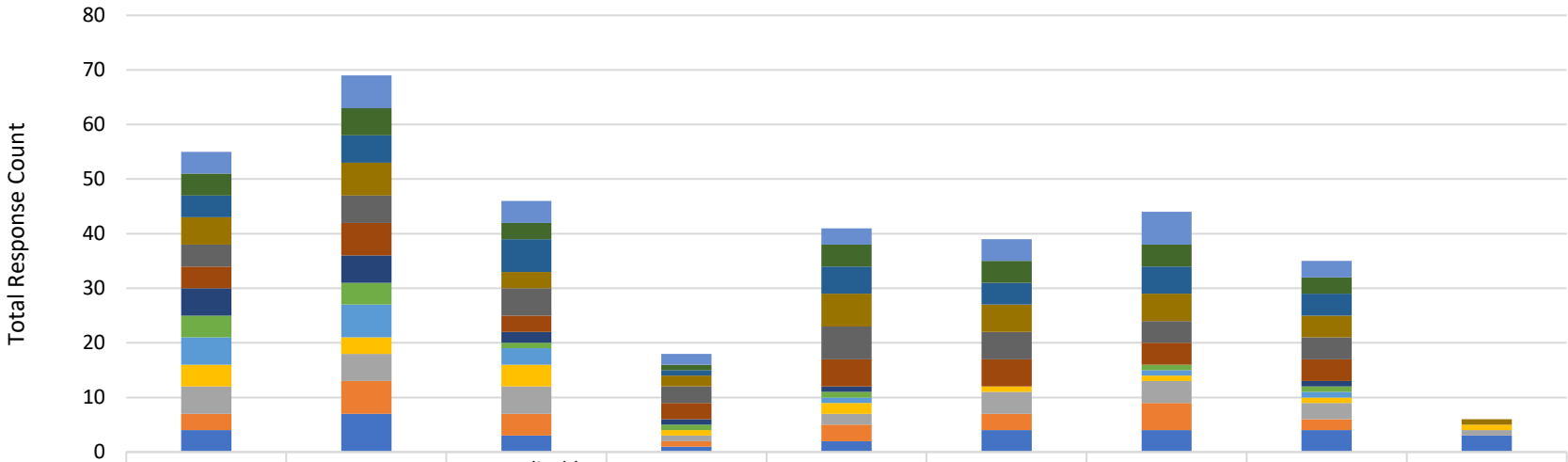
	Benefits	Low Cost	Applicability at enough locations where we operate	Other
IM-PA	7	3	6	0
IM-DSA	7	4	6	0
IM-DCCR	6	3	6	0
IM-Multi	6	2	5	0
IM.308	6	3	5	0
IM-Same	7	4	6	0
SURF-IA	4	2	3	1
SURF-A	4	1	2	1
SURF	4	1	3	2
ITP	7	5	7	0
CAS-D	7	5	7	0
CAS-A	7	5	7	0
CAVS	7	6	7	1

Figure 2-3. Comparison of responses to "What is it about [application] that interests your airline?" by application.



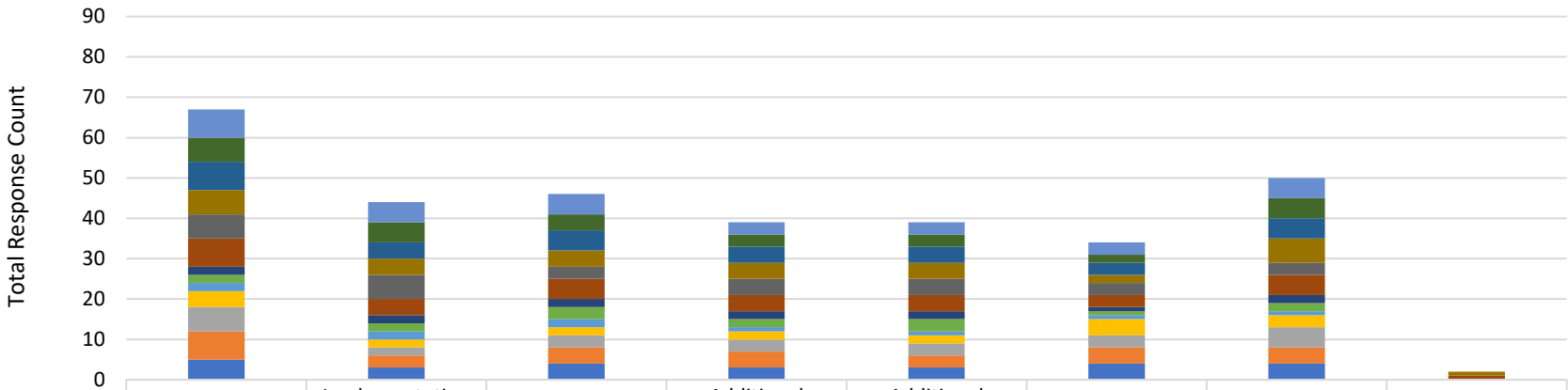
	Increased capacity/throughput	Reduced fuel burn	Reduced time in air	Reduced gate time	More predictable block times leading to schedule improvements	Reduced communications	Increased flexibility	Increased access	Increased pilot traffic awareness	Increased safety	Increased passenger satisfaction	Other
IM-PA	6	5	4	0	4	1	2	2	5	5	3	2
IM-DSA	5	5	4	0	5	1	3	2	6	6	3	2
IM-DCCR	7	6	5	0	4	1	3	2	5	6	2	0
IM-Multi	6	4	4	0	4	2	3	2	7	6	2	0
IM.308	6	5	5	1	5	2	3	3	5	5	3	2
IM-Same	7	6	6	1	5	2	4	3	7	5	2	0
SURF-IA	2	1	1	0	1	1	1	1	5	6	0	0
SURF-A	1	1	1	0	1	1	1	1	4	6	0	0
SURF	2	2	1	0	0	1	1	1	5	5	0	1
ITP	3	7	4	1	2	4	6	2	7	6	1	0
CAS-D	7	7	6	2	6	3	3	3	7	5	2	0
CAS-A	7	7	7	1	6	3	4	3	7	6	2	0
CAVS	7	7	7	1	5	3	4	4	7	6	1	1

Figure 2-4. Comparison of responses to "Describe how your airline believes [application] can bring benefit to your operation." by application.



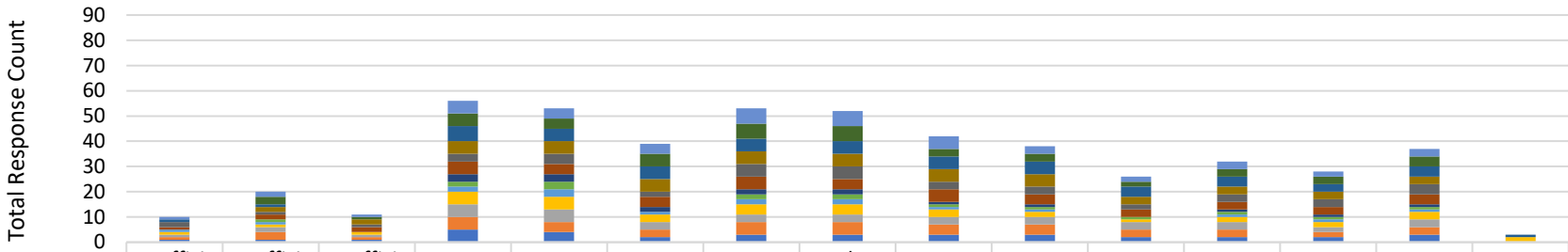
	Benefits	Cost	Not applicable at enough locations where we operate	General concept	Concept complexity	Necessary procedural changes	Necessary controller automation	Training Cost	Other
IM-PA	4	6	4	2	3	4	6	3	0
IM-DSA	4	5	3	1	4	4	4	3	0
IM-DCCR	4	5	6	1	5	4	5	4	0
IM-Multi	5	6	3	2	6	5	5	4	1
IM.308	4	5	5	3	6	5	4	4	0
IM-Same	4	6	3	3	5	5	4	4	0
SURF-IA	5	5	2	1	1	0	0	1	0
SURF-A	4	4	1	1	1	0	1	1	0
SURF	5	6	3	0	1	0	1	1	0
ITP	4	3	4	1	2	1	1	1	1
CAS-D	5	5	5	1	2	4	4	3	1
CAS-A	3	6	4	1	3	3	5	2	0
CAVS	4	7	3	1	2	4	4	4	3

Figure 2-5. Comparison of responses to "What is it about [application] that concerns your airline?" by application.



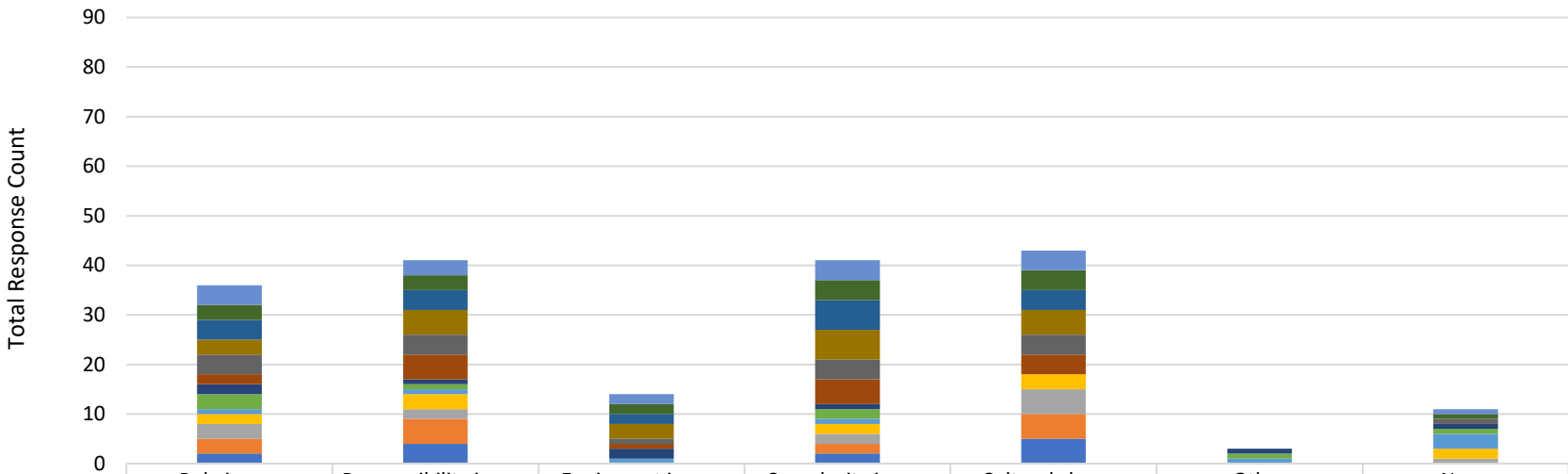
	Solidification of FAA commitments	Implementation of a two-rate Ground Delay Program (GDP)	Additional information on avionics costs	Additional information on installation and training costs	Additional information on flight deck integration	Other airline investment	Additional field demonstration data	Other
IM-PA	7	5	5	3	3	3	5	0
IM-DSA	6	5	4	3	3	2	5	0
IM-DCCR	7	4	5	4	4	3	5	0
IM-Multi	6	4	4	4	4	2	6	1
IM.308	6	6	3	4	4	3	3	0
IM-Same	7	4	5	4	4	3	5	1
SURF-IA	2	2	2	2	2	1	2	0
SURF-A	2	2	3	2	3	1	2	0
SURF	2	2	2	1	1	1	1	0
ITP	4	2	2	2	2	4	3	0
CAS-D	6	2	3	3	3	3	5	0
CAS-A	7	3	4	4	3	4	4	0
CAVS	5	3	4	3	3	4	4	0

Figure 2-6. Comparison of responses to "If your airline is interested in [application], are there contingencies on an investment?" by application.



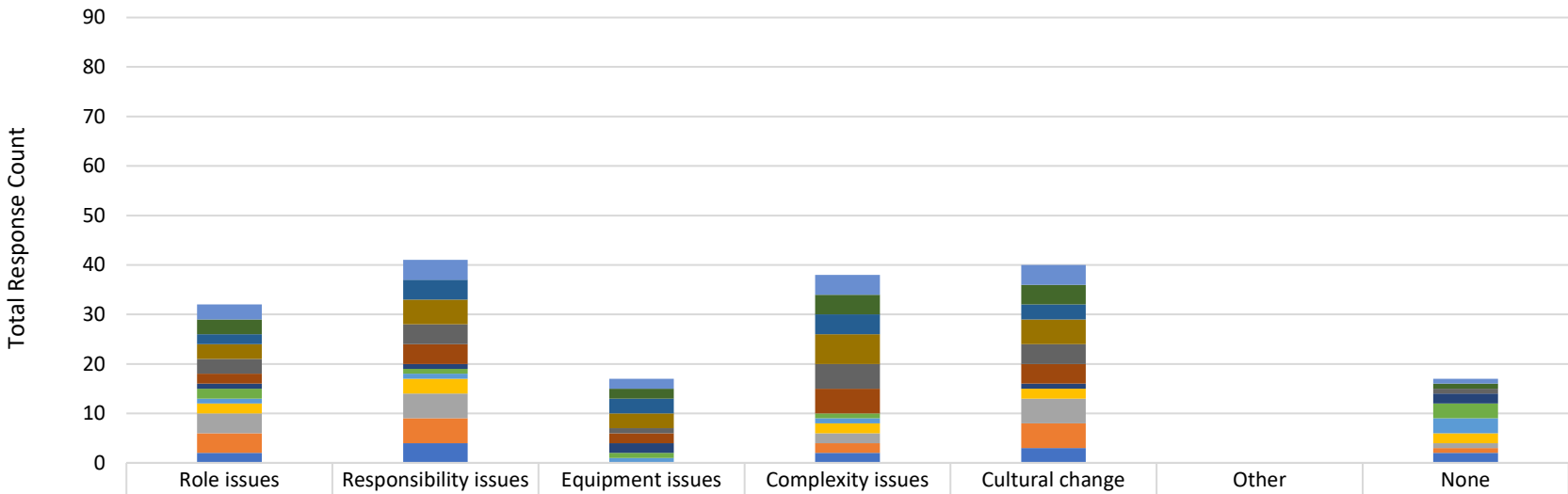
	Insufficient understanding of the ADS-B In application concepts	Insufficient understanding of the ADS-B In application benefits	Insufficient understanding of technical changes necessary on the aircraft	Insufficient funds	Lack of benefits data	Lack of field demonstration data	Unclear FAA commitments on automation investments	Unclear FAA commitments on necessary procedural changes	Lack of information on avionics costs	Lack of information on avionics installation requirements	Pilot acceptability issues	Controller acceptability issues	Lack of knowledge of the future operation of the airline	Training costs	Other
IM-PA	1	2	1	5	4	4	6	6	5	3	2	3	2	3	0
IM-DSA	0	3	1	5	4	5	6	6	3	3	2	3	3	4	0
IM-DCCR	1	1	0	6	5	5	5	5	5	5	4	4	3	4	1
IM-Multi	0	2	2	5	5	5	5	5	5	5	3	3	3	3	0
IM.308	2	1	1	3	4	2	5	5	3	3	2	3	3	4	0
IM-Same	1	2	2	5	4	4	5	4	5	4	3	3	3	4	0
SURF-IA	0	0	0	3	3	2	2	2	1	1	0	1	1	1	0
SURF-A	0	1	0	2	3	0	2	2	1	1	1	1	1	1	0
SURF	1	1	0	2	3	1	2	2	1	1	0	1	1	1	0
ITP	1	1	1	5	5	3	4	4	3	2	1	2	2	3	2
CAS-D	1	2	1	5	5	3	3	3	3	3	3	3	2	3	0
CAS-A	1	3	1	5	4	3	5	5	4	4	3	3	2	3	0
CAVS	1	1	1	5	4	2	3	3	3	3	2	2	2	3	0

Figure 2-7. Comparison of responses to "If your airline is interested but not willing to commit to an investment in [application, what barriers could be removed to incentivize your airline to invest?" by application.



	Role issues	Responsibility issues	Equipment issues	Complexity issues	Cultural change	Other	None
IM-PA	4	3	2	4	4	0	1
IM-DSA	3	3	2	4	4	0	1
IM-DCCR	4	4	2	6	4	0	0
IM-Multi	3	5	3	6	5	0	0
IM.308	4	4	1	4	4	0	1
IM-Same	2	5	1	5	4	0	0
SURF-IA	2	1	2	1	0	1	1
SURF-A	3	1	0	2	0	1	1
SURF	1	1	1	1	0	1	3
ITP	2	3	0	2	3	0	2
CAS-D	3	2	0	2	5	0	1
CAS-A	3	5	0	2	5	0	0
CAVS	2	4	0	2	5	0	0

Figure 2-8. Comparison of responses to "What barriers related to [application] do you see from a pilot's perspective that would need to be addressed?" by application.



	Role issues	Responsibility issues	Equipment issues	Complexity issues	Cultural change	Other	None
IM-PA	3	4	2	4	4	0	1
IM-DSA	3	0	2	4	4	0	1
IM-DCCR	2	4	3	4	3	0	0
IM-Multi	3	5	3	6	5	0	0
IM.308	3	4	1	5	4	0	1
IM-Same	2	4	2	5	4	0	0
SURF-IA	1	1	2	0	1	0	2
SURF-A	2	1	1	1	0	0	3
SURF	1	1	1	1	0	0	3
ITP	2	3	0	2	2	0	2
CAS-D	4	5	0	2	5	0	1
CAS-A	4	5	0	2	5	0	1
CAVS	2	4	0	2	3	0	2

Figure 2-9. Comparison of responses to "What barriers related to [application] do you see from an air traffic controller's perspective that would need to be addressed?" by application.

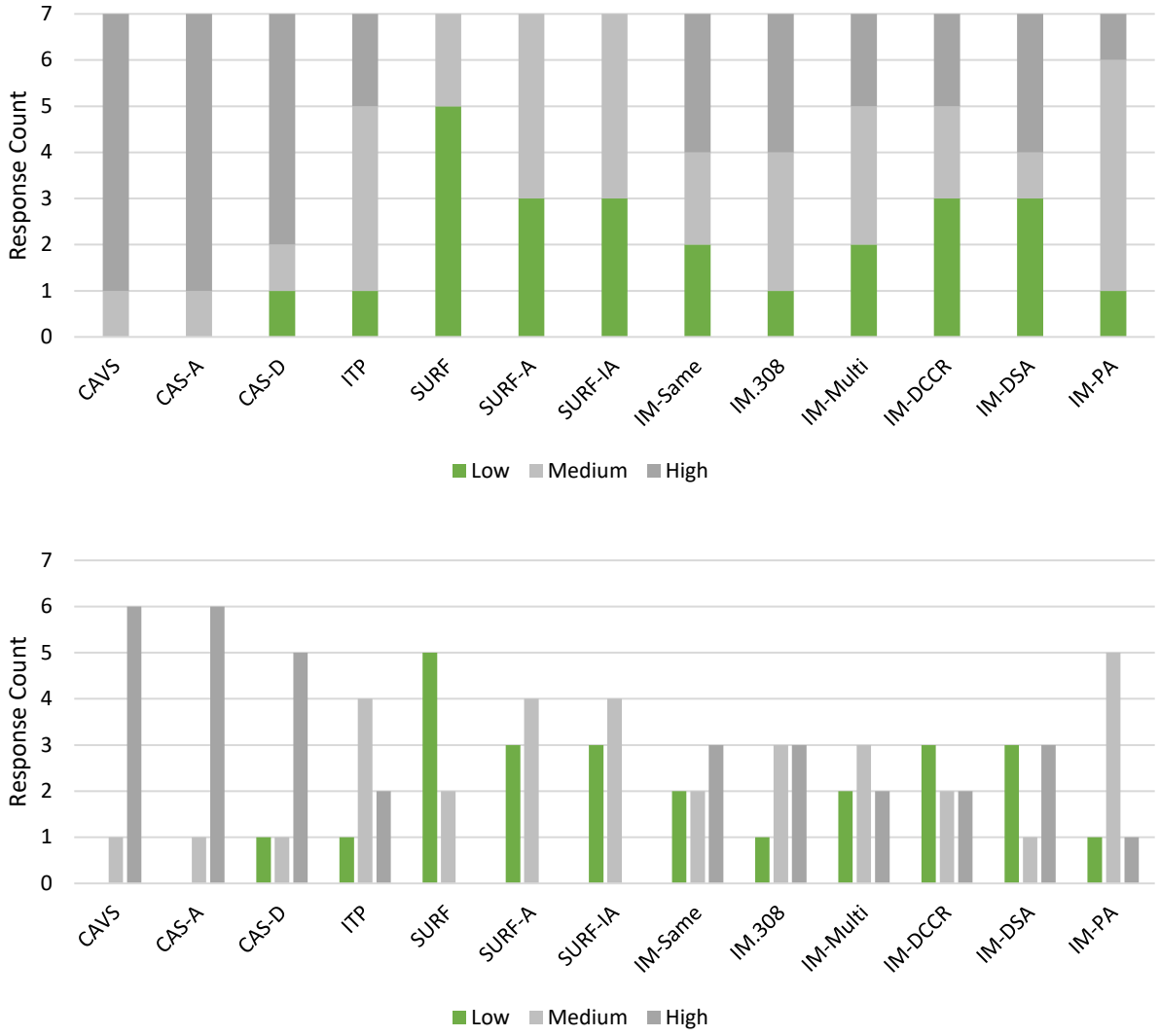


Figure 2-10. Ranked Order Comparison of responses to "Rate your priority for [application] amongst the set of ADS-B In applications." by application.

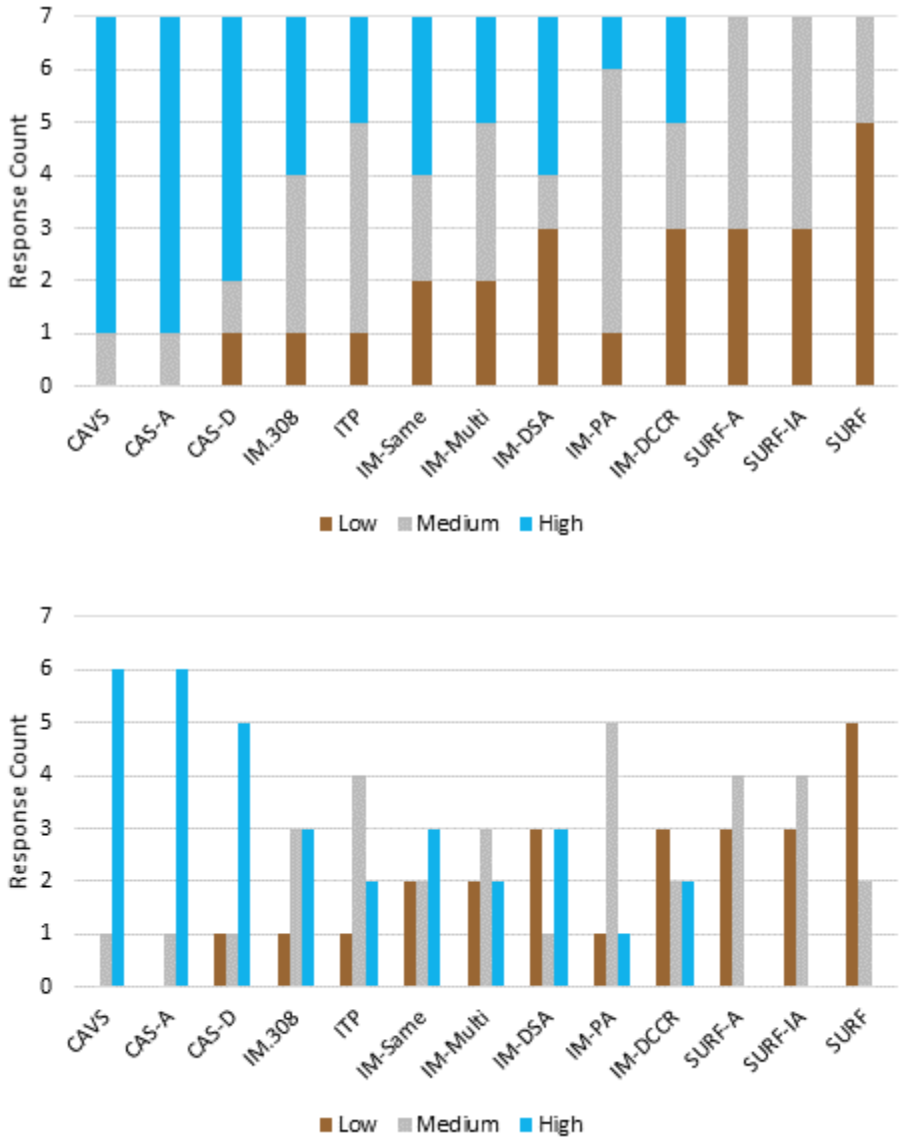


Figure 2-11. Comparison of responses to "Rate your priority for [application] amongst the set of ADS-B In applications." by application.

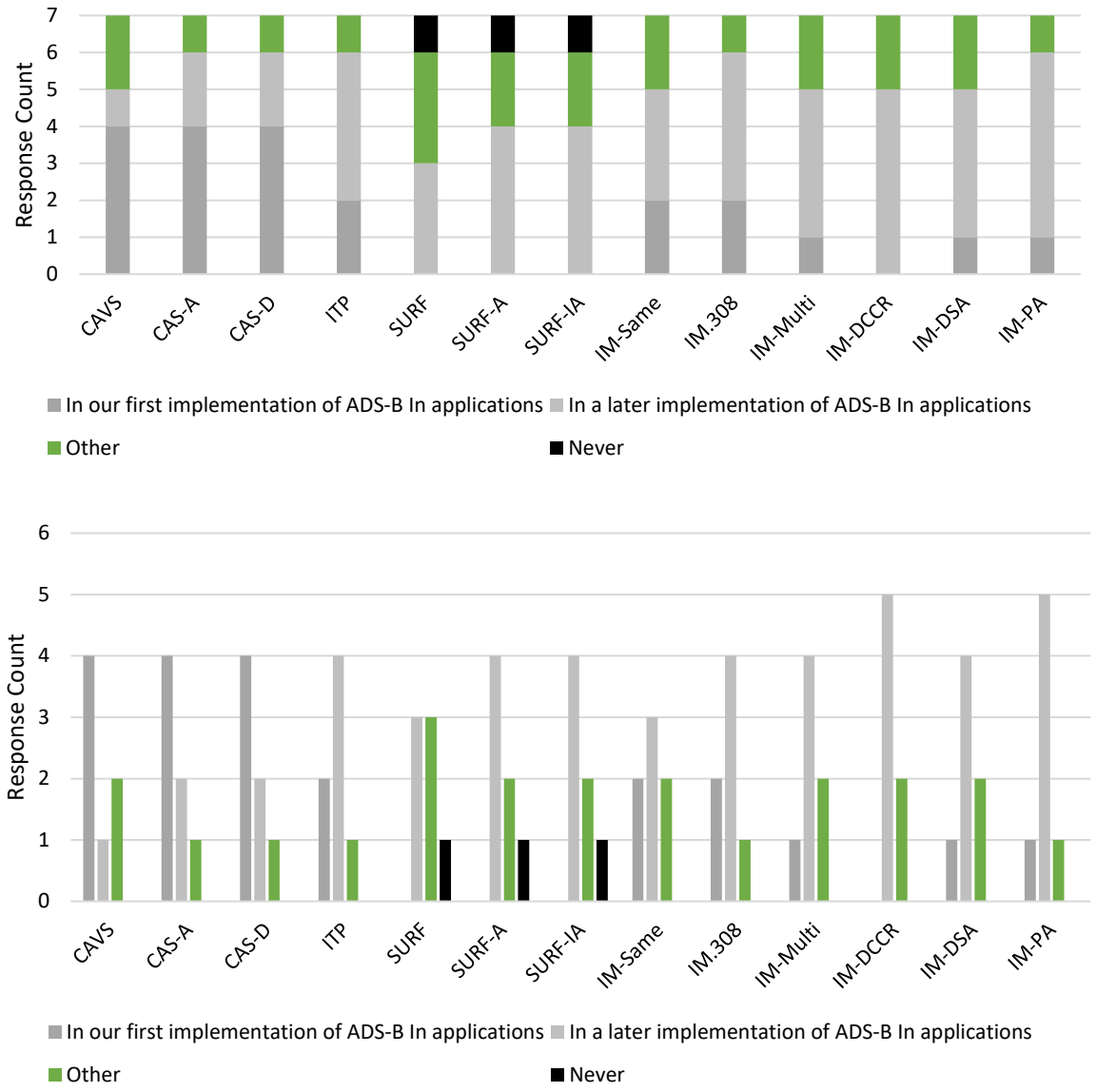


Figure 2-12. Comparison of responses to "When would your airline expect to equip with [application]" by application.

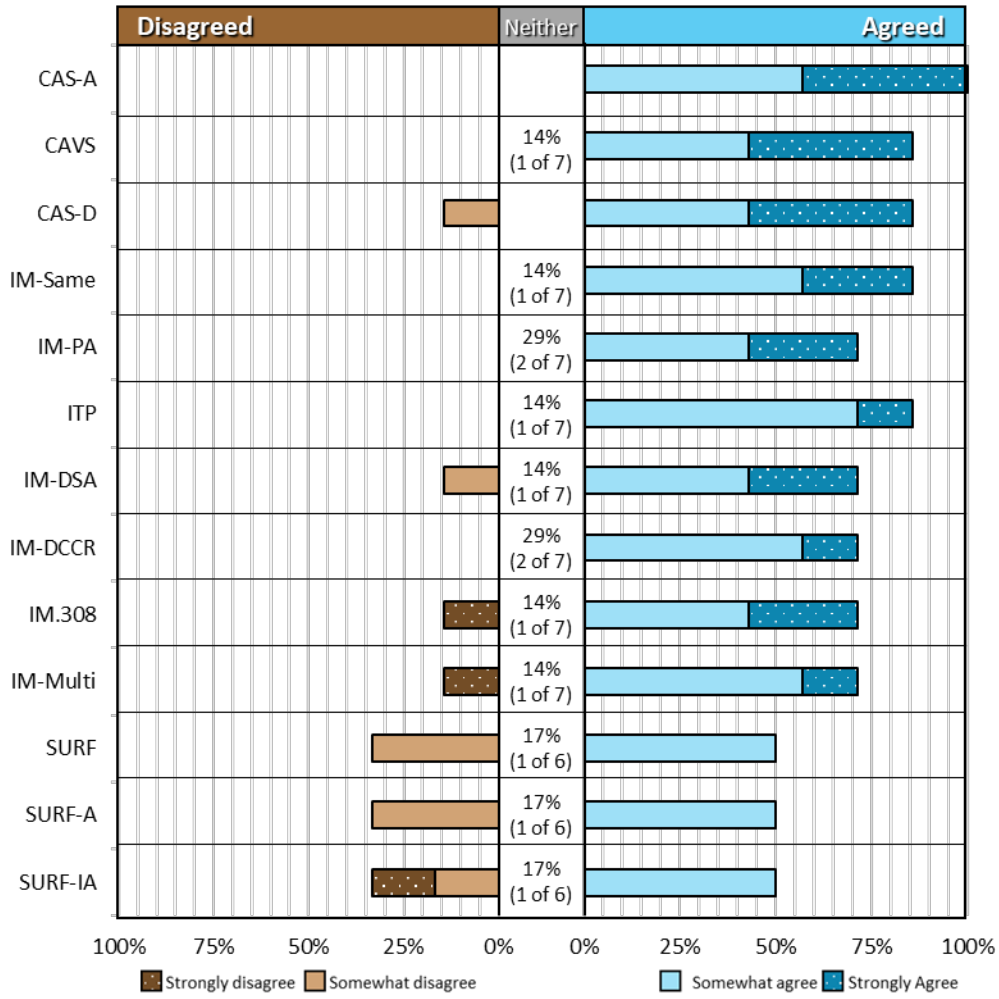


Figure 2-13. Comparison of responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in [application]" by application.

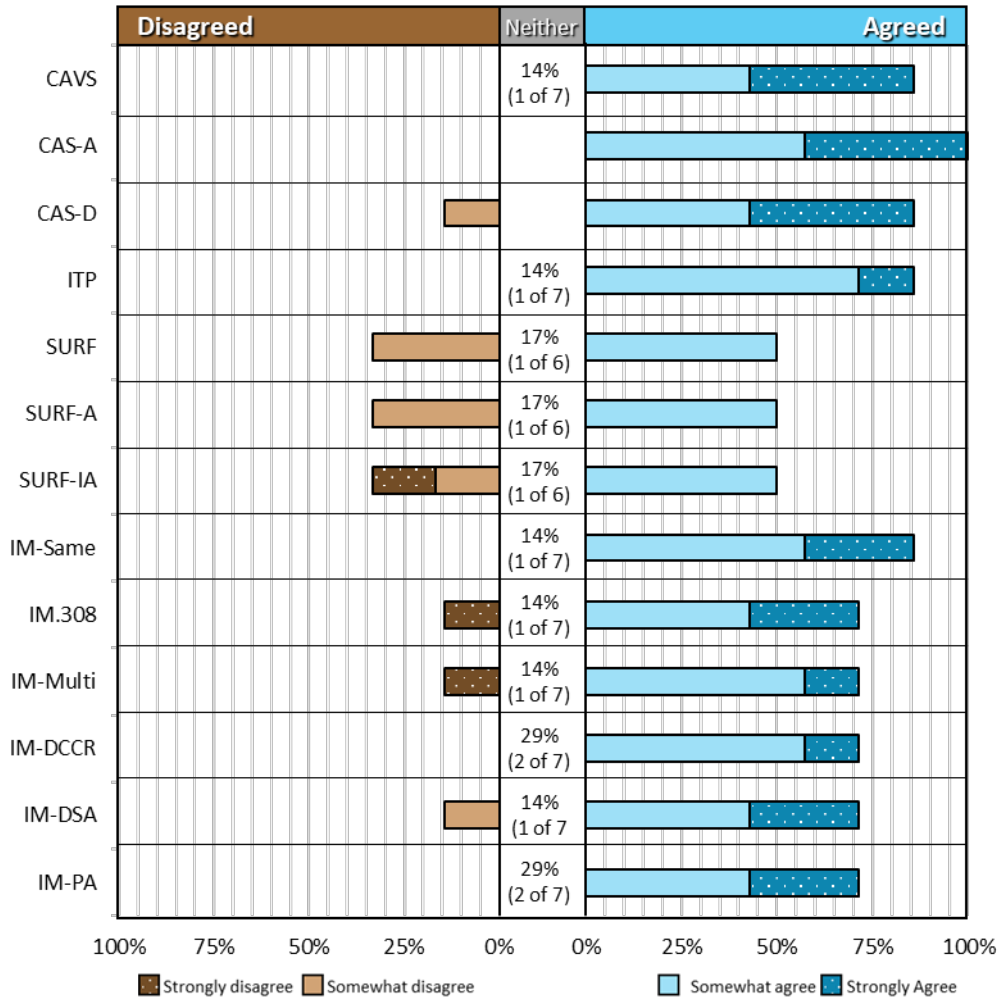


Figure 2-14. Comparison of Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in [application]" by application.

Q.2.Airline Comments

- Willing... I must have missed this discussion and any reqd [sic] qualifications... still unclear as to PA app benefit at our airline
- Paired approach is intriguing, with potential benefits. We have several concerns on the FAA side of the investment (timing is many, many years away) and on the operational acceptability of the concept with air traffic controllers. Would need to see firmer commitment from NATCA.
- Overall, our airline believes there is some ROI potential for CAS, ITP and FIM (IM.308 and PA)
- Development of standards and implementation at a critical mass of operational airports.

CDTI-Assisted Visual Separation (CAVS)

QA.3. My airline is interested in CAVS.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	1	14%
Neither	0	0%
Somewhat Agree	1	14%
Agree	0	0%
Strongly Agree	5	71%
N	7	
% Agreement	6	86%
% Disagreement	1	14%

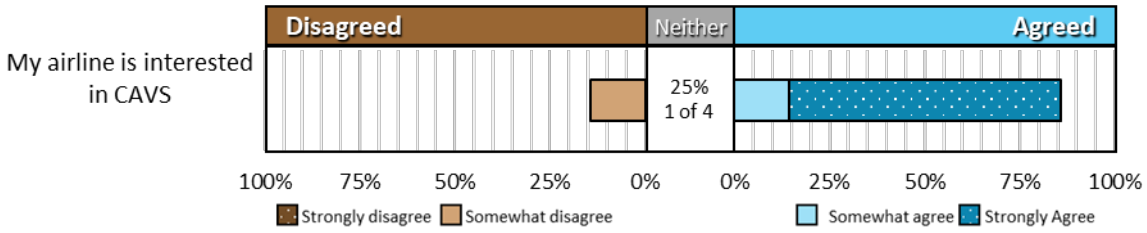


Figure A-1. Responses to "My airline is interested in CAVS."

QA.4. Rate your priority for CAVS amongst the set of ADS-B In applications.

	Count	Percentage
Low	0	0%
Medium	1	14%
High	6	86%
N	7	

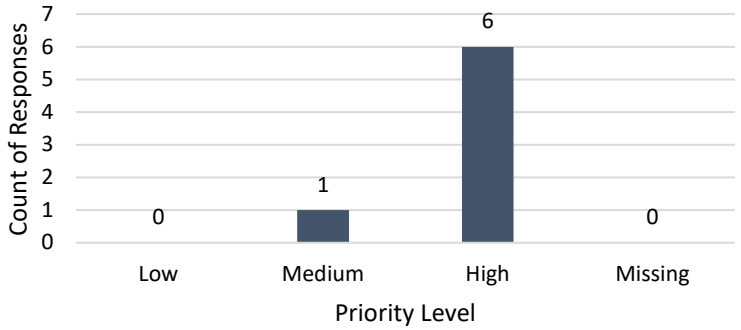


Figure A-2. Responses to "Rate your priority for CAVS amongst the set of ADS-B In applications."

QA.4.Airline Comments

- Prelim FAA cost-benefit analysis appears to be extremely favorable to our operation
- Our priorities are based primarily on the maturity of the concept (thus highest likelihood that the concept may actually be implemented), and the likelihood that the application will be applicable in northeast within a planned investment timeframe.
- Rated medium in case CAS didnt [sic] work out, CAVS may move to a higher priority
- It is key to our benefits case being an already approved application.

QA.5. What is it about CAVS that interests your airline?

	Primary	Secondary	No Interest
Benefits	6	1	0
Low Cost	1	5	0
Applicability at enough locations where we operate	7	0	0
Other	1	0	0
Nothing interests	0		
N	7		

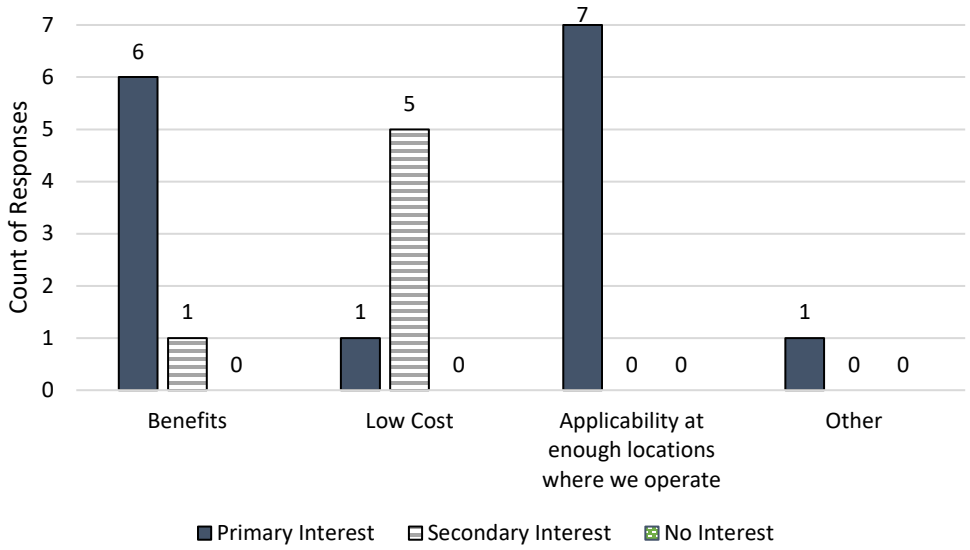


Figure A-3. Responses to "What is it about CAVS that interests your airline?"

QA.5.Airline Comments

- Reduce variability in visual ops

QA.6. Describe how your airline believes CAVS can bring benefit to your operation.

Increased capacity/throughput	5	71%	2	29%	0	0%	0	0%
Reduced fuel burn	3	43%	4	57%	0	0%	0	0%
Reduced time in air	4	57%	3	43%	0	0%	0	0%
Reduced gate time	0	0%	1	14%	1	14%	4	57 %
More predictable block times leading to schedule improvements	3	43%	2	29%	0	0%	1	14 %
Reduced communications	0	0%	3	43%	1	14%	2	29 %
Increased flexibility	0	0%	4	57%	1	14%	1	14 %
Increased access	1	14%	3	43%	2	29%	0	0%
Increased pilot traffic awareness	4	57%	3	43%	0	0%	0	0%
Increased safety	4	57%	2	29%	0	0%	0	0%
Increased passenger satisfaction	0	0%	1	14%	3	43%	2	29 %
Other	1	14%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

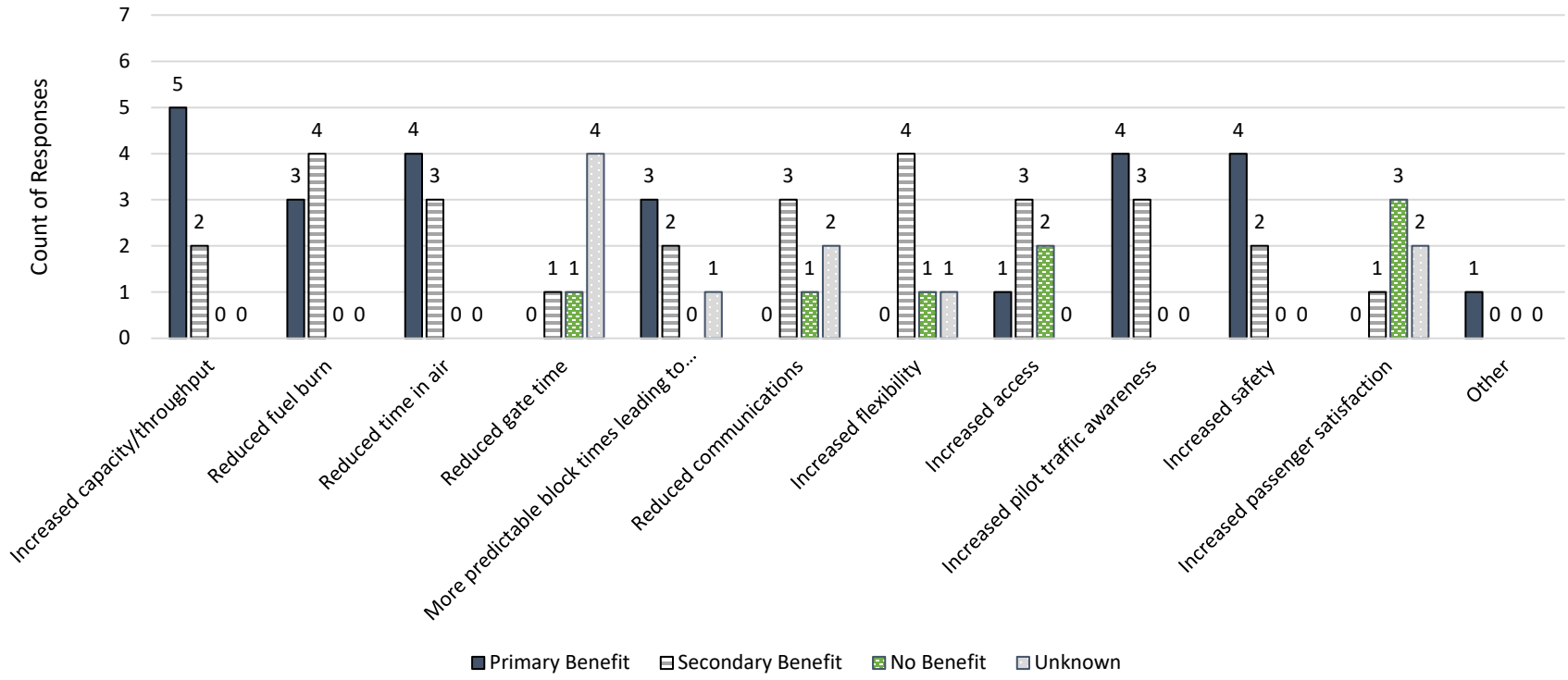


Figure A-4. Responses to "Describe how your airline believes CAVS can bring benefit to your operation."

QA.6.Airline Comments

- Reduced go arounds
- Potential benefits to the larger operation in efficiency and throughput have yet to be more precisely determined, although it is generally recognized it will be beneficial
- Predictability of benefit (as it relates to block time) is important, however, it is expected that the benefit for us will be limited, therefore it is unlikely that we could say that this will help us tighten block. If that can be proved [sic], it would be very valuable.

QA.7. What is it about CAVS that concerns your airline?

Benefits	2	29%	2	29%	2	29%
Cost	3	43%	4	57%	0	0%
Not applicable at enough locations where we operate	3	43%	0	0%	3	43%
General concept	1	14%	0	0%	5	71%
Concept complexity	1	14%	1	14%	4	57%
Necessary procedural changes	1	14%	3	43%	2	29%
Necessary controller automation	1	14%	3	43%	2	29%
Training Cost	1	14%	3	43%	3	43%
Other	3	43%	0	0%	0	0%
No concerns	0	0%				
N	7					

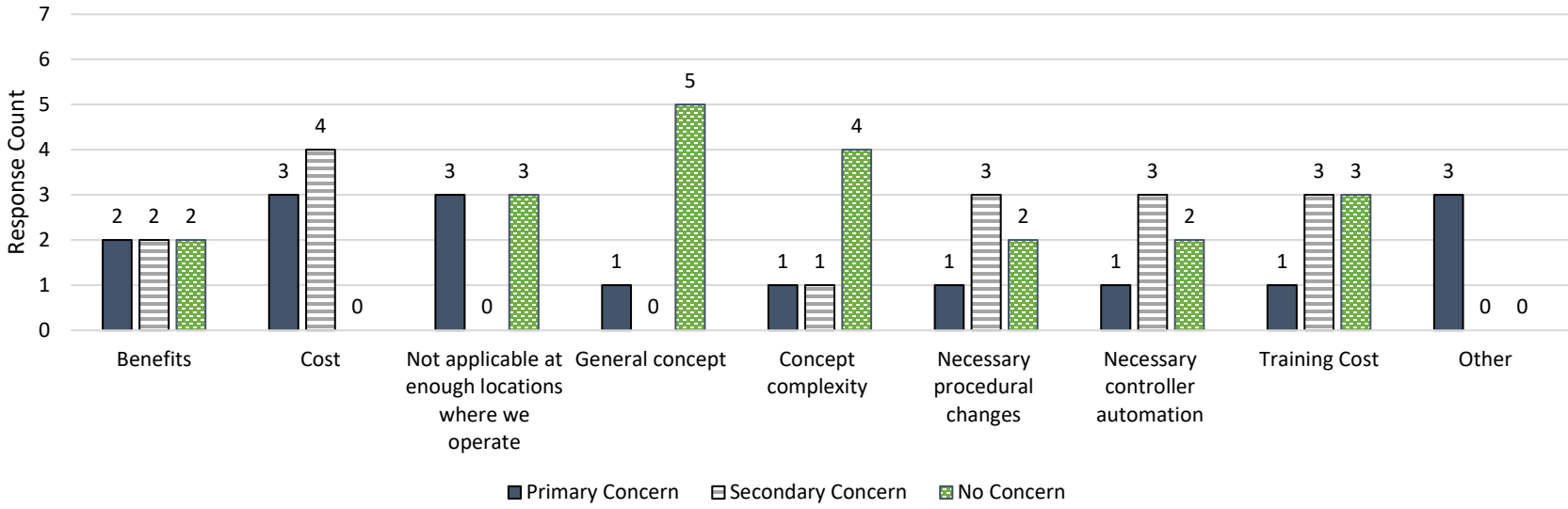


Figure A-5. Responses to "What is it about CAVS that concerns your airline?"

QA.7.Airline Comments

- Availability of Airbus solution
- We believe the benefits are better driven by CAS
- Airbus does not have SW solution yet, and we are not interested in 3rd party SW solution. Also, there are no current reliable plans to use this in the northeast.
- We believe a key element to the benefit is ATC allowing us to turn from downwind to base at our discretion to follow traffic on a straight in final. This is not the case at many airports today.

QA.8. If your airline is interested in CAVS, are there contingencies on an investment?

Solidification of FAA commitments	5	71%	0	0%	1	14%
Implementation of a two-rate Ground Delay Program (GDP)	1	14%	2	29%	3	43%
Additional information on avionics costs	2	29%	2	29%	2	29%
Additional information on installation and training costs	2	29%	1	14%	3	43%
Additional information on flight deck integration	2	29%	1	14%	3	43%
Other airline investment	1	14%	3	43%	2	29%
Additional field demonstration data	3	43%	1	14%	3	43%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
N	7					

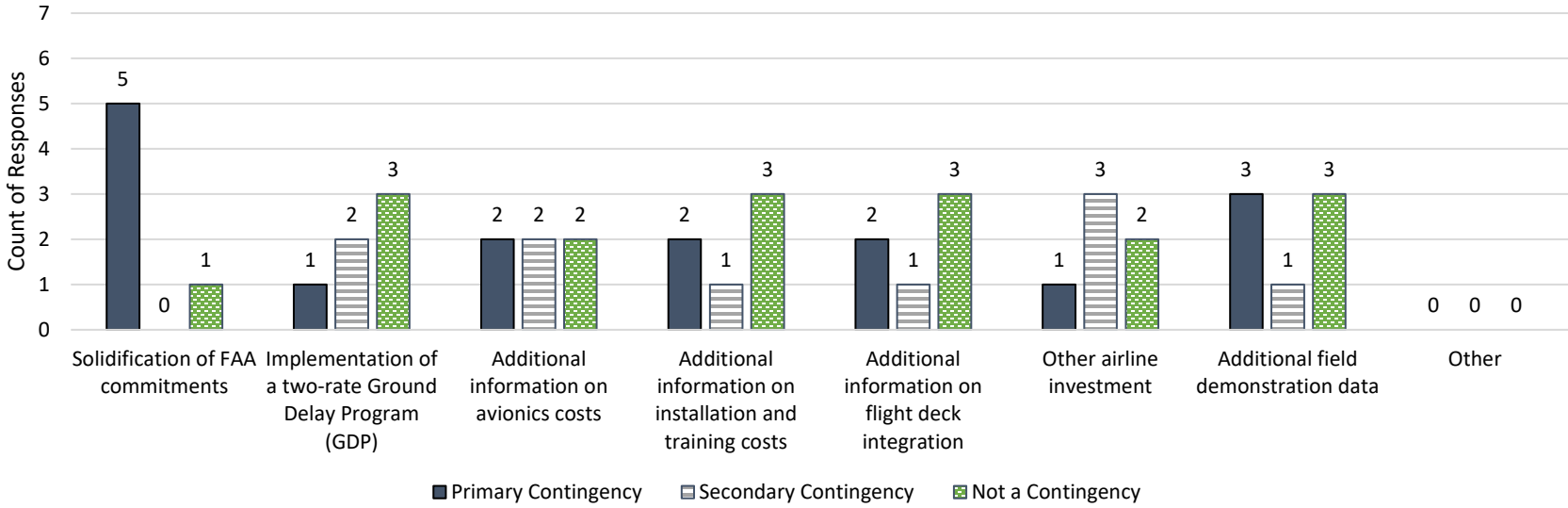


Figure A-6. Responses to "If your airline is interested in CAVS, are there contingencies on an investment?"

QA.8.Airline Comments

- Please consider my response to two-rate GDP as "uninformed" vs "disinterested." I don't recall this discussion.
- We believe a key element to the benefit is ATC allowing us to turn from downwind to base at our discretion to follow traffic on a straight in final. This is not the case at many airports today. Additional field demonstration data will be gathered during our trial.

QA.9. If your airline is interested but not willing to commit to an investment in CAVS, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	17%	4	67%
Insufficient understanding of the ADS-B In application benefits	0	0%	1	17%	4	67%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	17%	4	67%
Insufficient funds	3	50%	2	33%	1	17%
Lack of benefits data	2	33%	2	33%	2	33%
Lack of field demonstration data	2	33%	0	0%	3	50%
Unclear FAA commitments on automation investments	3	50%	0	0%	2	33%
Unclear FAA commitments on necessary procedural changes	2	33%	1	17%	2	33%
Lack of information on avionics costs	1	17%	2	33%	2	33%
Lack of information on avionics installation requirements	1	17%	2	33%	2	33%
Pilot acceptability issues	0	0%	2	33%	3	50%
Controller acceptability issues	2	33%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	2	33%	3	50%
Training costs	1	17%	2	33%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

Appendix E: Mainline Operator Questionnaire De-identified Responses

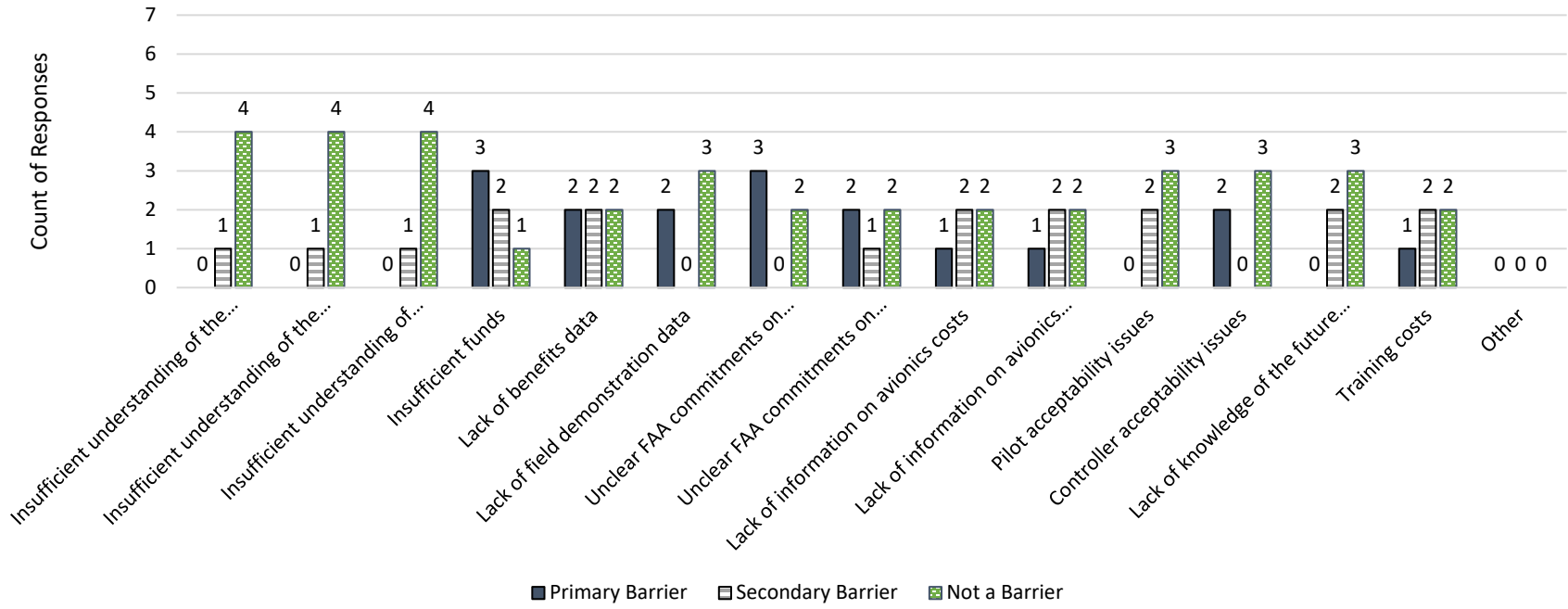


Figure A-7. Responses to "If your airline is interested but not willing to commit to an investment in CAVS, what barriers could be removed to incentivize your airline to invest?"

QA.9.Airline Comments

- FAA commitment is major barrier, especially FAA commitment to use the application in our operating areas.

QA.10. What barriers related to CAVS do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	29%
Responsibility issues	4	57%
Equipment issues	0	0%
Complexity issues	2	29%
Cultural change	5	71%
Other	0	0%
None	0	0%
N	7	

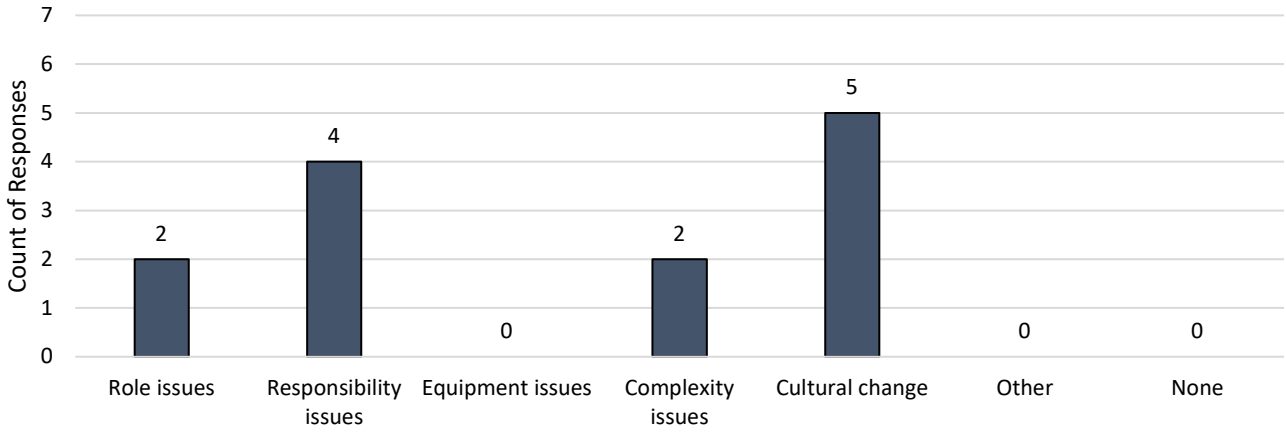


Figure A-8. Responses to "What barriers related to CAVS do you see from a line pilot's perspective that would need to be addressed?"

QA.10.Airline Comments

- Pilots will love this!
- This entails a paradigm shift (like when iPads were introduced to the cockpit). The newness will need to addressed [sic].

QA.11. What barriers related to CAVS do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	33%
Responsibility issues	4	67%
Equipment issues	0	0%
Complexity issues	2	33%
Cultural change	3	50%

Other	0	0%
None	2	33%
N	6	

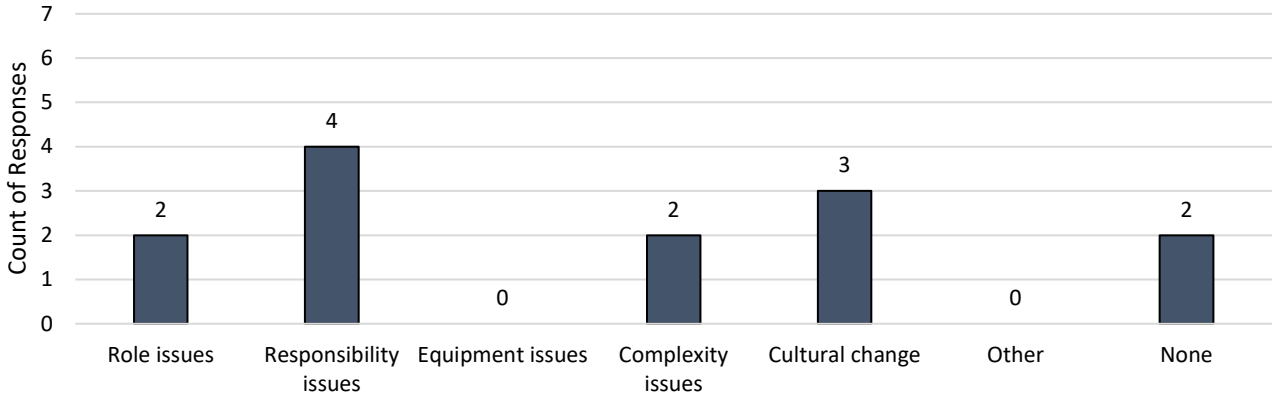


Figure A-9. Responses to "What barriers related to CAVS do you see from an air traffic controller's perspective that would need to be addressed?"

QA.11.Airline Comments

- Unable to discern their concerns
- We believe a key element to the benefit is ATC allowing us to turn from downwind to base at our discretion to follow traffic on a straight in final. This is not the case at many airports today. Because we see CAVS as a flight deck only support tool controllers would do things as they do today.

QA.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in CAVS.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	14%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	3	43%
N	7	
% Agreement	6	86%
% Disagreement	0	0%

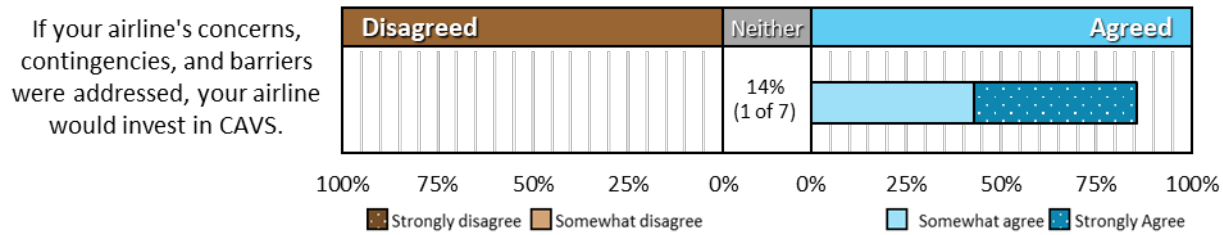


Figure A-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in CAVS."

QA.12.Airline Comments

- '- CAVS application alone would prob not justify investment, but CAVS definitely makes a significant contribution along with other applications.
- Pending additional positive field demonstration data.

QA.13. When would your airline expect to equip with CAVS?

	Count	Percentage
In our first implementation of ADS-B In applications	4	57%
In a later implementation of ADS-B In applications	1	14%
Other	2	29%
Never	0	0%
N	7	

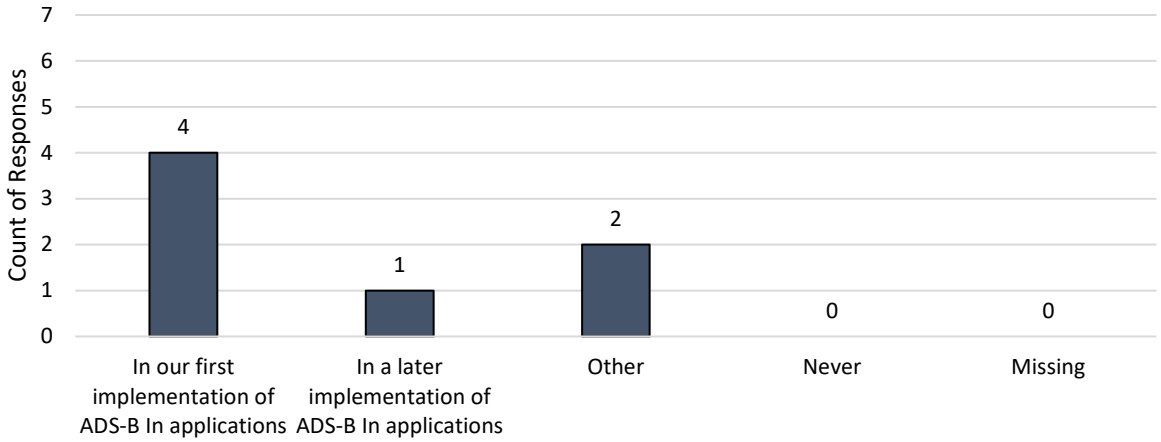


Figure A-11. Responses to "When would your airline expect to equip with CAVS?"

QA.13.Airline Comments

- None

QC.14. Do you have any additional thoughts for the NAC to share with the FAA related to CAVS?

- Might hope to see more universally common applications (CAVS, CAS, FIM same corner) quickly validated by operational data and added to Baseline MCL tab.
- This application appears to be at least 2-3 years away from operational implementation. If the schedule slips, it will erode more faith in the FAA's ability to implement the simplest application.

CDTI-Assisted Separation (CAS) – Approach

QB.3. My airline is interested in CAS - Approach.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	2	29%
Agree	0	0%
Strongly Agree	5	71%
N	7	
% Agreement	7	100%
% Disagreement	0	0%

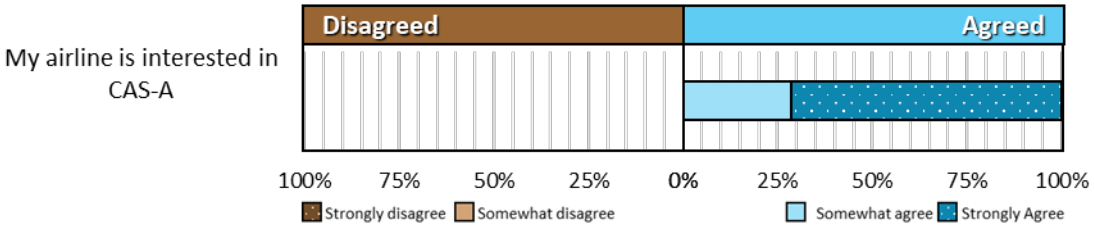


Figure B-1. Responses to "My airline is interested in CAS - Approach."

QB.4. Rate your priority for CAS - Approach amongst the set of ADS-B In applications.

	Count	Percentage
Low	0	0%
Medium	1	14%
High	6	86%
N	7	

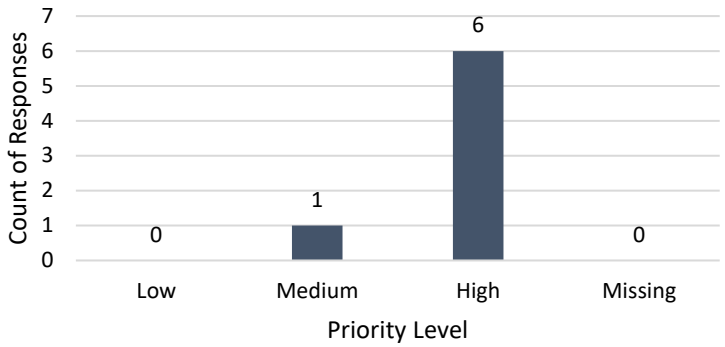


Figure B-2. Responses to "Rate your priority for CAS - Approach amongst the set of ADS-B In applications."

QB.4.Airline Comments

- We believe a key element to the benefit is decreasing track miles, efficient spacing and more predictable throughput.

QB.5. What is it about CAS - Approach that interests your airline?

Benefits	7	100%	0	0%	0	0%
Low Cost	2	29%	3	43%	0	0%
Applicability at enough locations where we operate	7	100%	0	0%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

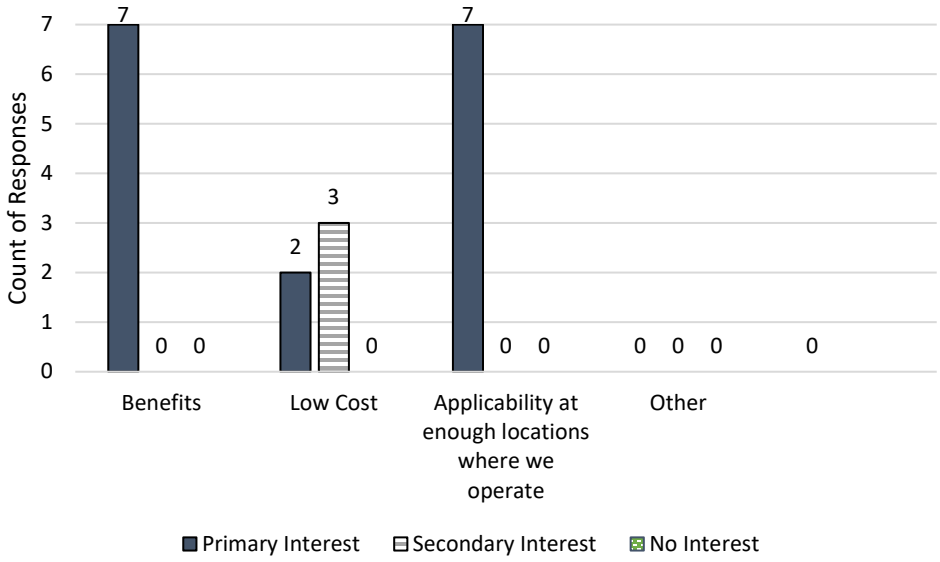


Figure B-3. Responses to "What is it about CAS - Approach that interests your airline?"

QB.5.Airline Comments

- This does not appear to be a low cost option (so cannot say low cost interests us). Location of use will be a primary interest for us.
- We believe a key element to the benefit is ATC allowing us to turn from downwind to base at our discretion to follow traffic on a straight in final. This is not the case at many airports today.

QB.6. Describe how your airline believes CAS - Approach can bring benefit to your operation.

Increased capacity/throughput	7	100%	0	0%	0	0%	0	0%
Reduced fuel burn	3	43%	4	57%	0	0%	0	0%
Reduced time in air	3	43%	4	57%	0	0%	0	0%
Reduced gate time	0	0%	1	14%	1	14%	4	57 %
More predictable block times leading to schedule improvements	5	71%	1	14%	0	0%	1	14 %
Reduced communications	0	0%	3	43%	1	14%	2	29 %
Increased flexibility	1	14%	3	43%	1	14%	1	14 %
Increased access	1	14%	2	29%	2	29%	1	14 %
Increased pilot traffic awareness	4	57%	3	43%	0	0%	0	0%
Increased safety	4	57%	2	29%	0	0%	0	0%
Increased passenger satisfaction	1	14%	1	14%	2	29%	2	29 %
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

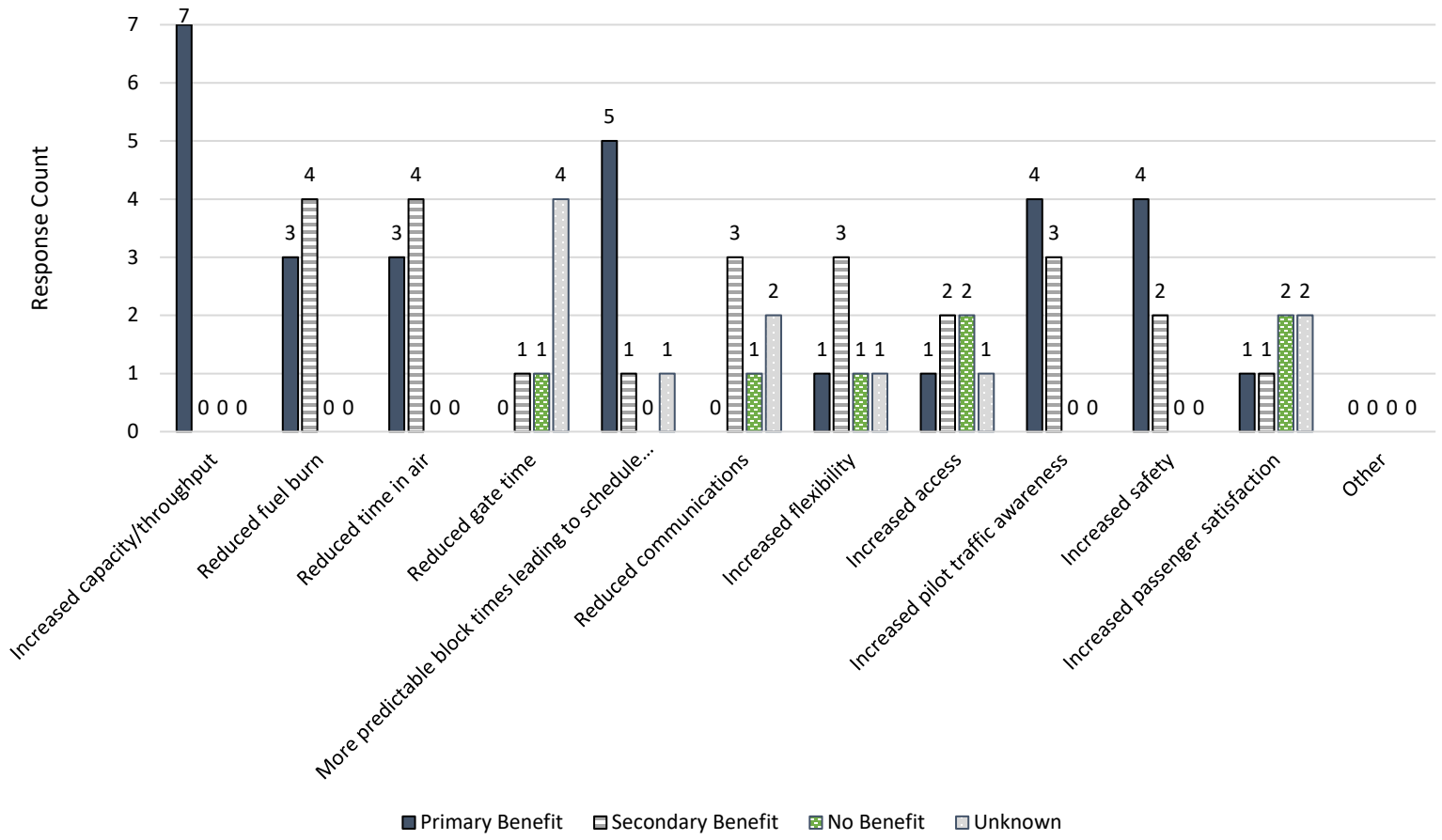


Figure B-4. Responses to "Describe how your airline believes CAS - Approach can bring benefit to your operation."

QB.6.Airline Comments

- At this point, rubber needs to meet the road on if benefits will justify costs. Looking hopeful, but not over til [later].
- AIRS should address our concerns of it being untested in the real world however widespread controller acceptance of CAS is necessary at enough locations we operate.

QB.7. What is it about CAS - Approach that concerns your airline?

Benefits	3	43%	0	0%	2	29%
Cost	4	57%	2	29%	0	0%
Not applicable at enough locations where we operate	4	57%	0	0%	2	29%
General concept	1	14%	0	0%	4	57%
Concept complexity	1	14%	2	29%	2	29%
Necessary procedural changes	2	29%	1	14%	2	29%
Necessary controller automation	5	71%	0	0%	1	14%
Training Cost	1	14%	1	14%	3	43%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

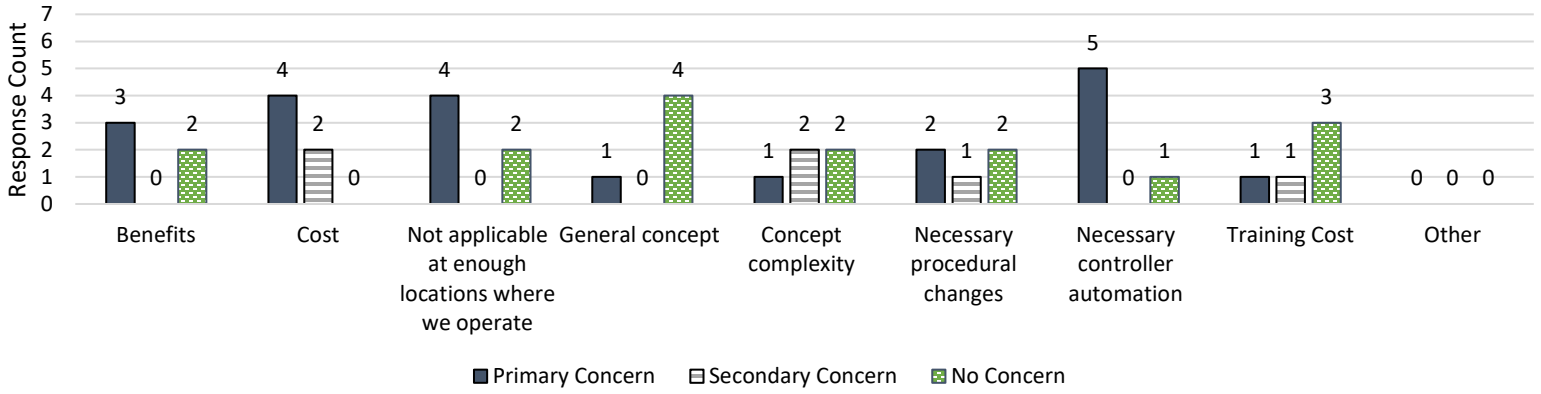


Figure 0-5. Responses to "What is it about CAS - Approach that concerns your airline?"

QB.7.Airline Comments

- '- FAA must follow through on controller automation to enable this application. - Re OAL investment and field demo data: will probably need some operational data to justify investment at our airline

QB.8. If your airline is interested in CAS - Approach, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	1	14%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	1	14%	2	29%	3	43%
Additional information on avionics costs	2	29%	2	29%	2	29%
Additional information on installation and training costs	2	29%	2	29%	3	43%
Additional information on flight deck integration	1	14%	2	29%	3	43%
Other airline investment	1	14%	3	43%	2	29%
Additional field demonstration data	3	43%	1	14%	2	29%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
N	7					

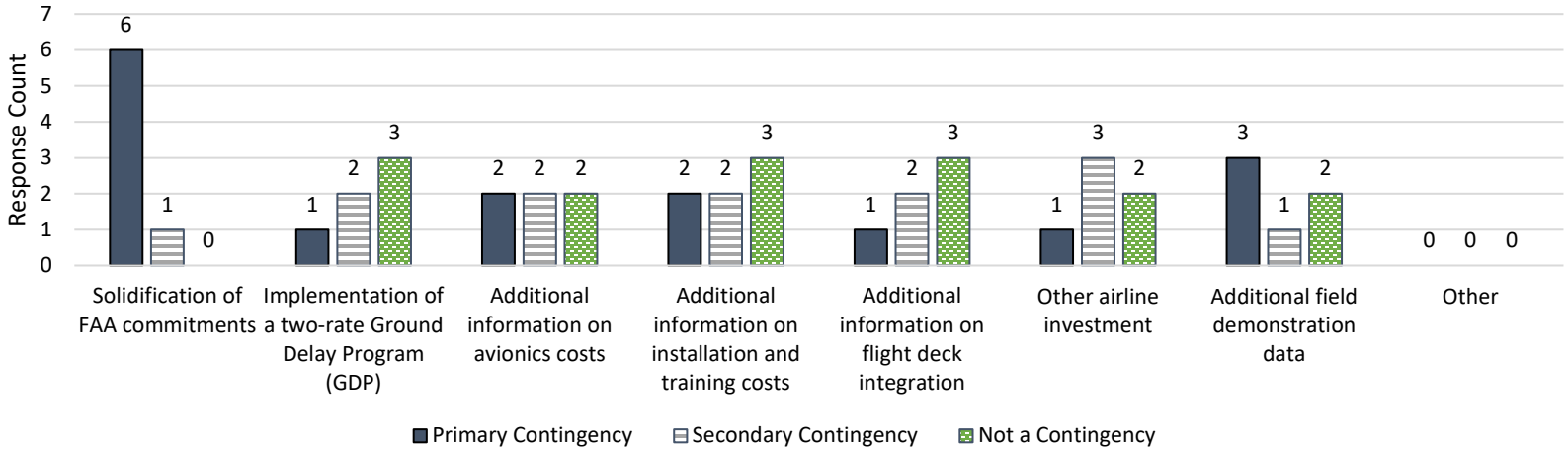


Figure B-6. Responses to "If your airline is interested in CAS - Approach, are there contingencies on an investment?"

QB.8.Airline Comments

- None

QB.9. If your airline is interested but not willing to commit to an investment in CAS - Approach, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	20%	4	80%
Insufficient understanding of the ADS-B In application benefits	0	0%	3	60%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	20%	4	80%
Insufficient funds	2	40%	3	60%	0	0%
Lack of benefits data	1	20%	3	60%	1	20%
Lack of field demonstration data	2	40%	1	20%	2	40%
Unclear FAA commitments on automation investments	4	80%	1	20%	0	0%
Unclear FAA commitments on necessary procedural changes	3	60%	2	40%	0	0%
Lack of information on avionics costs	1	20%	3	60%	1	20%
Lack of information on avionics installation requirements	1	20%	3	60%	1	20%
Pilot acceptability issues	0	0%	3	60%	2	40%
Controller acceptability issues	2	40%	1	20%	2	40%
Lack of knowledge of the future operation of the airline	0	0%	2	40%	3	60%
Training costs	1	20%	2	40%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate	0	0%				
N	5					

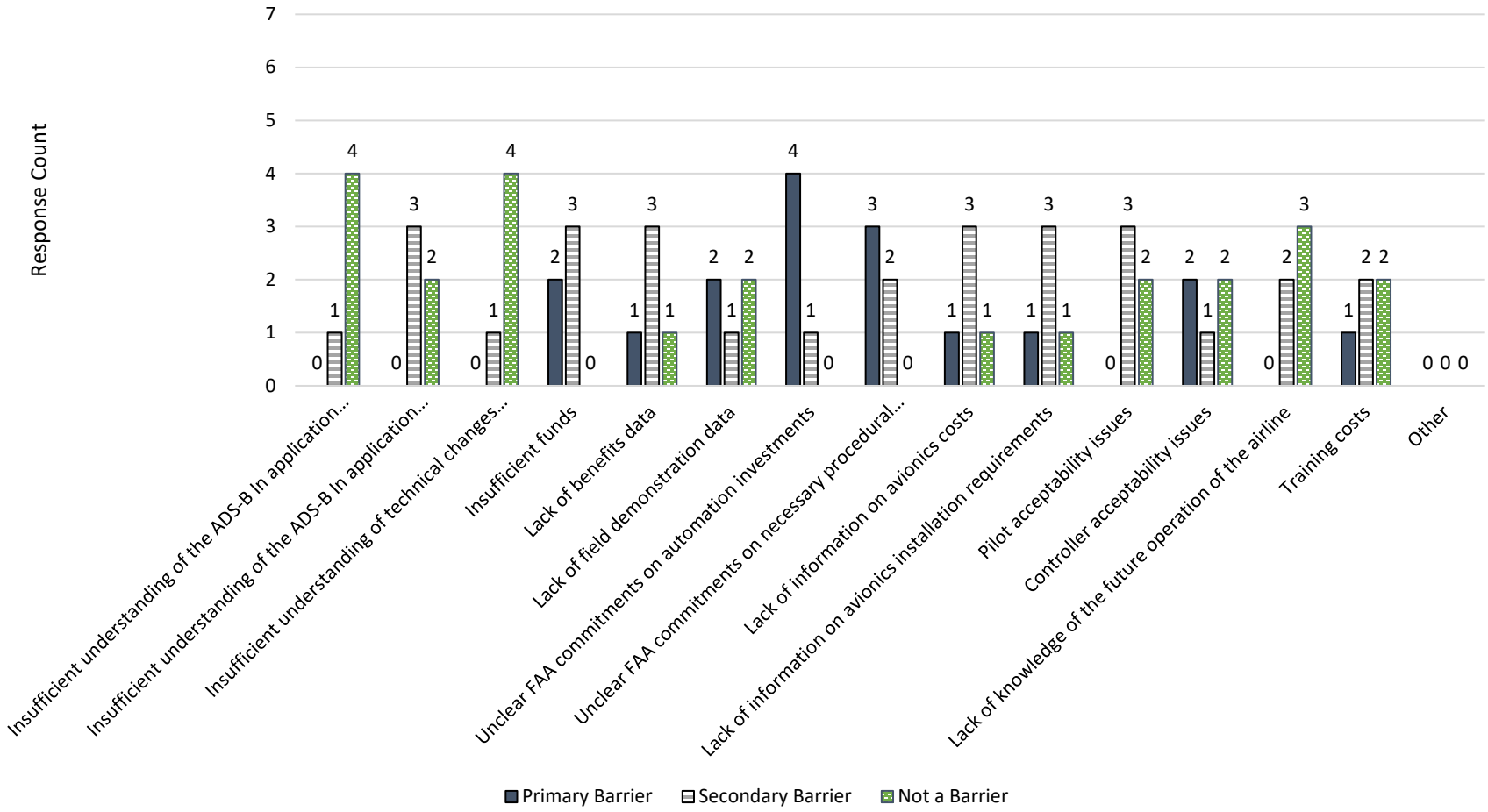


Figure B-7. Responses to "If your airline is interested but not willing to commit to an investment in CAS - Approach, what barriers could be removed to incentivize your airline to invest?"

QB.9.Airline Comments

- Need thorough validation of FAA Cost-Benefit analysis *and* additional internal consideration of impact on our operation.

QB.10. What barriers related to CAS - Approach do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	5	71%
Equipment issues	0	0%
Complexity issues	2	29%
Cultural change	5	71%
Other	0	0%
None	0	0%
N	7	

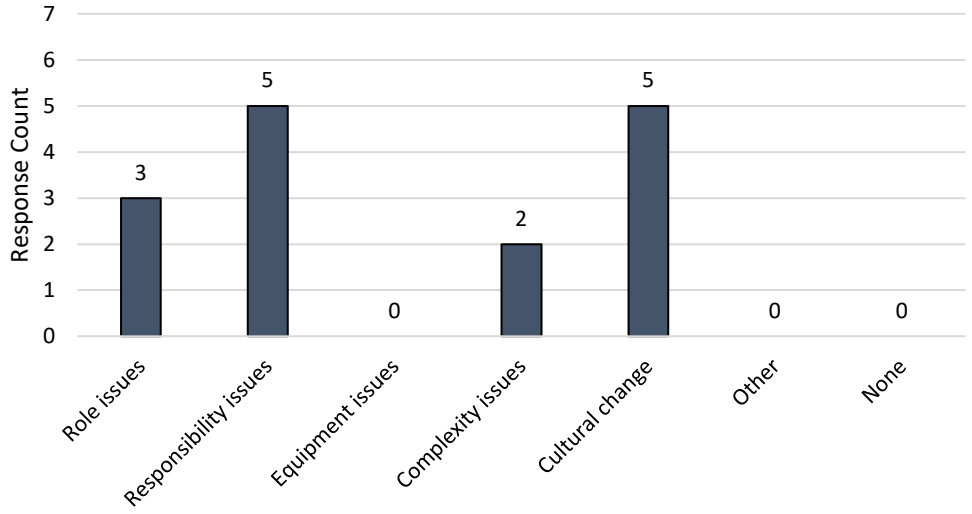


Figure B-8. Responses to "What barriers related to CAS - Approach do you see from a line pilot's perspective that would need to be addressed?"

QB.10.Airline Comments

- Very do-able from Line Pilot perspective

QB.11. What barriers related to CAS - Approach do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	4	67%
Responsibility issues	5	83%
Equipment issues	0	0%
Complexity issues	2	33%
Cultural change	5	83%
Other	0	0%
None	1	17%
N	7	

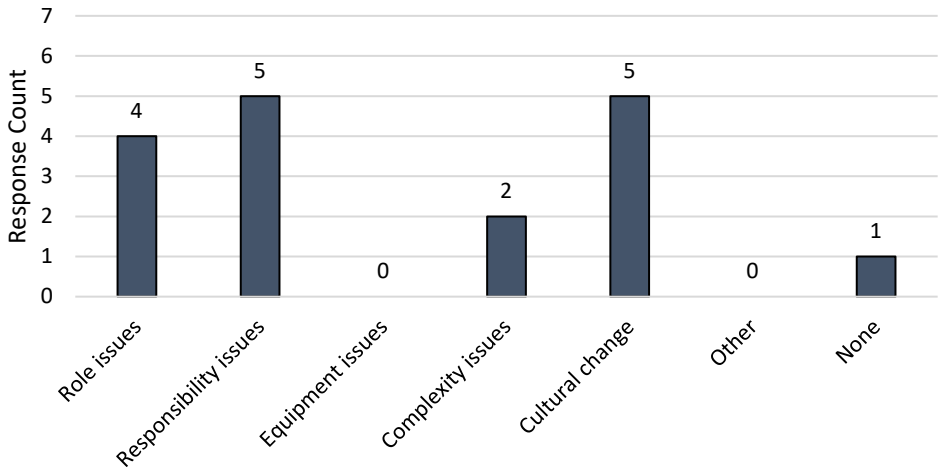


Figure B-9. Responses to "What barriers related to CAS - Approach do you see from an air traffic controller's perspective that would need to be addressed?"

QB.11.Airline Comments

- Unable to discern impact on controllers

QB.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in CAS - Approach.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	4	57%
Agree	0	0%
Strongly Agree	3	43%
N	7	
% Agreement	7	100%
% Disagreement	0	0%

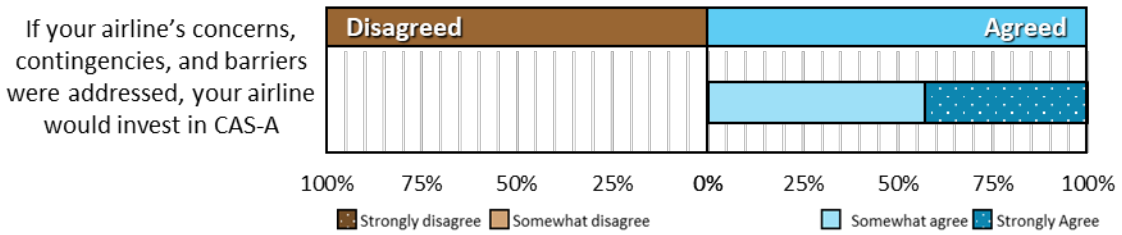


Figure B-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in CAS - Approach."

QB.12.Airline Comments

- If benefits develop as it appears they might, investment would be very likely. Depends on volume and availability of operational data.

QB.13. When would your airline expect to equip with CAS - Approach?

	Count	Percentage
In our first implementation of ADS-B In applications	4	57%
In a later implementation of ADS-B In applications	2	29%
Other	1	14%
Never	0	0%
N	7	

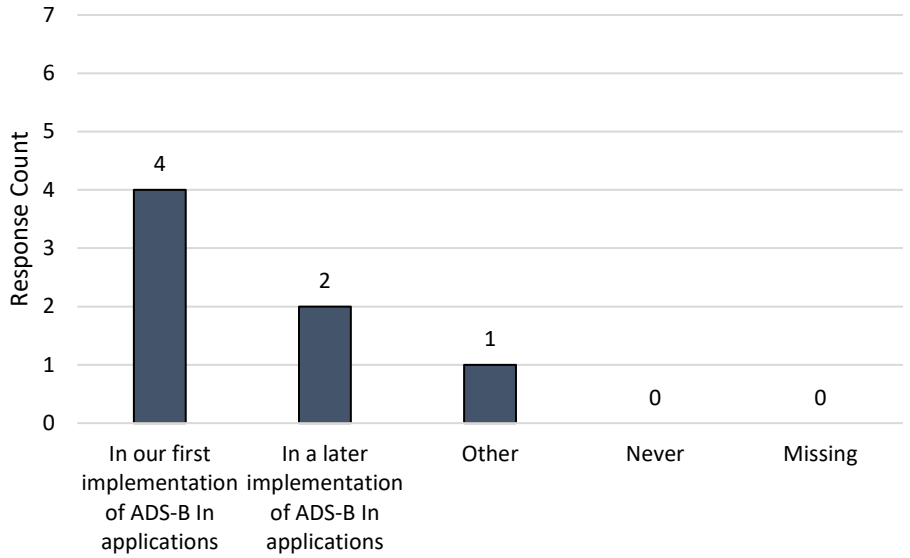


Figure B-11. Responses to "When would your airline expect to equip with CAS - Approach?"

QB.13.Airline Comments

- TBD based on COVID recovery, financial health of company, and favorable development of benefits

QB.14. Do you have any additional thoughts for the NAC to share with the FAA related to CAVS?

- FAA needs to follow through with controller automation for this to get off the ground.
- Believe there are other benefits to CAS in down line operations due to being able to keep airline on schedule
- CAS is potentially the most beneficial application. The development of an OpSpec should be a priority.

CDTI-Assisted Separation (CAS) – Departure

QC.3. My airline is interested in CAS - Departure.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	14%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	3	43%
N	7	
% Agreement	6	86%
% Disagreement	0	0%

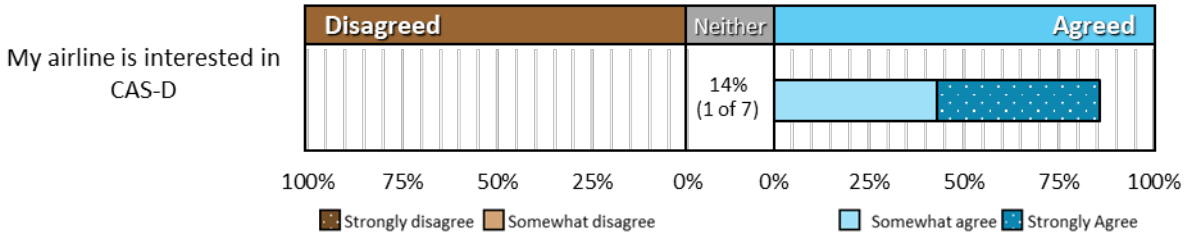


Figure C-1. Responses to "My airline is interested in CAS - Departure."

QC.4. Rate your priority for CAS - Departure amongst the set of ADS-B In applications.

	Count	Percentage
Low	1	14%
Medium	1	14%
High	5	71%
N	7	

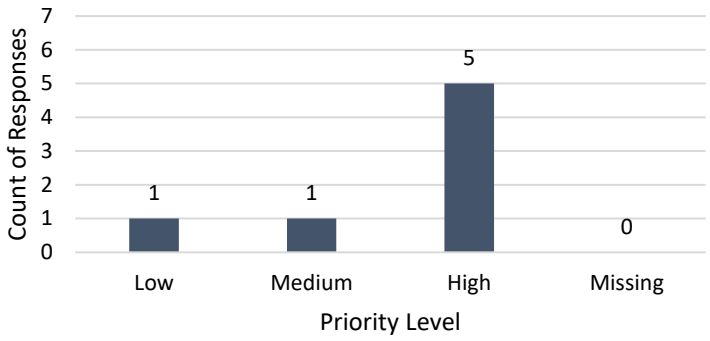


Figure C-2. Responses to "Rate your priority for CAS - Departure amongst the set of ADS-B In applications."

QC.4.Airline Comments

- Initial indications are that it might not offer significant benefit

QC.5. What is it about CAS - Departure that interests your airline?

Benefits	6	86%	1	14%	0	0%
Low Cost	1	14%	4	57%	0	0%
Applicability at enough locations where we operate	4	57%	3	43%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

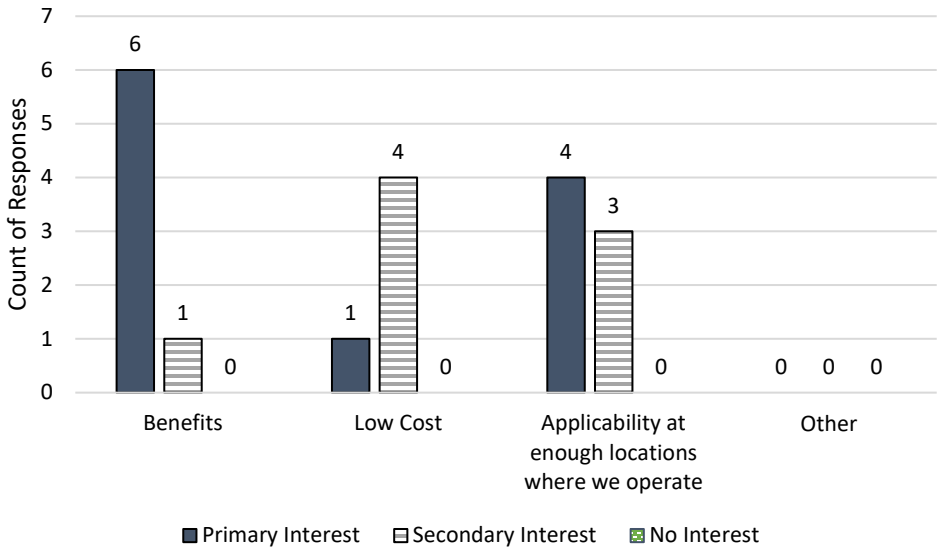


Figure C-3. Responses to "What is it about CAS - Departure that interests your airline?"

QC.5.Airline Comments

- Same with CAS approach, we are interested in what the costs would be, but cannot say that this as a low cost application.
- Has the potential to help significantly at one of our hubs.

QC.6. Describe how your airline believes CAS - Departure can bring benefit to your operation.

Increased capacity/throughput	6	86%	1	14%	0	0%	0	0%
Reduced fuel burn	3	43%	4	57%	0	0%	0	0%
Reduced time in air	3	43%	3	43%	0	0%	0	0%
Reduced gate time	0	0%	2	29%	2	29%	2	29 %
More predictable block times leading to schedule improvements	3	43%	3	43%	0	0%	1	14 %
Reduced communications	0	0%	3	43%	2	29%	1	14 %
Increased flexibility	0	0%	3	43%	2	29%	1	14 %
Increased access	1	14%	2	29%	3	43%	0	0%
Increased pilot traffic awareness	3	43%	4	57%	0	0%	0	0%
Increased safety	3	43%	2	29%	1	14%	0	0%
Increased passenger satisfaction	1	14%	1	14%	3	43%	1	14 %
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

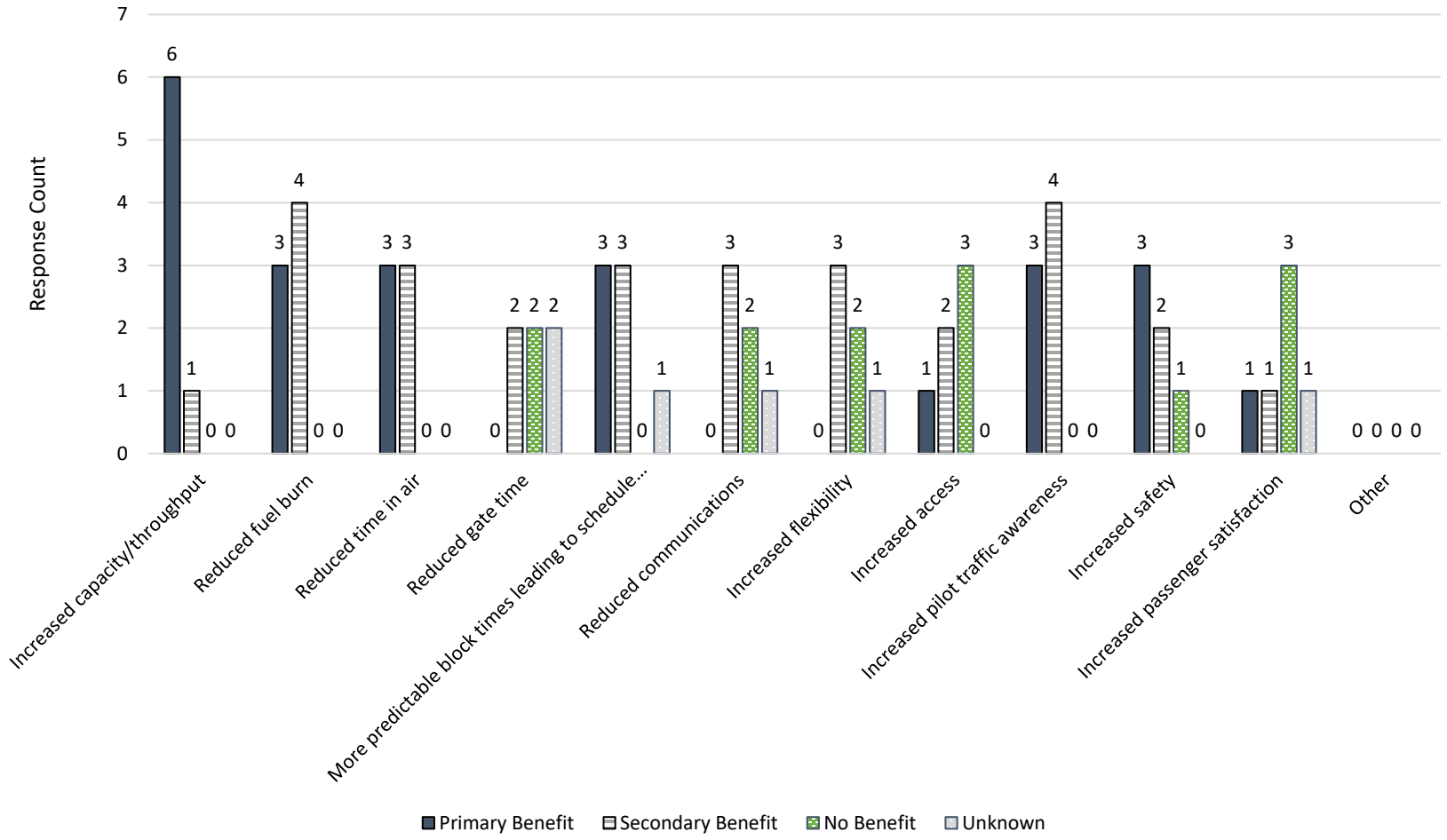


Figure C-4. Responses to "Describe how your airline believes CAS - Departure can bring benefit to your operation."

QC.6.Airline Comments

- Has the potential to help significantly at one of our hubs. Fuel savings from less taxi time.

QC.7. What is it about CAS - Departure that concerns your airline?

Benefits	3	43%	2	29%	1	14%
Cost	3	43%	2	29%	1	14%
Not applicable at enough locations where we operate	5	71%	0	0%	2	29%
General concept	0	0%	1	14%	5	71%
Concept complexity	1	14%	1	14%	4	57%
Necessary procedural changes	2	29%	2	29%	2	29%
Necessary controller automation	3	43%	1	14%	2	29%
Training Cost	1	14%	2	29%	3	43%
Other	0	0%	1	14%	0	0%
No concerns	0	0%				
N	7					

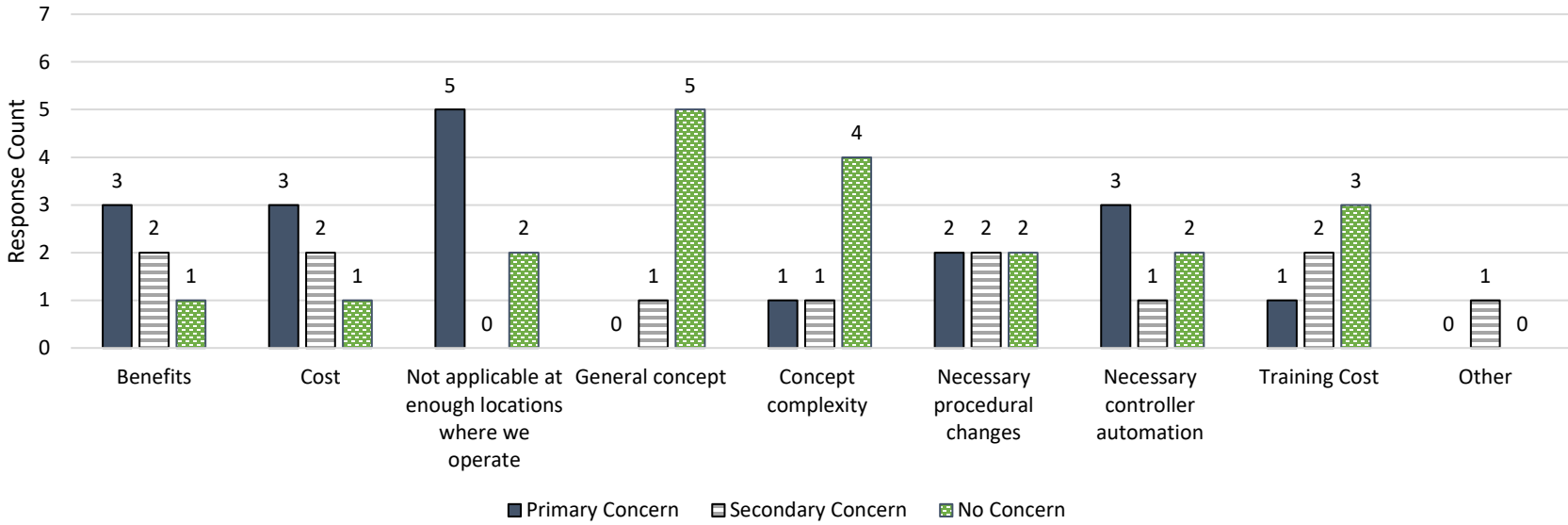


Figure C-5. Responses to "What is it about CAS - Departure that concerns your airline?"

QC.7.Airline Comments

- Currently untested
- Initial observation is that we are rarely constrained with departures out of a single gate. [Departure operations have] been successfully deployed to maximize departure efficiency.
- AIRS should address our concerns of it being untested in the real world however widespread controller acceptance of CAS is necessary at enough locations we operate.

QC.8. If your airline is interested in CAS - Departure, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	0	0%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	1	14%	1	14%	3	43%
Additional information on avionics costs	2	29%	1	14%	2	29%
Additional information on installation and training costs	1	14%	2	29%	2	29%
Additional information on flight deck integration	1	14%	2	29%	2	29%
Other airline investment	1	14%	2	29%	2	29%
Additional field demonstration data	3	43%	2	29%	2	29%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
N	7					

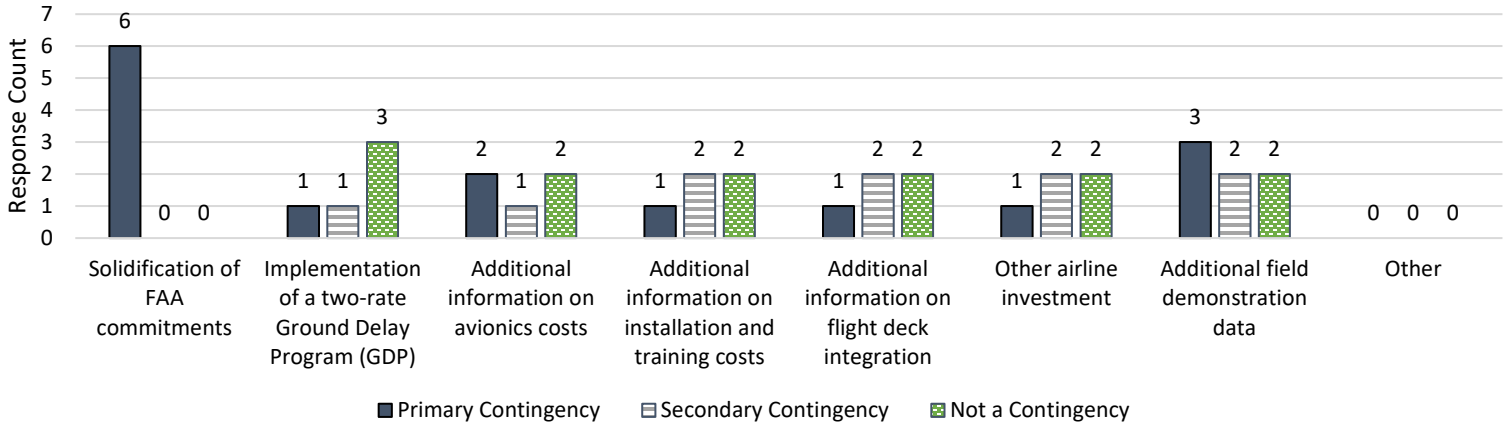


Figure C-6. Responses to "If your airline is interested in CAS - Departure, are there contingencies on an investment?"

QC.8.Airline Comments

- AIRS should address our concerns of it being untested in the real world however widespread controller acceptance of CAS is necessary at enough locations we operate.

QC.9. If your airline is interested but not willing to commit to an investment in CAS - Departure, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	17%	4	67%
Insufficient understanding of the ADS-B In application benefits	1	17%	1	17%	3	50%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	17%	4	67%
Insufficient funds	4	67%	1	17%	1	17%
Lack of benefits data	3	50%	2	33%	1	17%
Lack of field demonstration data	2	33%	1	17%	2	33%
Unclear FAA commitments on automation investments	3	50%	0	0%	1	17%
Unclear FAA commitments on necessary procedural changes	2	33%	1	17%	1	17%
Lack of information on avionics costs	1	17%	2	33%	2	33%
Lack of information on avionics installation requirements	1	17%	2	33%	2	33%
Pilot acceptability issues	1	17%	2	33%	2	33%
Controller acceptability issues	2	33%	1	17%	2	33%
Lack of knowledge of the future operation of the airline	0	0%	2	33%	3	50%
Training costs	1	17%	2	33%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

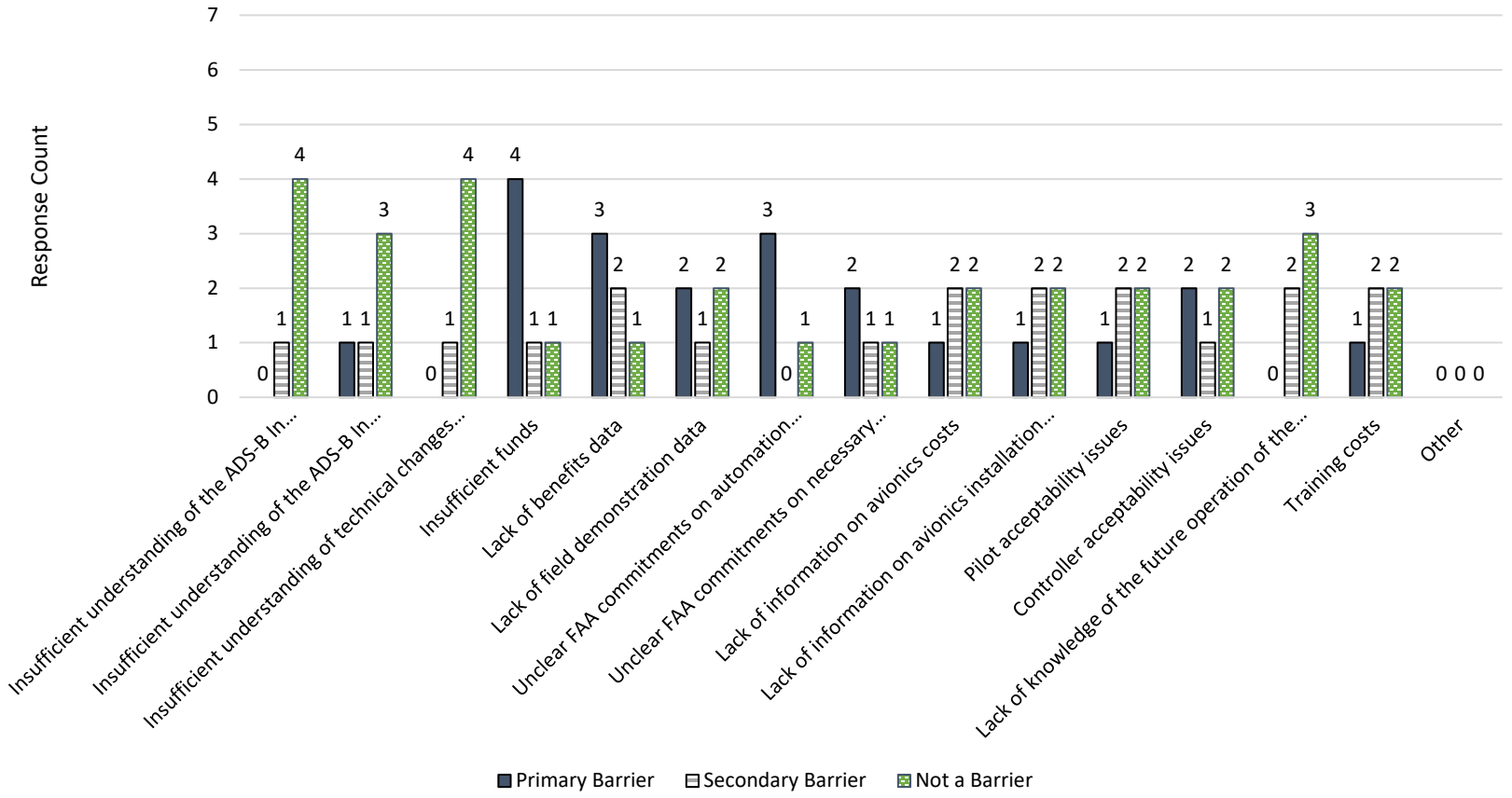


Figure C-7. Responses to "If your airline is interested but not willing to commit to an investment in CAS - Departure, what barriers could be removed to incentivize your airline to invest?"

QC.9.Airline Comments

Simply cannot discern if it will be a benefit to our operation

QC.10. What barriers related to CAS - Departure do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	2	29%
Equipment issues	0	0%
Complexity issues	2	29%
Cultural change	5	71%
Other	0	0%
None	1	14%
N	7	

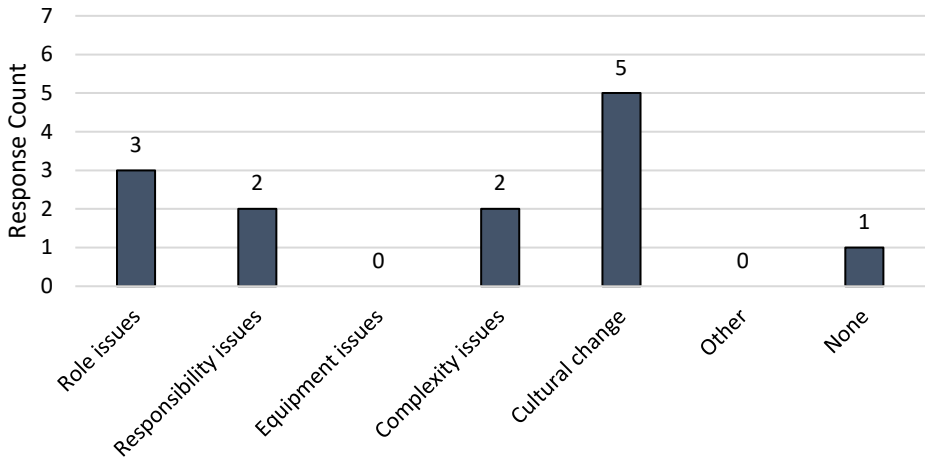


Figure C-8. Responses to "What barriers related to CAS - Departure do you see from a line pilot's perspective that would need to be addressed?"

QC.10.Airline Comments

- None

QC.11. What barriers related to CAS - Departure do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	4	57%
Responsibility issues	5	71%
Equipment issues	0	0%
Complexity issues	2	29%
Cultural change	5	71%
Other	0	0%
None	1	14%
N	7	

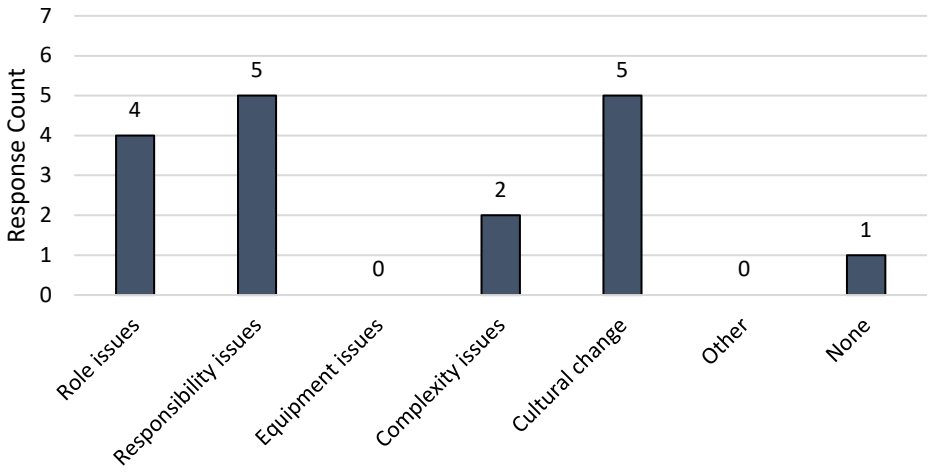


Figure C-9. Responses to "What barriers related to CAS - Departure do you see from an air traffic controller's perspective that would need to be addressed?"

QC.11.Airline Comments

- None

QC.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in CAS - Departure.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	1	14%
Neither	0	0%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	3	43%
N	7	
% Agreement	6	86%
% Disagreement	1	14%

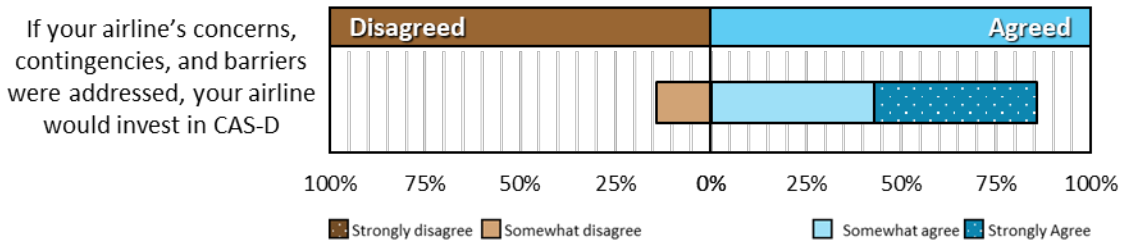


Figure C-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in CAS - Departure."

QC.12.Airline Comments

- None

QC.13. When would your airline expect to equip with CAS - Departure?

	Count	Percentage
In our first implementation of ADS-B In applications	4	57%
In a later implementation of ADS-B In applications	2	29%
Other	1	14%
Never	0	0%
N	N	

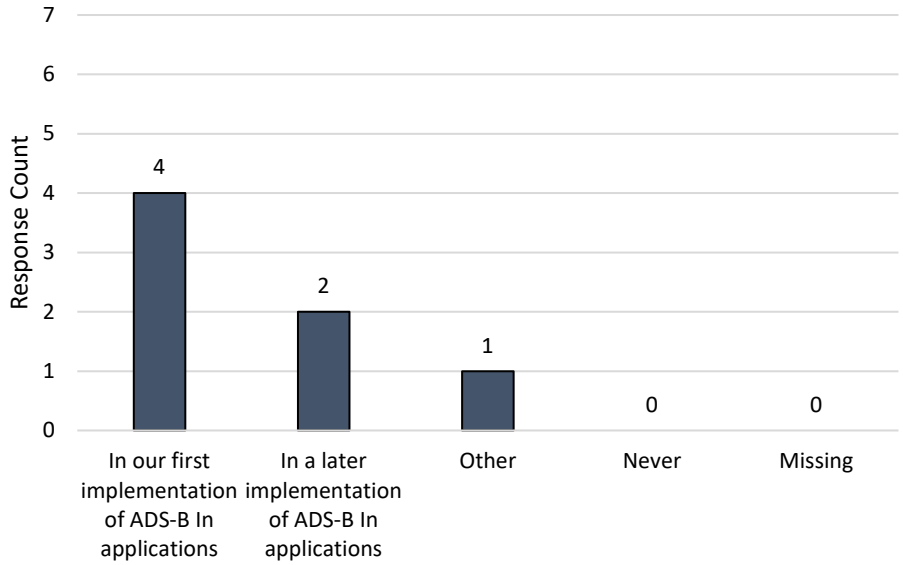


Figure C-11. Responses to "When would your airline expect to equip with CAS - Departure?"

QC.13.Airline Comments

- None

QC.14. Do you have any additional thoughts for the NAC to share with the FAA related to CAS - Departure?

- Not likely as an individual investment; possible collateral benefit
- Maintaining runway rates during multiple visual conditions is a major benefit for our airline.
- CAS Departure may be an "easier" application than CAS approach in some locations.
- AIRS should address our concerns of it being untested in the real world however widespread controller acceptance of CAS is necessary at enough locations we operate.

Oceanic In-Trail Procedure (ITP)

QD.3. My airline is interested in ITP.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	6	86%
Agree	0	0%
Strongly Agree	1	14%
N	7	
% Agreement	7	100%
% Disagreement	0	0%

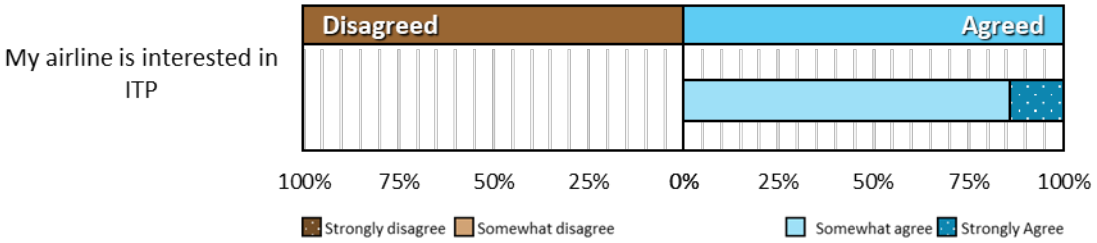


Figure D-1. Responses to "My airline is interested in ITP."

QD.4. Rate your priority for ITP amongst the set of ADS-B In applications.

	Count	Percentage
Low	1	14%
Medium	4	57%
High	2	29%
N	7	

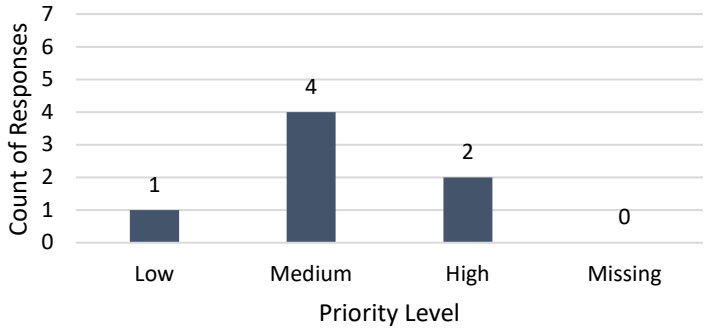


Figure D-2. Responses to "Rate your priority for ITP amongst the set of ADS-B In applications."

QD.4.Airline Comments

- None

QD.5. What is it about ITP that interests your airline?

Benefits	6	86%	1	14%	0	0%
Low Cost	1	14%	4	57%	0	0%
Applicability at enough locations where we operate	5	71%	2	29%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

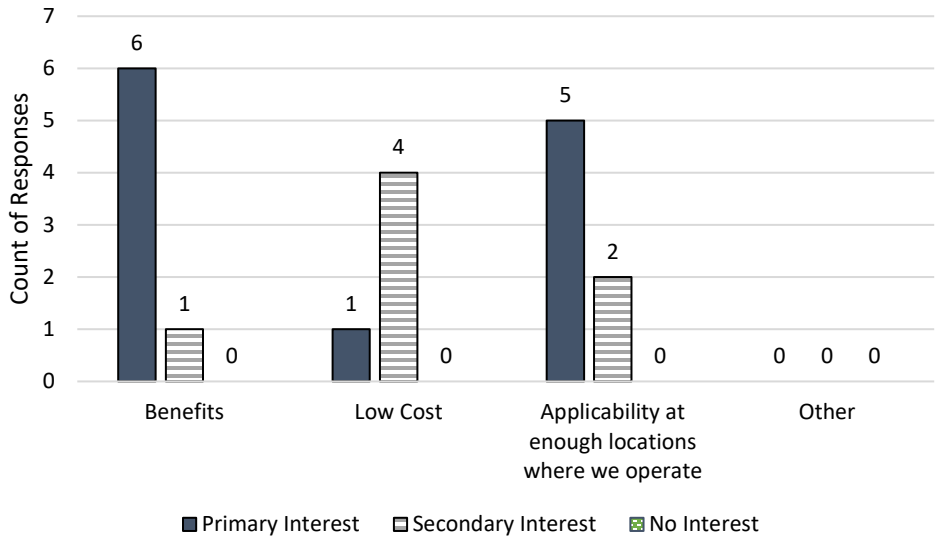


Figure D-3. Responses to "What is it about ITP that interests your airline?"

QD.5.Airline Comments

- Only makes sense on oceanic aircraft

QD.6. Describe how your airline believes ITP can bring benefit to your operation.

Increased capacity/throughput	2	29%	1	14%	3	43%	0	0%
Reduced fuel burn	7	100%	0	0%	0	0%	0	0%
Reduced time in air	3	43%	1	14%	2	29%	0	0%
Reduced gate time	0	0%	1	14%	2	29%	3	43%
More predictable block times leading to schedule improvements	1	14%	1	14%	2	29%	2	29%
Reduced communications	1	14%	3	43%	1	14%	1	14%
Increased flexibility	4	57%	2	29%	0	0%	0	0%
Increased access	0	0%	2	29%	3	43%	1	14%
Increased pilot traffic awareness	3	43%	4	57%	0	0%	0	0%
Increased safety	6	86%	0	0%	0	0%	0	0%
Increased passenger satisfaction	1	14%	0	0%	3	43%	2	29%
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

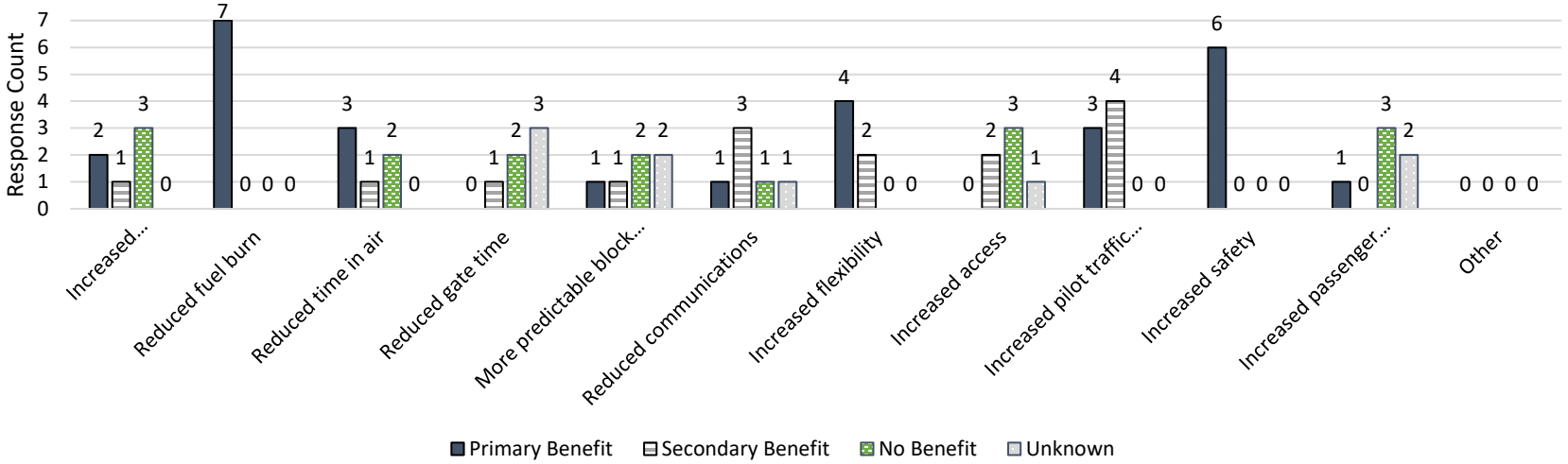


Figure D-4. Responses to "Describe how your airline believes ITP can bring benefit to your operation."

QD.6.Airline Comments

- None

QD.7. What is it about ITP that concerns your airline?

Benefits	3	43%	1	14%	1	14%
Cost	2	29%	1	14%	2	29%
Not applicable at enough locations where we operate	4	57%	0	0%	2	29%
General concept	1	14%	0	0%	4	57%
Concept complexity	1	14%	1	14%	3	43%
Necessary procedural changes	1	14%	0	0%	4	57%
Necessary controller automation	1	14%	0	0%	4	57%
Training Cost	1	14%	0	0%	3	43%
Other	1	14%	0	0%	0	0%
No concerns	0	0%				
N	7					

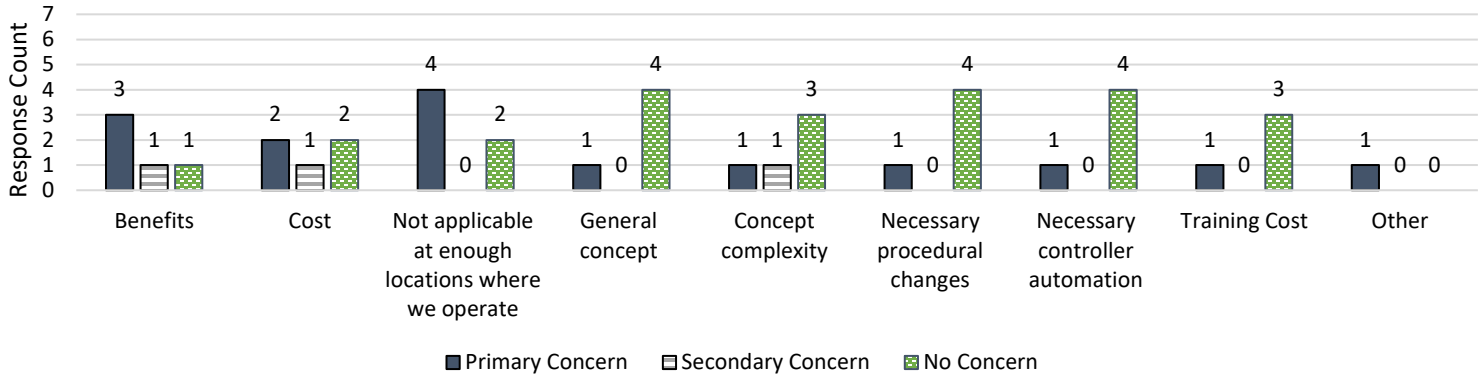


Figure D-5. Responses to "What is it about ITP that concerns your airline?"

QD.7.Airline Comments

- Space-based ADS-B
- It would be helpful to have an analysis showing the benefit now as well as in the future as oceanic separation standards decrease and equipage of RNP4/FANS aircraft increase. Our sense is there is a small benefit now, but it will decrease in the near to medium term as RNP4/FANS equipage increases.

QD.8. If your airline is interested in ITP, are there contingencies on an investment?

Solidification of FAA commitments	3	50%	1	17%	1	17%
Implementation of a two-rate Ground Delay Program (GDP)	1	17%	1	17%	3	50%
Additional information on avionics costs	1	17%	1	17%	3	50%
Additional information on installation and training costs	1	17%	1	17%	3	50%
Additional information on flight deck integration	1	17%	1	17%	3	50%
Other airline investment	1	17%	3	50%	1	17%
Additional field demonstration data	2	33%	1	17%	2	33%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
N	6					

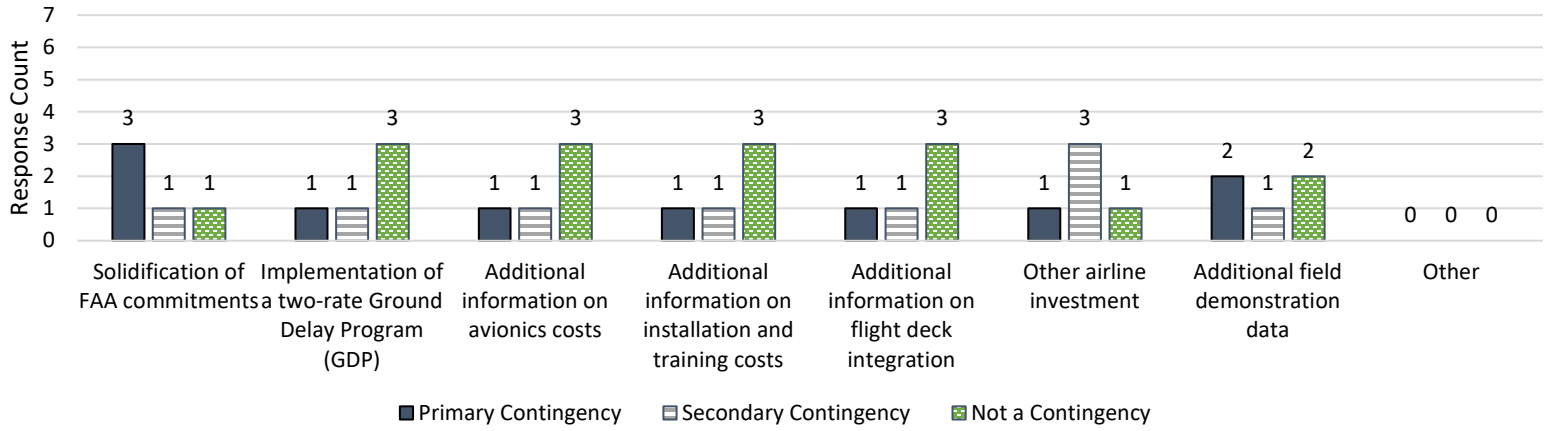


Figure D-6. Responses to "If your airline is interested in ITP, are there contingencies on an investment?"

QD.8.Airline Comments

- ITP benefits are dependent on the equipage of other aircraft. This limits benefits. That along with applicability to our current operating area are contingencies.

QD.9. If your airline is interested but not willing to commit to an investment in ITP, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	17%	4	67%
Insufficient understanding of the ADS-B In application benefits	0	0%	1	17%	4	67%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	17%	4	67%
Insufficient funds	2	33%	3	50%	0	0%
Lack of benefits data	2	33%	3	50%	0	0%
Lack of field demonstration data	2	33%	1	17%	2	33%
Unclear FAA commitments on automation investments	2	33%	2	33%	1	17%
Unclear FAA commitments on necessary procedural changes	1	17%	3	50%	1	17%
Lack of information on avionics costs	1	17%	2	33%	2	33%
Lack of information on avionics installation requirements	1	17%	1	17%	3	50%
Pilot acceptability issues	0	0%	1	17%	4	67%
Controller acceptability issues	2	33%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	2	33%	3	50%
Training costs	1	17%	2	33%	2	33%
Other	2	33%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

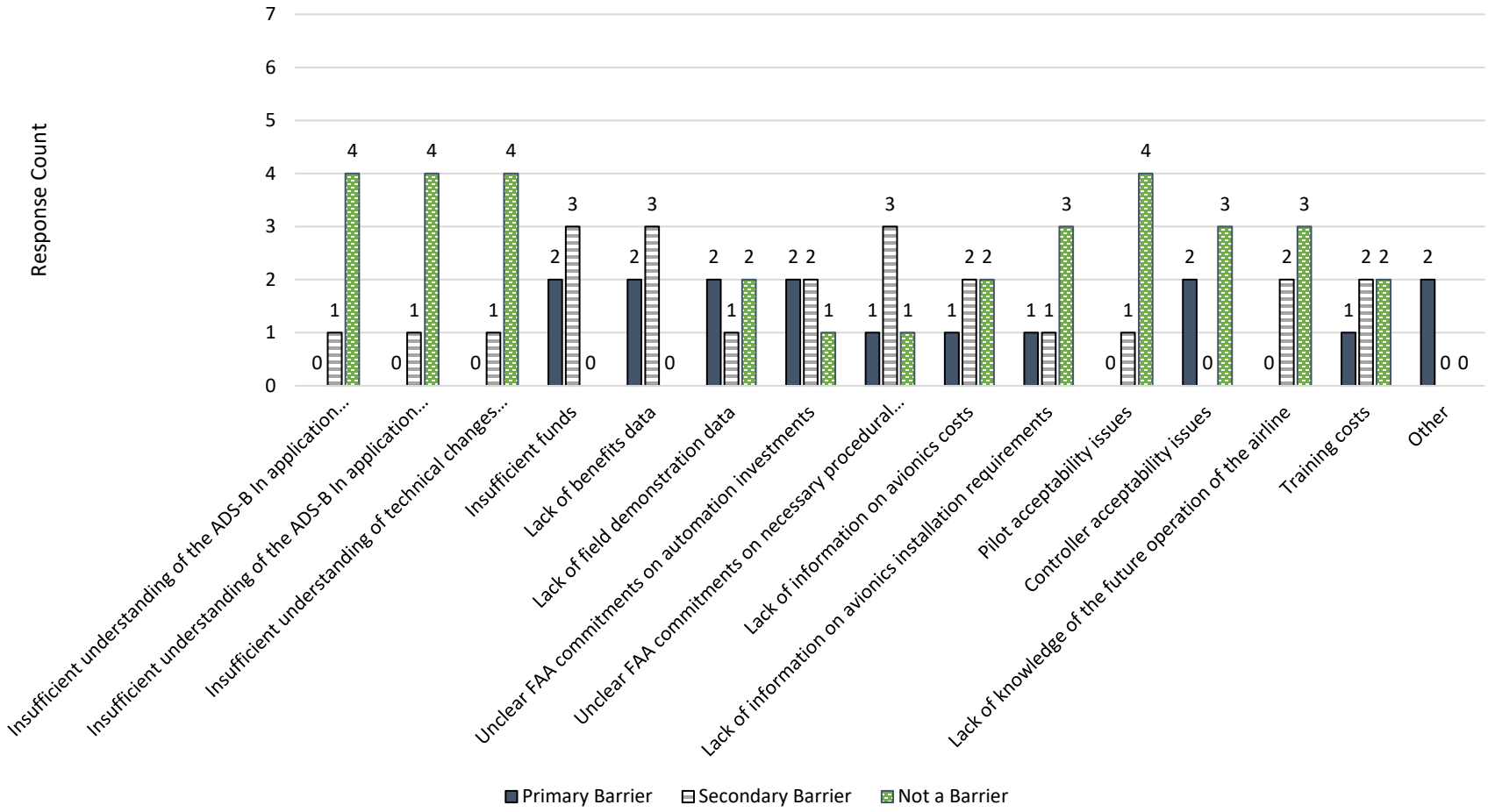


Figure D-7. Responses to "If your airline is interested but not willing to commit to an investment in ITP, what barriers could be removed to incentivize your airline to invest?"

QD.9.Airline Comments

- Knowing ANSPs will allow its use
- Does Space Based ADS-B remove benefits
- Would need to conduct a robust internal study of how often we are held down on the tracks due to ovhd traffic

QD.10. What barriers related to ITP do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	29%
Responsibility issues	3	43%
Equipment issues	0	0%
Complexity issues	2	29%
Cultural change	3	43%
Other	0	0%
None	2	29%
N	7	

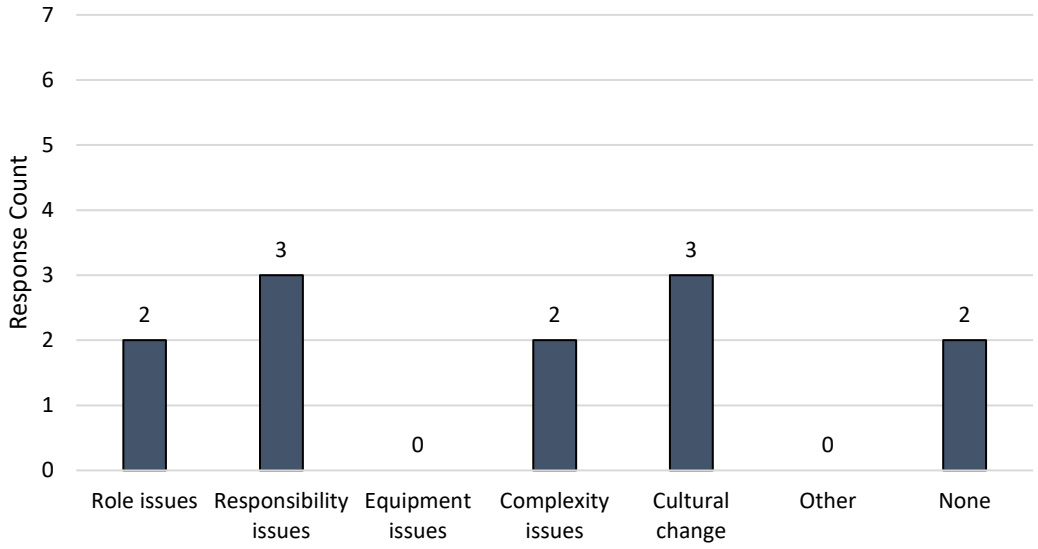


Figure D-8. Responses to "What barriers related to ITP do you see from a line pilot's perspective that would need to be addressed?"

QD.10.Airline Comments

- None

QD.11. What barriers related to ITP do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	33%
Responsibility issues	3	50%
Equipment issues	0	0%
Complexity issues	2	33%
Cultural change	2	33%
Other	0	0%
None	2	33%
N	6	

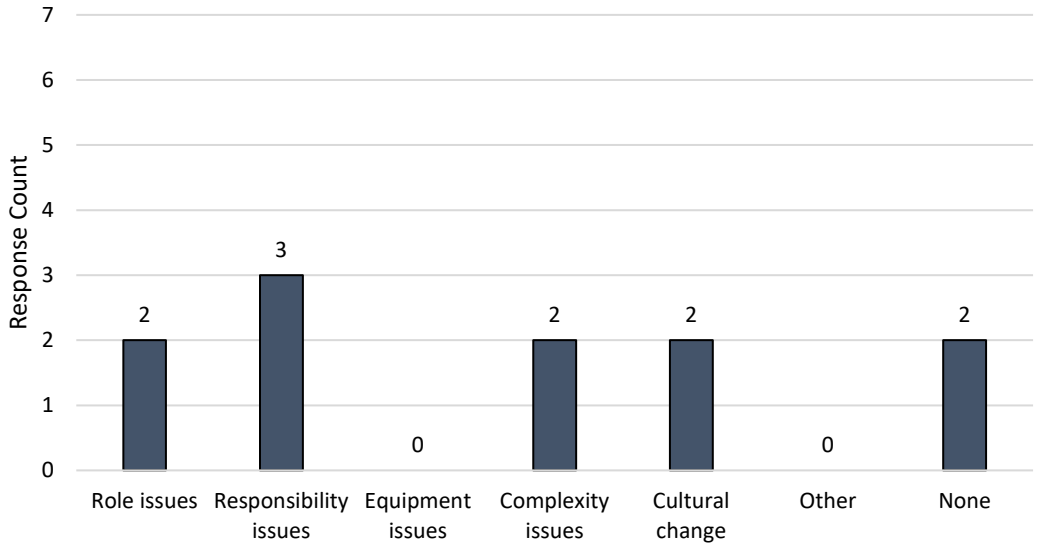


Figure D-9. Responses to "What barriers related to ITP do you see from an air traffic controller's perspective that would need to be addressed?"

QD.11.Airline Comments

- unable to discern controller issues

QD.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in ITP.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	14%
Somewhat Agree	5	71%
Agree	0	0%
Strongly Agree	1	14%
N	7	
% Agreement	6	86%
% Disagreement	0	0%

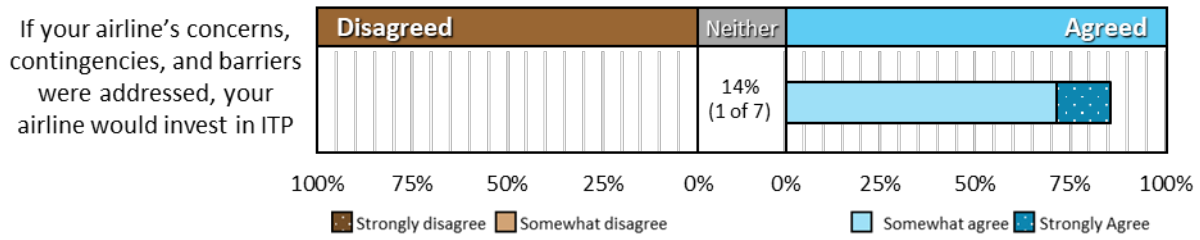


Figure D-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in ITP."

QD.12.Airline Comments

- At this time appears to be collateral benefit only

QD.13. When would your airline expect to equip with ITP?

	Count	Percentage
In our first implementation of ADS-B In applications	2	29%
In a later implementation of ADS-B In applications	4	57%
Other	1	14%
Never	0	0%
N	7	

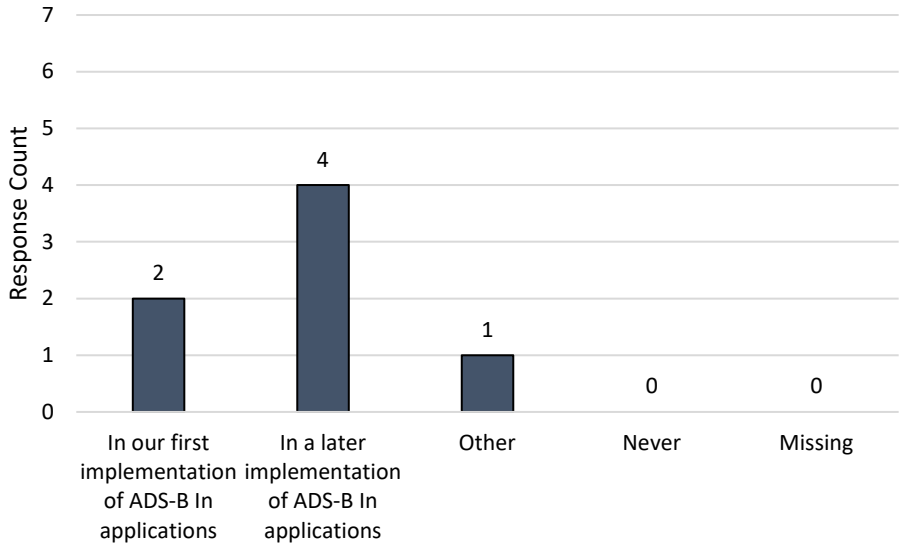


Figure D-11. Responses to "When would your airline expect to equip with ITP?"

QD.13.Airline Comments

- Benefit has not been determined

QD.14. Do you have any additional thoughts for the NAC to share with the FAA related to ITP?

- Appears to promise benefit, but likely wouldn't justify individual investment. Maybe bundled or included with another application would lead to collateral benefit.

Surface (SURF)

QE.3. My airline is interested in SURF.

		Percentage
Strongly Disagree	1	14%
Disagree	0	0%
Somewhat Disagree	2	29%
Neither	1	14%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	0	0%
N	7	
% Agreement	3	43%
% Disagreement	3	43%

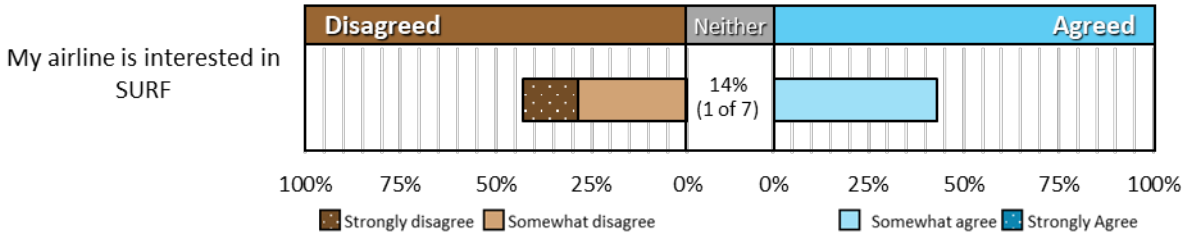


Figure E-1. Responses to "My airline is interested in SURF."

QE.4. Rate your priority for SURF amongst the set of ADS-B In applications.

	Count	Percentage
Low	5	71%
Medium	2	29%
High	0	0%
N	7	

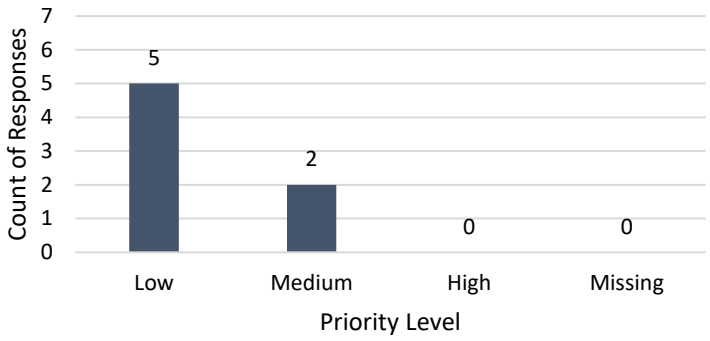


Figure E-2. Responses to "Rate your priority for SURF amongst the set of ADS-B In applications."

QE.4.Airline Comments

- None

QE.5. What is it about SURF that interests your airline?

Benefits	2	33%	2	33%	0	0%
Low Cost	1	17%	0	0%	2	33%
Applicability at enough locations where we operate	2	33%	1	17%	1	17%
Other	2	33%	0	0%	0	0%
Nothing interests	1	17%				
N	6					

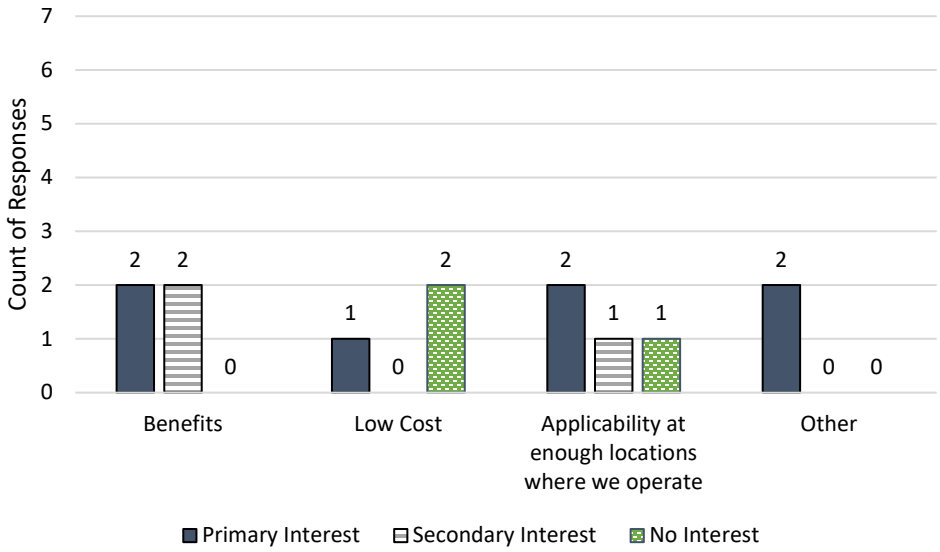


Figure E-3. Responses to "What is it about SURF that interests your airline?"

QE.5.Airline Comments

- Nothing about SURF interests my airline

QE.6. Describe how your airline believes SURF can bring benefit to your operation.

Increased capacity/throughput	2	29%	0	0%	1	14%	1	14%
Reduced fuel burn	1	14%	1	14%	2	29%	0	0%
Reduced time in air	1	14%	0	0%	2	29%	0	0%
Reduced gate time	0	0%	0	0%	2	29%	1	14%
More predictable block times leading to schedule improvements	0	0%	0	0%	2	29%	1	14%
Reduced communications	0	0%	1	14%	1	14%	1	14%
Increased flexibility	0	0%	1	14%	2	29%	0	0%
Increased access	0	0%	1	14%	2	29%	0	0%
Increased pilot traffic awareness	4	57%	1	14%	0	0%	0	0%
Increased safety	3	43%	2	29%	1	14%	0	0%
Increased passenger satisfaction	0	0%	0	0%	3	43%	0	0%
Other	1	14%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						

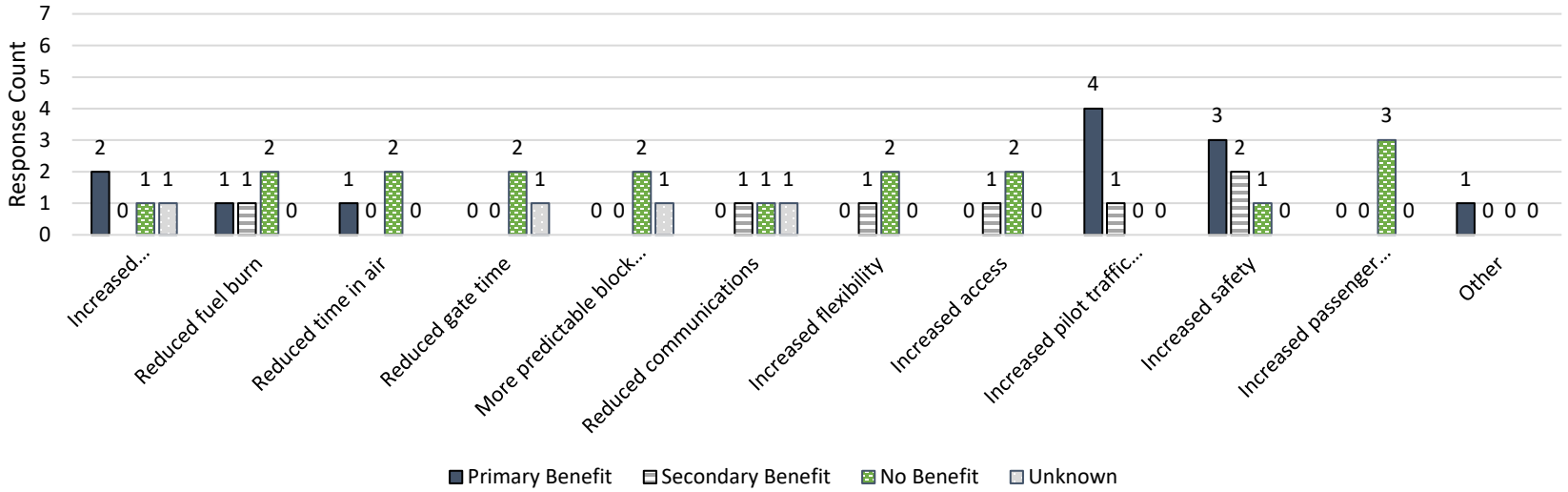


Figure E-4. Responses to "Describe how your airline believes SURF can bring benefit to your operation."

QE.6.Airline Comments

- Increased safety during taxi
- SURF does not bring benefit
- Fuel benefit is from better awareness of when to start second engine

QE.7. What is it about SURF that concerns your airline?

Benefits	4	57%	1	14%	0	0%
Cost	5	71%	1	14%	1	14%
Not applicable at enough locations where we operate	3	43%	0	0%	2	29%
General concept	0	0%	0	0%	3	43%
Concept complexity	0	0%	1	14%	2	29%
Necessary procedural changes	0	0%	0	0%	3	43%
Necessary controller automation	1	14%	0	0%	3	43%
Training Cost	1	14%	0	0%	2	29%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

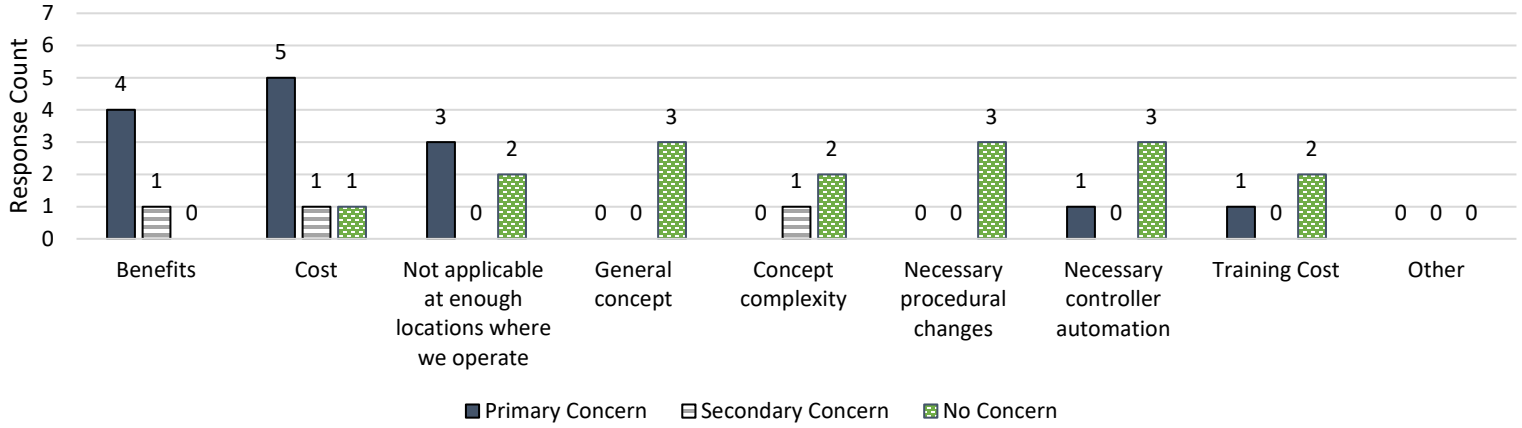


Figure E-5. Responses to "What is it about SURF that concerns your airline?"

QE.7.Airline Comments

- Currently we have no pricing info for SURF.

QE.8. If your airline is interested in SURF, are there contingencies on an investment?

Solidification of FAA commitments	2	29%	0	0%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	1	14%	1	14%	0	0%
Additional information on avionics costs	2	29%	0	0%	0	0%
Additional information on installation and training costs	1	14%	0	0%	0	0%
Additional information on flight deck integration	1	14%	0	0%	0	0%
Other airline investment	0	0%	1	14%	0	0%
Additional field demonstration data	1	14%	0	0%	1	14%
Other	0	0%	0	0%	0	0%
No contingencies	2	29%				
N	7					

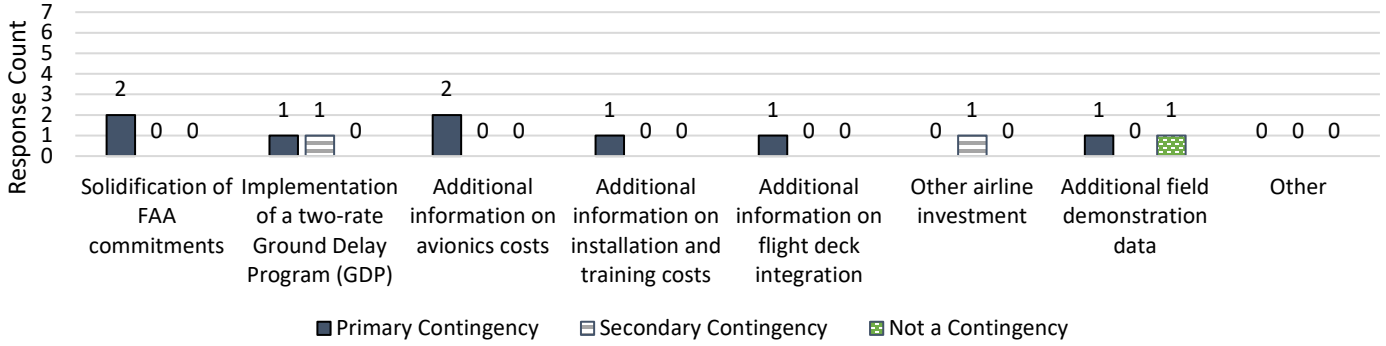


Figure E-6. Responses to "If your airline is interested in SURF, are there contingencies on an investment?"

QE.8.Airline Comments

- Need to see data on benefits on this application
- Not applicable - not interested in application
- Currently we have no pricing info for SURF.

QE.9. If your airline is interested but not willing to commit to an investment in SURF, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	17%	2	33%
Insufficient understanding of the ADS-B In application benefits	1	17%	0	0%	2	33%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	3	50%
Insufficient funds	1	17%	1	17%	1	17%
Lack of benefits data	1	17%	2	33%	1	17%
Lack of field demonstration data	0	0%	1	17%	2	33%
Unclear FAA commitments on automation investments	2	33%	0	0%	2	33%
Unclear FAA commitments on necessary procedural changes	1	17%	1	17%	2	33%
Lack of information on avionics costs	1	17%	0	0%	2	33%
Lack of information on avionics installation requirements	1	17%	0	0%	2	33%
Pilot acceptability issues	0	0%	0	0%	3	50%
Controller acceptability issues	1	17%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	1	17%	2	33%
Training costs	1	17%	0	0%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	1	17%				
N	6					

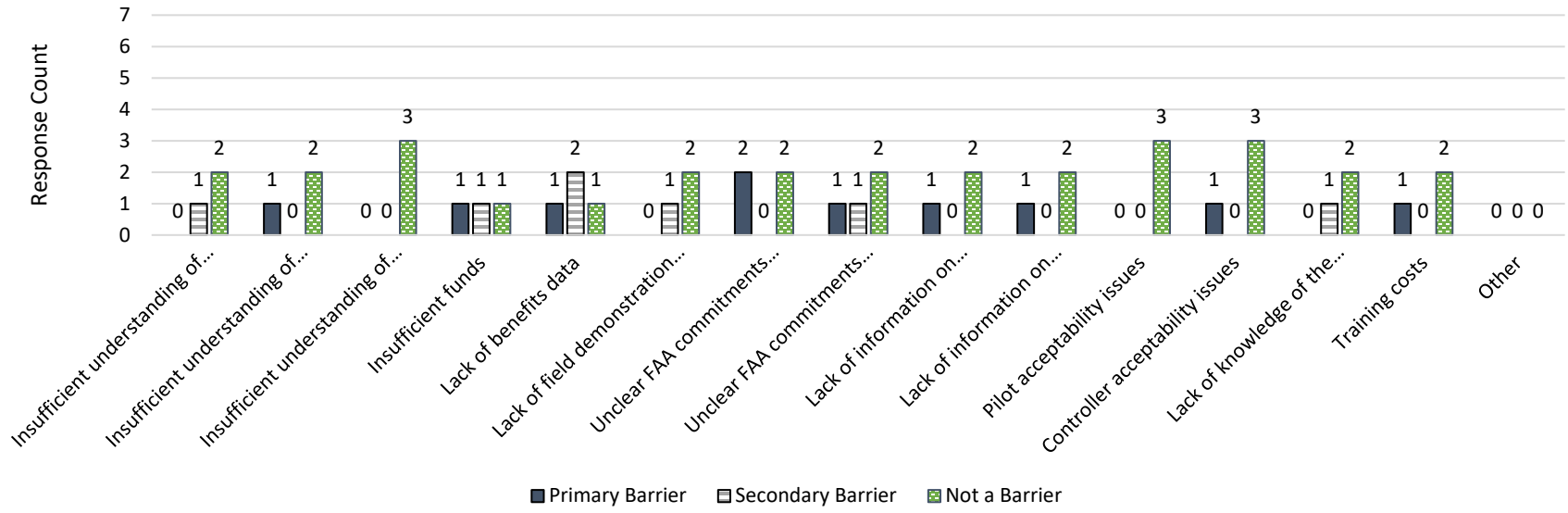


Figure E-7. Responses to "If your airline is interested but not willing to commit to an investment in SURF, what barriers could be removed to incentivize your airline to invest?"

QE.9.Airline Comments

- Nothing can motivate investment
- Simply don't see a risk issue or benefit worthy of pursuit
- Not applicable - not interested in application

QE.10. What barriers related to SURF do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	1	14%
Responsibility issues	1	14%
Equipment issues	1	14%
Complexity issues	1	14%
Cultural change	0	0%
Other	1	14%
None	3	43%
N	7	

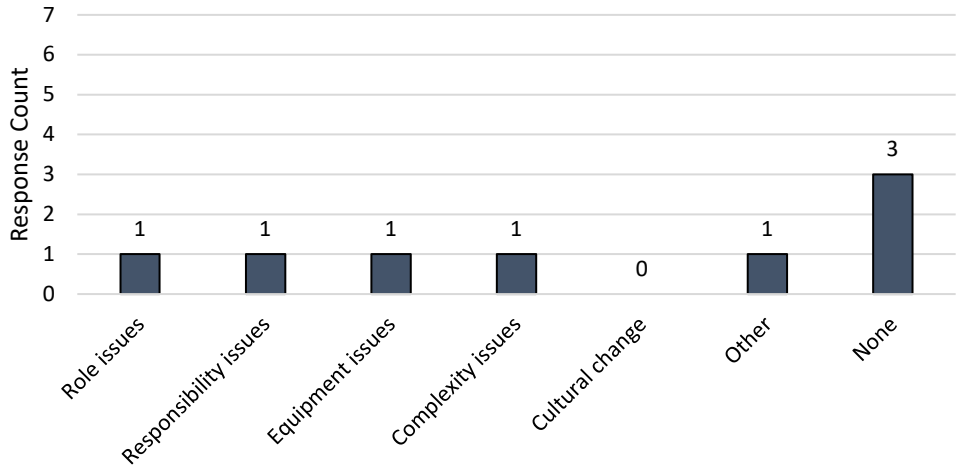


Figure E-8. Responses to "What barriers related to SURF do you see from a line pilot's perspective that would need to be addressed?"

QE.10.Airline Comments

- Possible distraction
- Not applicable - not interested in application

QE.11. What barriers related to SURF do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	1	17%
Responsibility issues	1	17%
Equipment issues	1	17%
Complexity issues	1	17%
Cultural change	0	0%
Other	0	0%
None	3	50%
N	6	

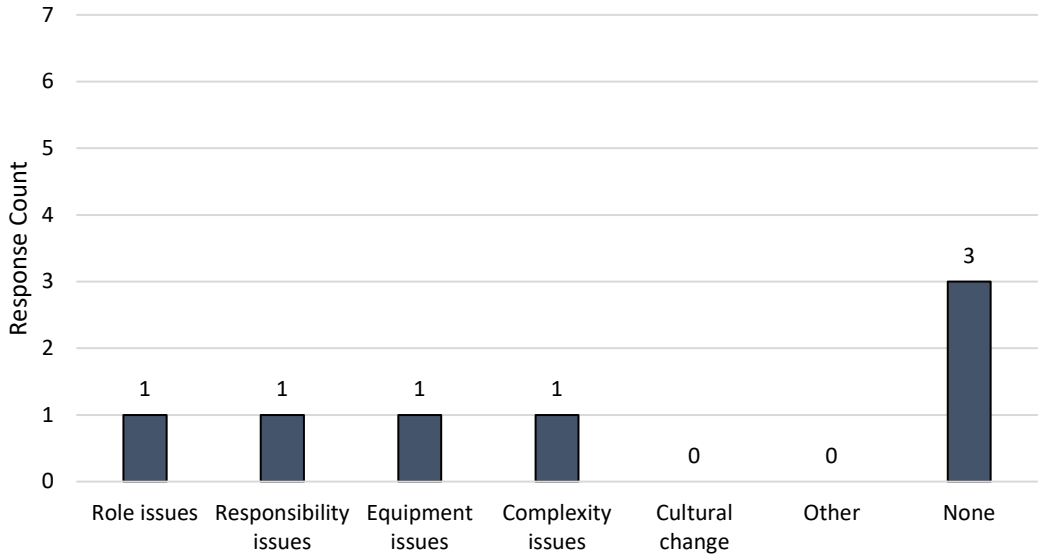


Figure E-9. Responses to "What barriers related to SURF do you see from an air traffic controller's perspective that would need to be addressed?"

QE.11.Airline Comments

- Not applicable - not interested in application

QE.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in SURF.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	2	33%
Neither	1	17%
Somewhat Agree	3	50%
Agree	0	0%
Strongly Agree	0	0%
N	6	
% Agreement	3	50%
% Disagreement	2	33%

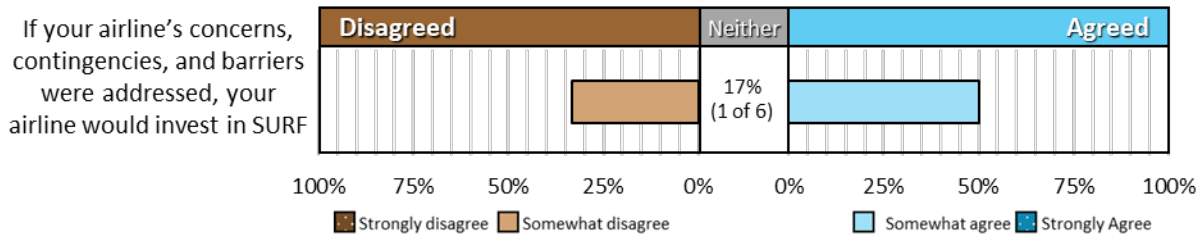


Figure E-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in SURF."

QE.12.Airline Comments

- Not applicable - not interested in application

QE.13. When would your airline expect to equip with SURF?

	Count	Percentage
In our first implementation of ADS-B In applications	0	0%
In a later implementation of ADS-B In applications	3	43%
Other	3	43%
Never	1	14%
N	7	

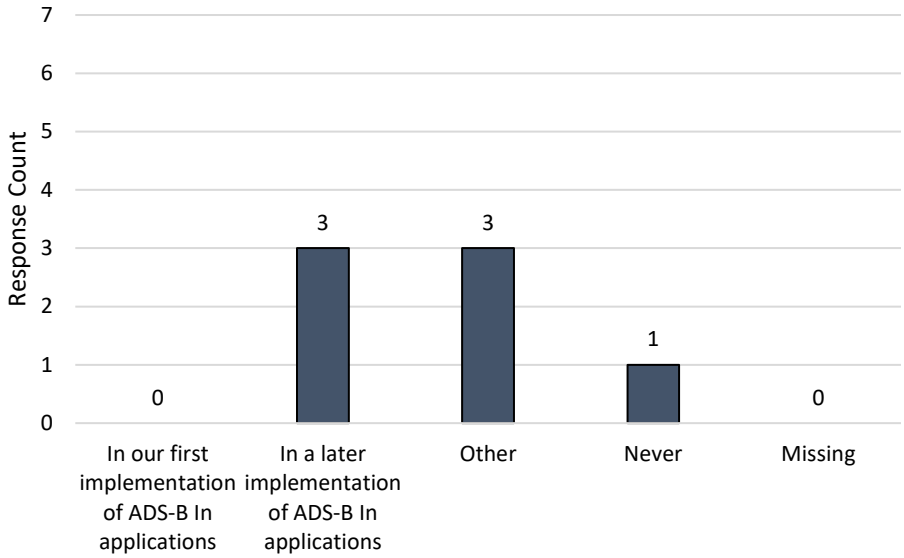


Figure E-11. Responses to "When would your airline expect to equip with SURF?"

QE.13.Airline Comments

- Needed ROI
- It appears SURF may not be available when other ADS B In apps are.

QE.14. Do you have any additional thoughts for the NAC to share with the FAA related to SURF?

- Hard to "sell" a safety feature without an identified and acknowledged risk

Surface Alerting (SURF-A)

QF.3. My airline is interested in SURF-A.

		Percentage
Strongly Disagree	1	14%
Disagree	0	0%
Somewhat Disagree	2	29%
Neither	0	0%
Somewhat Agree	4	57%
Agree	0	0%
Strongly Agree	0	0%
N	7	
% Agreement	4	57%
% Disagreement	3	43%

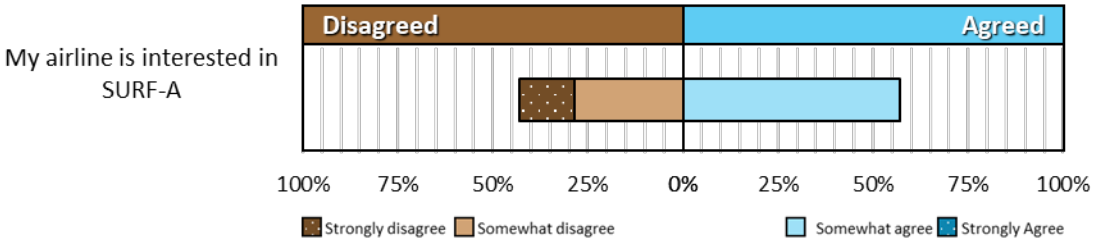


Figure F-1. Responses to "My airline is interested in SURF-A."

QF.4. Rate your priority for SURF-A amongst the set of ADS-B In applications.

	Count	Percentage
Low	3	43%
Medium	4	57%
High	0	0%
N	7	

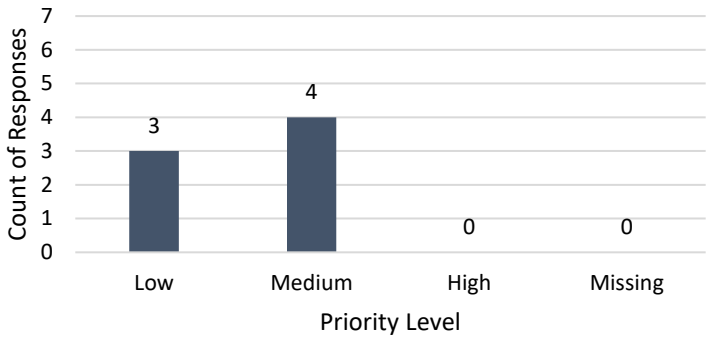


Figure F-2. Responses to "Rate your priority for SURF-A amongst the set of ADS-B In applications."

QF.4.Airline Comments

- None

QF.5. What is it about SURF-A that interests your airline?

Benefits	2	33%	2	33%	0	0%
Low Cost	1	17%	0	0%	2	33%
Applicability at enough locations where we operate	2	33%	0	0%	2	33%
Other	1	17%	0	0%	0	0%
Nothing interests	2	33%				
N	6					

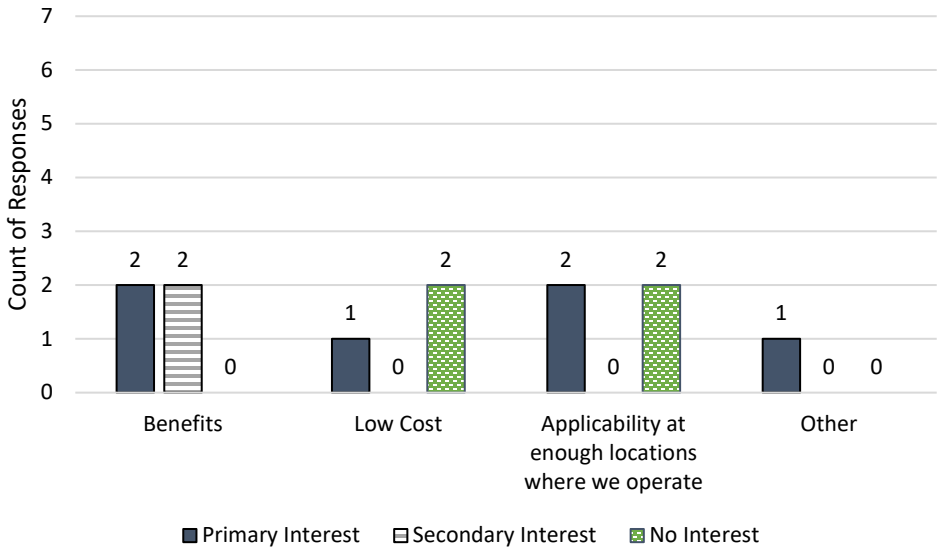


Figure F-3. Responses to "What is it about SURF-A that interests your airline?"

QF.5.Airline Comments

- Nothing about SURF-A interests my airline
- Nothing about SURF-A interests my airline

QF.6. Describe how your airline believes SURF-A can bring benefit to your operation.

Increased capacity/throughput	1	14%	0	0%	2	29%	0	0%
Reduced fuel burn	1	14%	0	0%	2	29%	0	0%
Reduced time in air	1	14%	0	0%	2	29%	0	0%
Reduced gate time	0	0%	0	0%	1	14%	2	29%
More predictable block times leading to schedule improvements	1	14%	0	0%	2	29%	1	14%
Reduced communications	0	0%	1	14%	1	14%	1	14%
Increased flexibility	0	0%	1	14%	2	29%	0	0%
Increased access	0	0%	1	14%	2	29%	0	0%
Increased pilot traffic awareness	3	43%	1	14%	0	0%	0	0%
Increased safety	5	71%	1	14%	0	0%	0	0%
Increased passenger satisfaction	0	0%	0	0%	3	43%	0	0%
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

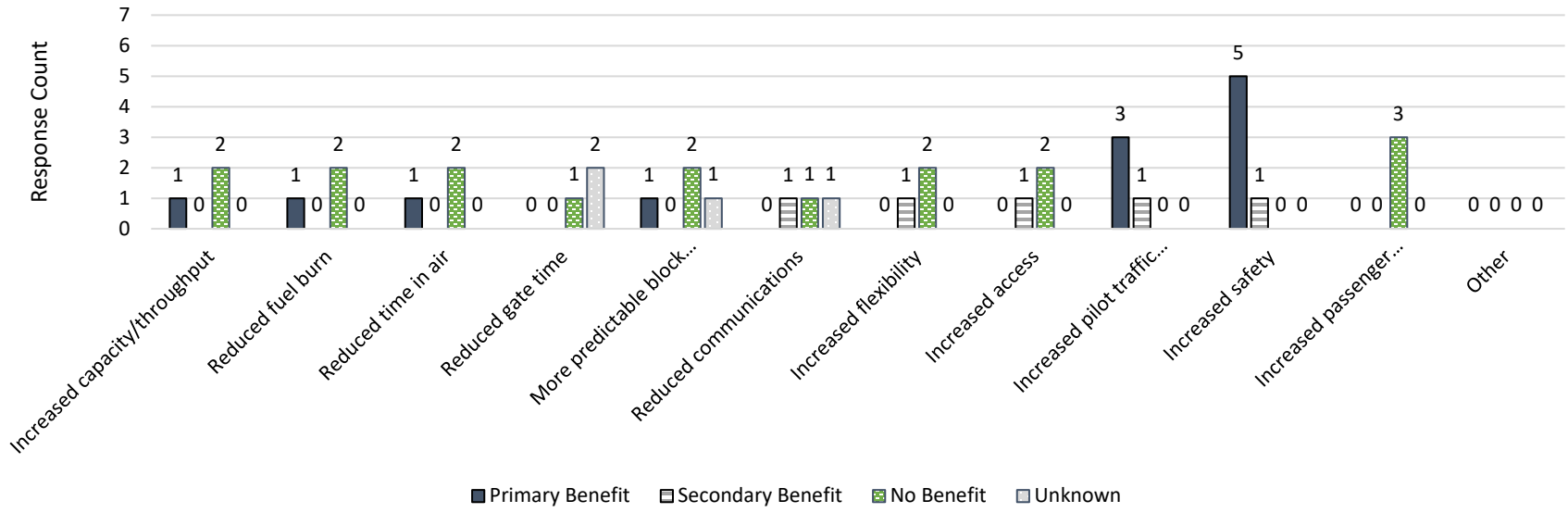


Figure F-4. Responses to "Describe how your airline believes SURF-A can bring benefit to your operation."

QF.6.Airline Comments

- SURF-A does not bring benefit

QF.7. What is it about SURF-A that concerns your airline?

Benefits	3	43%	1	14%	1	14%
Cost	4	57%	0	0%	1	14%
Not applicable at enough locations where we operate	1	14%	0	0%	2	29%
General concept	0	0%	1	14%	3	43%
Concept complexity	0	0%	1	14%	2	29%
Necessary procedural changes	0	0%	0	0%	3	43%
Necessary controller automation	1	14%	0	0%	3	43%
Training Cost	1	14%	0	0%	2	29%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

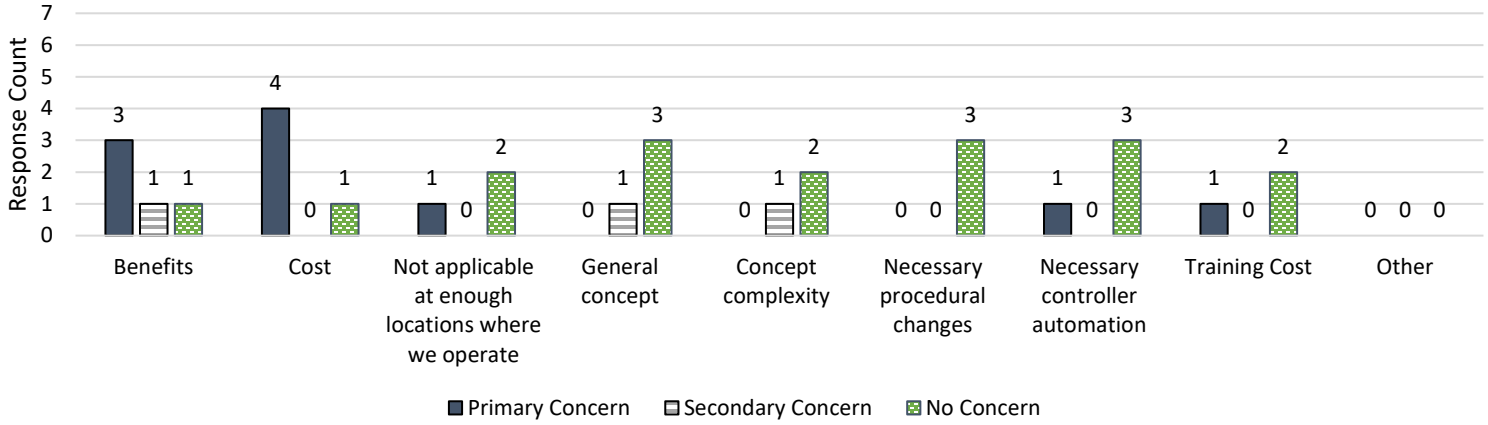


Figure F-5. Responses to "What is it about SURF-A that concerns your airline?"

QF.7.Airline Comments

- SURF-A does not bring benefit

QF.8. If your airline is interested in SURF-A, are there contingencies on an investment?

Solidification of FAA commitments	2	29%	0	0%	1	14%
Implementation of a two-rate Ground Delay Program (GDP)	1	14%	1	14%	1	14%
Additional information on avionics costs	2	29%	1	14%	0	0%
Additional information on installation and training costs	2	29%	0	0%	1	14%
Additional information on flight deck integration	2	29%	1	14%	0	0%
Other airline investment	0	0%	1	14%	1	14%
Additional field demonstration data	2	29%	0	0%	2	29%
Other	0	0%	0	0%	0	0%
No contingencies	2	29%				
N	7					

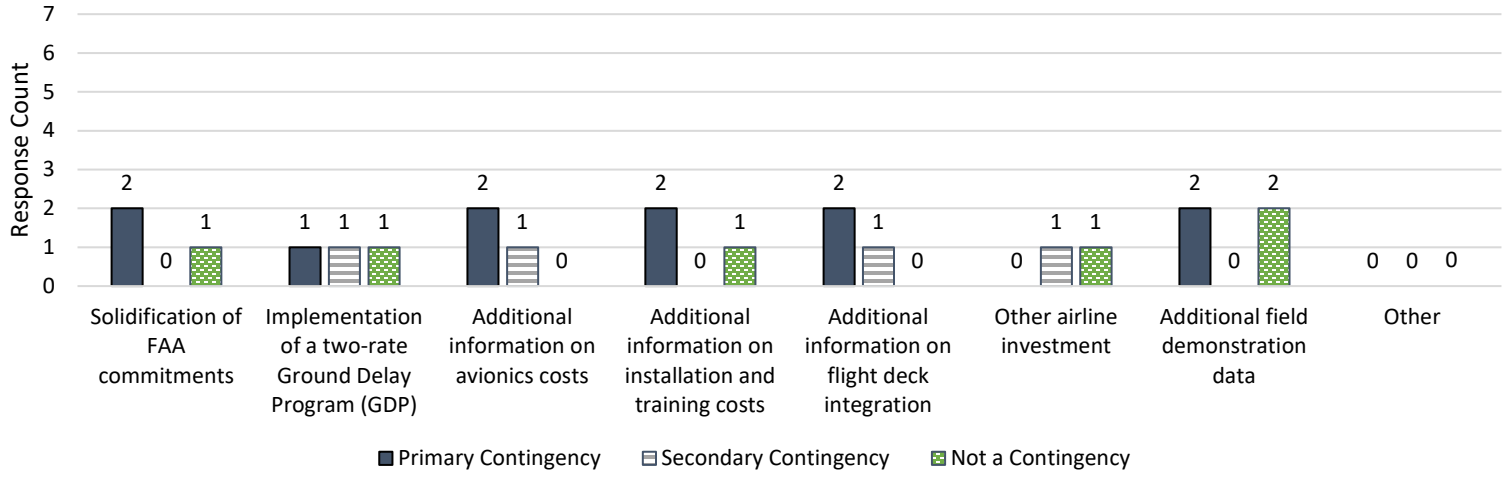


Figure F-6. Responses to "If your airline is interested in SURF-A, are there contingencies on an investment?"

QF.8.Airline Comments

- Not applicable - not interested in application

QF.9. If your airline is interested but not willing to commit to an investment in SURF-A, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	3	50%
Insufficient understanding of the ADS-B In application benefits	1	17%	0	0%	2	33%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	3	50%
Insufficient funds	2	33%	0	0%	1	17%
Lack of benefits data	2	33%	1	17%	1	17%
Lack of field demonstration data	0	0%	0	0%	3	50%
Unclear FAA commitments on automation investments	2	33%	0	0%	2	33%
Unclear FAA commitments on necessary procedural changes	1	17%	1	17%	2	33%
Lack of information on avionics costs	1	17%	0	0%	2	33%
Lack of information on avionics installation requirements	1	17%	0	0%	2	33%
Pilot acceptability issues	0	0%	1	17%	2	33%
Controller acceptability issues	1	17%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	1	17%	2	33%
Training costs	1	17%	0	0%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	1	17%				
N	6					

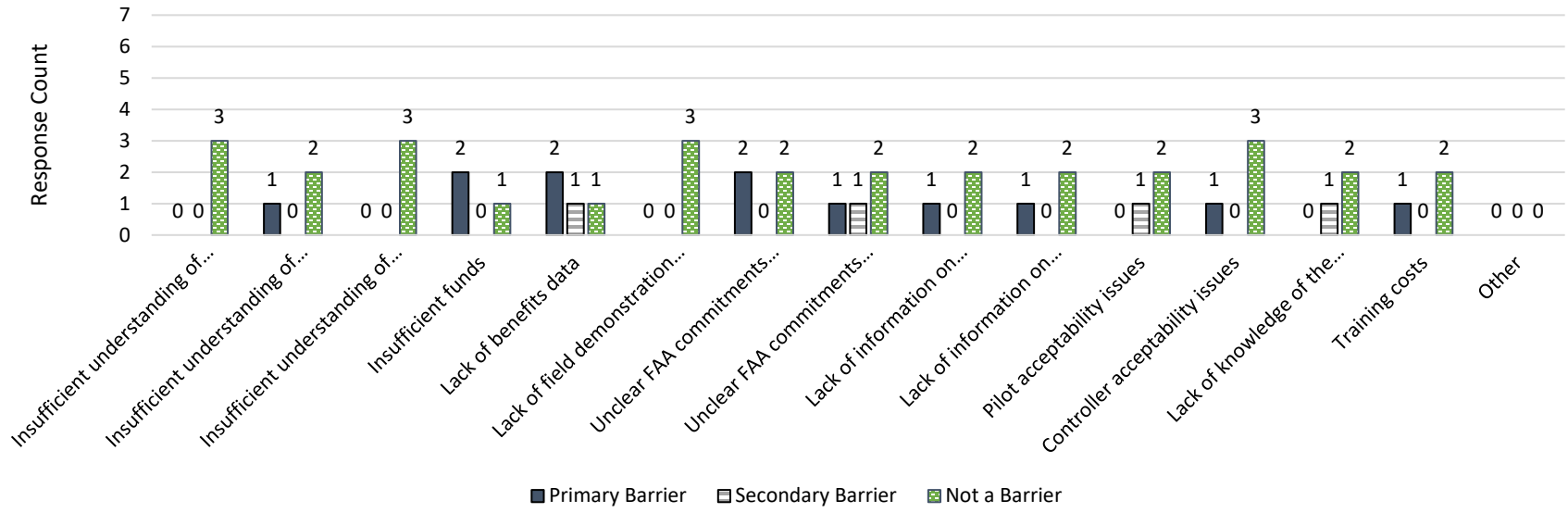


Figure F-7. Responses to "If your airline is interested but not willing to commit to an investment in SURF-A, what barriers could be removed to incentivize your airline to invest?"

QF.9.Airline Comments

- Bottom line: can I justify its cost with a benefit? Still unclear...
- Nothing can motivate investment

QF.10. What barriers related to SURF-A do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	1	14%
Equipment issues	0	0%
Complexity issues	2	29%
Cultural change	0	0%
Other	1	14%
None	1	14%
N	7	

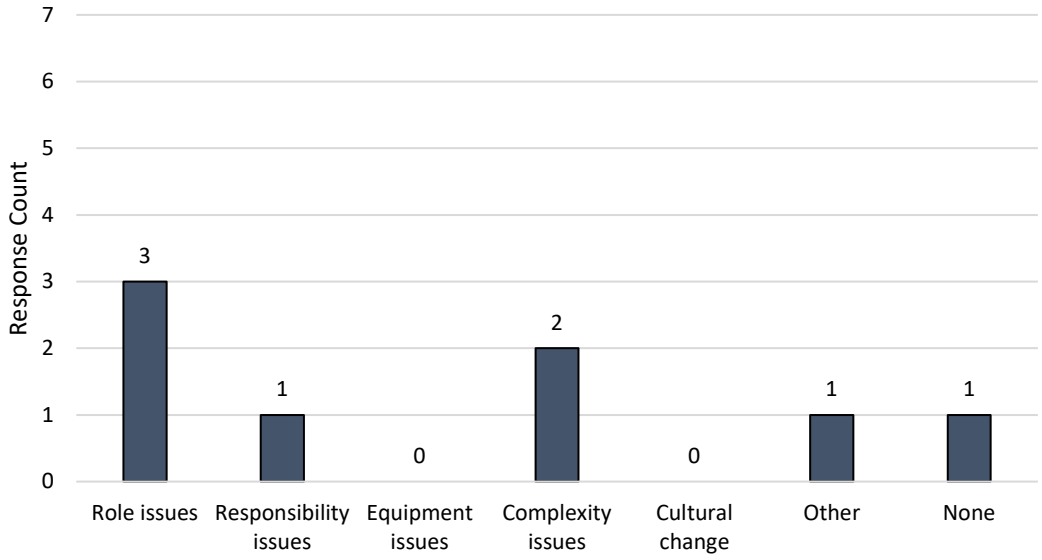


Figure F-8. Responses to "What barriers related to SURF-A do you see from a line pilot's perspective that would need to be addressed?"

QF.10.Airline Comments

- Not applicable - not interested in application

QF.11. What barriers related to SURF-A do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	29%
Responsibility issues	1	14%
Equipment issues	1	14%
Complexity issues	1	14%
Cultural change	0	0%
Other	0	0%
None	3	43%
N	7	

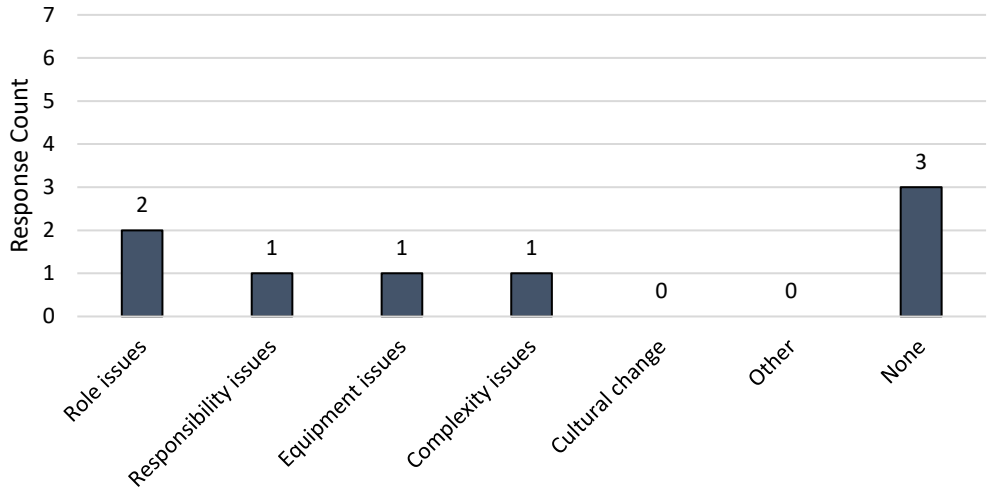


Figure F-9. Responses to "What barriers related to SURF-A do you see from an air traffic controller's perspective that would need to be addressed?"

QF.11.Airline Comments

- False warnings
- Not applicable - not interested in application
- Potentially issues similar to TCAS RA with false warnings.

QF.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in SURF-A.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	2	33%
Neither	1	17%
Somewhat Agree	3	50%
Agree	0	0%
Strongly Agree	0	0%
N	6	
% Agreement	3	50%
% Disagreement	2	33%

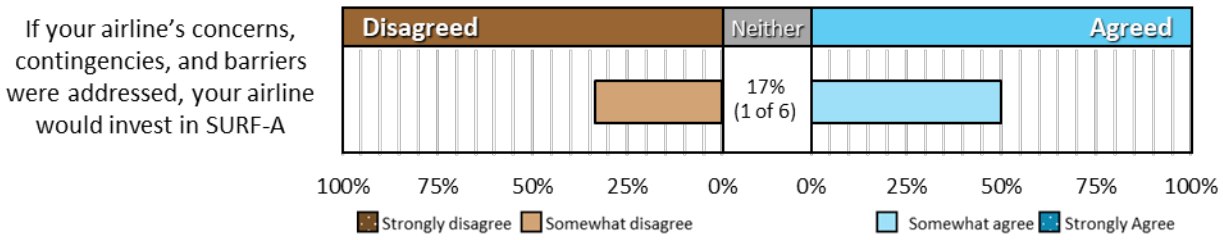


Figure F-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in SURF-A."

QF.12.Airline Comments

- Not applicable - not interested in application

QF.13. When would your airline expect to equip with SURF-A?

	Count	Percentage
In our first implementation of ADS-B In applications	0	0%
In a later implementation of ADS-B In applications	4	57%
Other	2	29%
Never	1	14%
N	7	

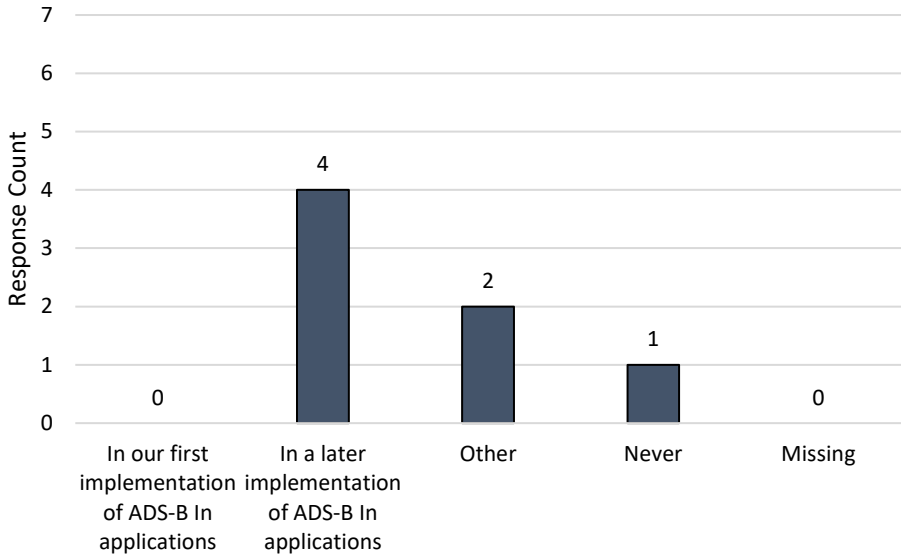


Figure F-11. Responses to "When would your airline expect to equip with SURF-A?"

QF.13.Airline Comments

- Unknown
- Needed ROI

QF.14. Do you have any additional thoughts for the NAC to share with the FAA related to SURF-A?

- As with previous application, hard to sell a safety feature without an identified and acknowledged threat

Surface Indicating and Alerting (SURF-IA)

QG.3. My airline is interested in SURF-IA.

		Percentage
Strongly Disagree	1	14%
Disagree	0	0%
Somewhat Disagree	2	29%
Neither	0	0%
Somewhat Agree	4	57%
Agree	0	0%
Strongly Agree	0	0%
N	7	
% Agreement	4	57%
% Disagreement	3	43%

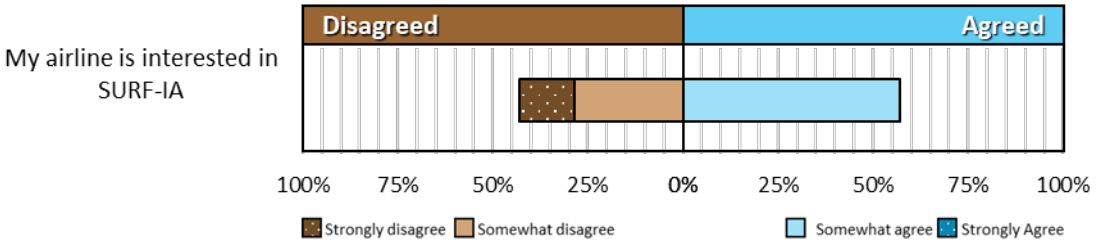


Figure G-1. Responses to "My airline is interested in SURF-IA."

QG.4. Rate your priority for SURF-IA amongst the set of ADS-B In applications.

	Count	Percentage
Low	3	43%
Medium	4	57%
High	0	0%
N	7	

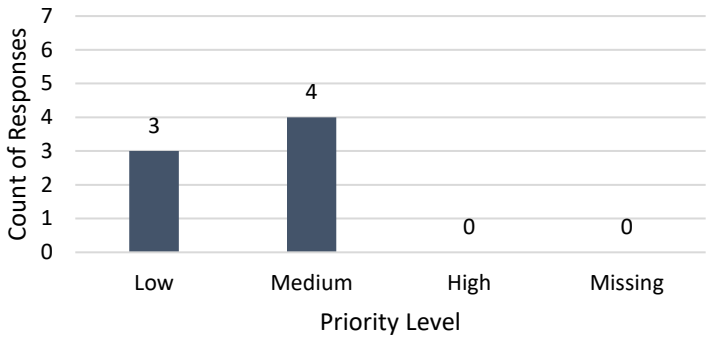


Figure G-2. Responses to "Rate your priority for SURF-IA amongst the set of ADS-B In applications."

QG.4.Airline Comments

- None

QG.5. What is it about SURF-IA that interests your airline?

Benefits	2	29%	2	29%	0	0%
Low Cost	2	29%	0	0%	2	29%
Applicability at enough locations where we operate	2	29%	1	14%	1	14%
Other	1	14%	0	0%	0	0%
Nothing interests	2	29%				
N	7					

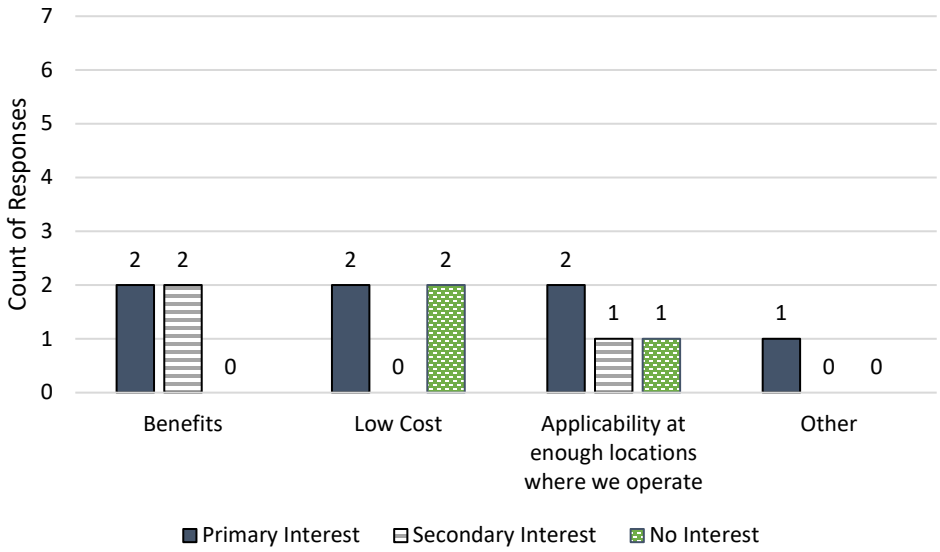


Figure G-3. Responses to "What is it about SURF-IA that interests your airline?"

QG.5.Airline Comments

- None

QG.6. Describe how your airline believes SURF-IA can bring benefit to your operation.

Increased capacity/throughput	2	29%	0	0%	2	29%	0	0%
Reduced fuel burn	1	14%	0	0%	2	29%	0	0%
Reduced time in air	1	14%	0	0%	2	29%	0	0%
Reduced gate time	0	0%	0	0%	1	14%	2	29%
More predictable block times leading to schedule improvements	1	14%	0	0%	1	14%	2	29%
Reduced communications	0	0%	1	14%	2	29%	0	0%
Increased flexibility	0	0%	1	14%	2	29%	0	0%
Increased access	0	0%	1	14%	2	29%	0	0%
Increased pilot traffic awareness	4	57%	1	14%	0	0%	0	0%
Increased safety	6	86%	0	0%	0	0%	0	0%
Increased passenger satisfaction	0	0%	0	0%	3	43%	0	0%
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

Appendix E: Mainline Operator Questionnaire De-identified Responses

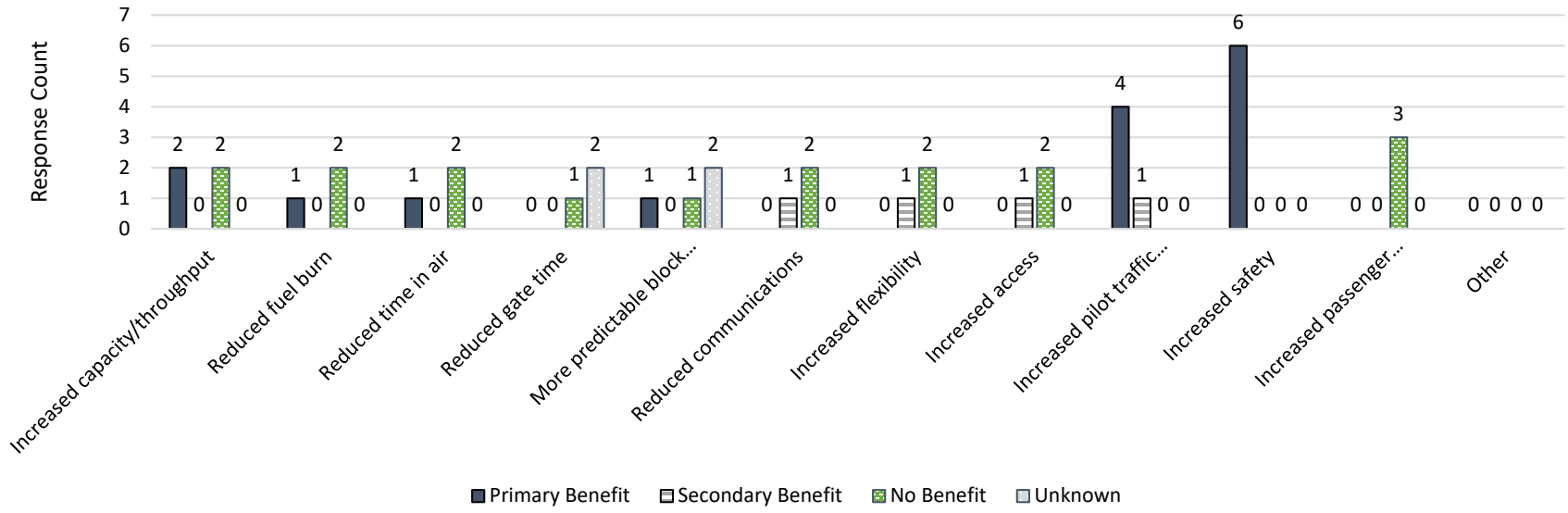


Figure G-4. Responses to "Describe how your airline believes SURF-IA can bring benefit to your operation."

QG.6.Airline Comments

- None

QG.7. What is it about SURF-IA that concerns your airline?

Benefits	5	71%	0	0%	1	14%
Cost	5	71%	0	0%	1	14%
Not applicable at enough locations where we operate	2	29%	0	0%	2	29%
General concept	0	0%	1	14%	3	43%
Concept complexity	0	0%	1	14%	2	29%
Necessary procedural changes	0	0%	0	0%	3	43%
Necessary controller automation	0	0%	0	0%	3	43%
Training Cost	1	14%	0	0%	2	29%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

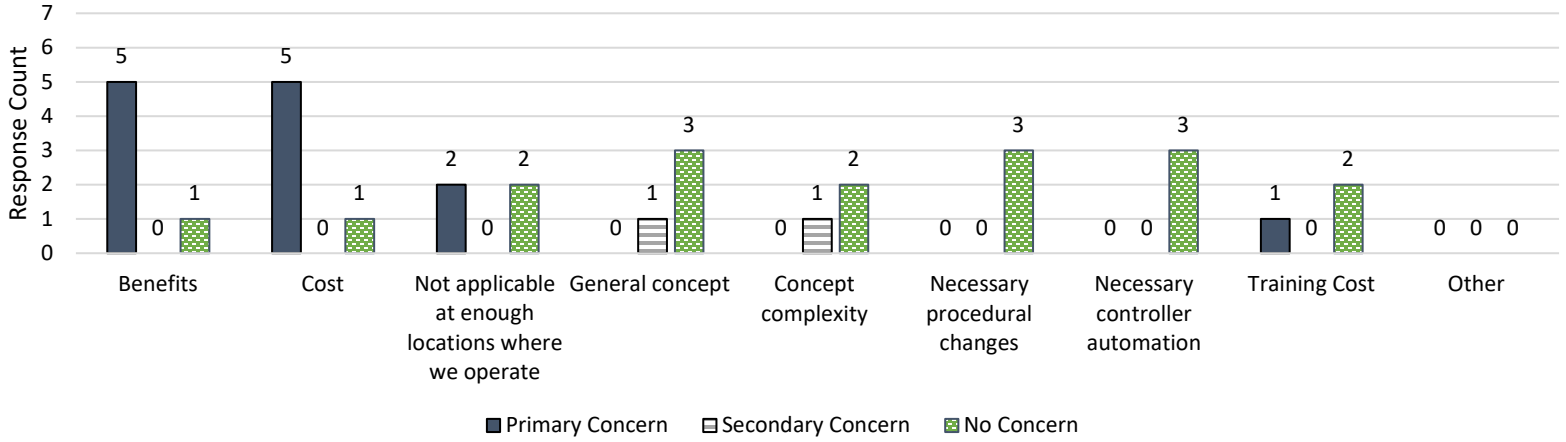


Figure G-5. Responses to "What is it about SURF-IA that concerns your airline?"

QG.7.Airline Comments

- Nothing about SURF-IA interests my airline

QG.8. If your airline is interested in SURF-IA, are there contingencies on an investment?

Solidification of FAA commitments	2	29%	0	0%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	1	14%	1	14%	0	0%
Additional information on avionics costs	2	29%	0	0%	0	0%
Additional information on installation and training costs	2	29%	0	0%	0	0%
Additional information on flight deck integration	2	29%	0	0%	0	0%
Other airline investment	0	0%	1	14%	0	0%
Additional field demonstration data	2	29%	0	0%	1	14%
Other	0	0%	0	0%	0	0%
No contingencies	3	43%				
N	7					

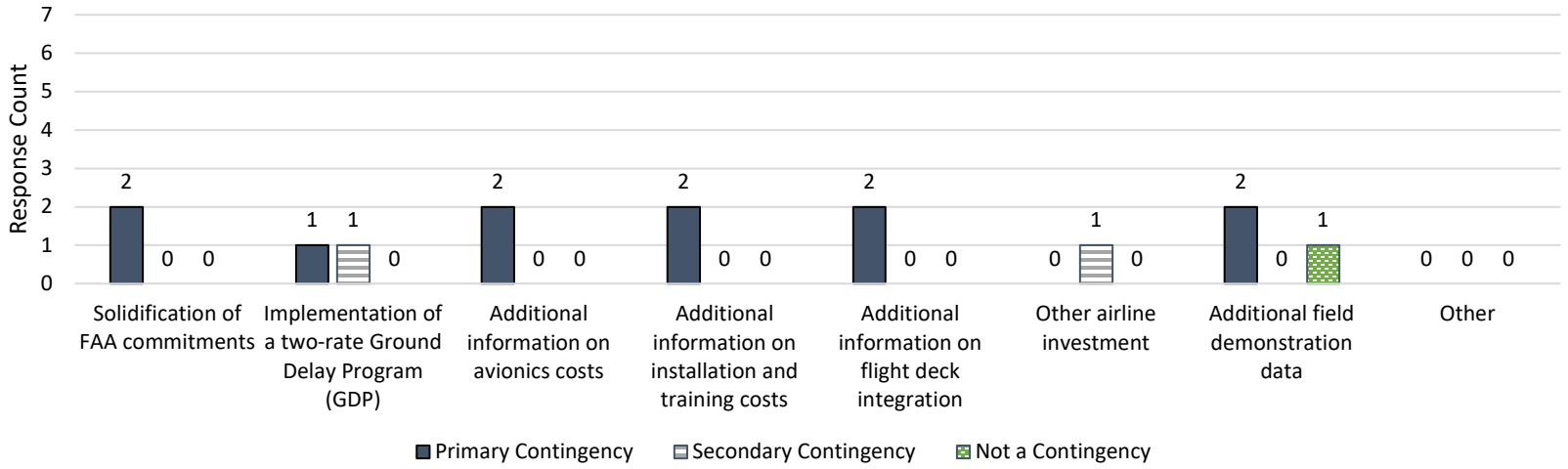


Figure G-6. Responses to "If your airline is interested in SURF-IA, are there contingencies on an investment?"

QG.8.Airline Comments

- Not applicable - not interested in application

QG.9. If your airline is interested but not willing to commit to an investment in SURF-IA, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	3	60%
Insufficient understanding of the ADS-B In application benefits	0	0%	0	0%	3	60%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	3	60%
Insufficient funds	2	40%	1	20%	1	20%
Lack of benefits data	1	20%	2	40%	0	0%
Lack of field demonstration data	2	40%	0	0%	2	40%
Unclear FAA commitments on automation investments	2	40%	0	0%	2	40%
Unclear FAA commitments on necessary procedural changes	1	20%	1	20%	2	40%
Lack of information on avionics costs	1	20%	0	0%	2	40%
Lack of information on avionics installation requirements	1	20%	0	0%	2	40%
Pilot acceptability issues	0	0%	0	0%	3	60%
Controller acceptability issues	1	20%	0	0%	3	60%
Lack of knowledge of the future operation of the airline	0	0%	1	20%	2	40%
Training costs	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate	1	20%				
N	5					

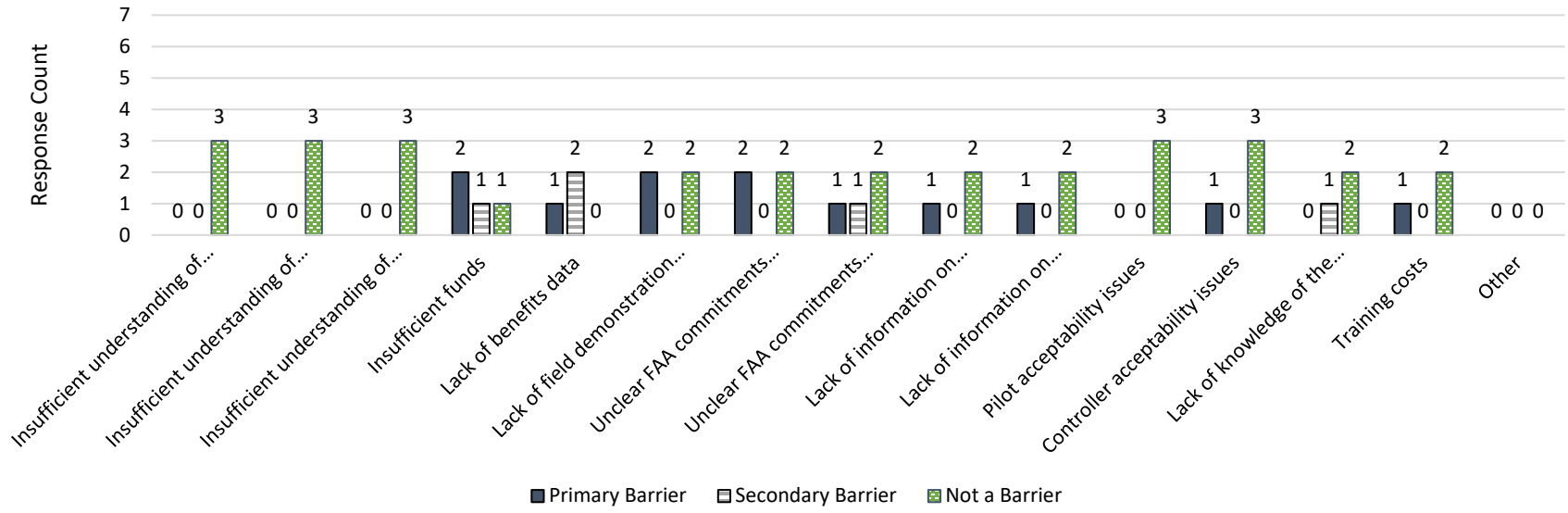


Figure G-7. Responses to "If your airline is interested but not willing to commit to an investment in SURF-IA, what barriers could be removed to incentivize your airline to invest?"

QG.9.Airline Comments

- Nothing can motivate investment

QG.10. What barriers related to SURF-IA do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	29%
Responsibility issues	1	14%
Equipment issues	2	29%
Complexity issues	1	14%
Cultural change	0	0%
Other	1	14%
None	1	14%
N	7	

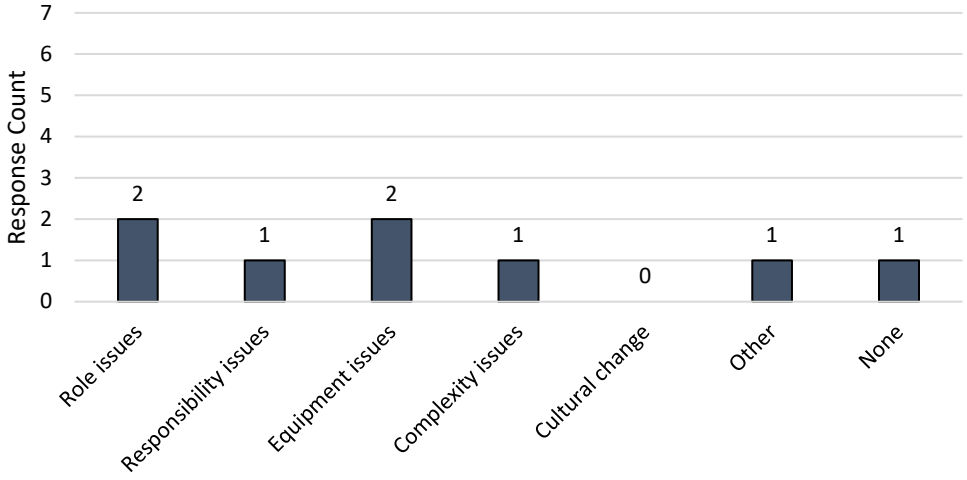


Figure G-8. Responses to "What barriers related to SURF-IA do you see from a line pilot's perspective that would need to be addressed?"

QG.10.Airline Comments

- False warnings.
- Not applicable - not interested in application

QG.11. What barriers related to SURF-IA do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	1	14%
Responsibility issues	1	14%
Equipment issues	2	29%
Complexity issues	0	0%
Cultural change	1	14%
Other	0	0%
None	2	29%
N	7	

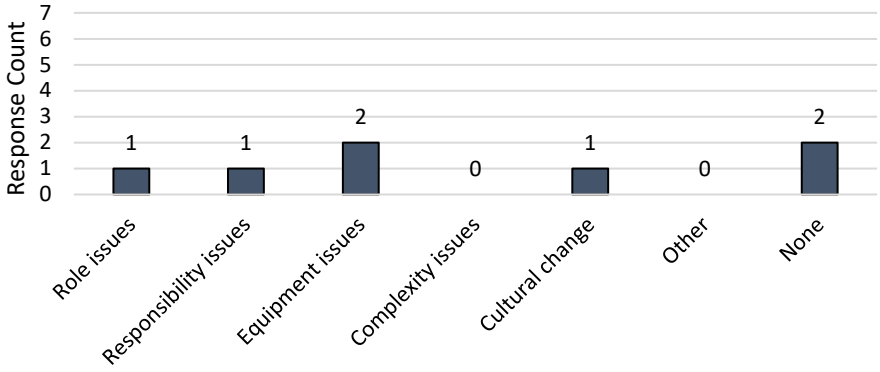


Figure G-9. Responses to "What barriers related to SURF-IA do you see from an air traffic controller's perspective that would need to be addressed?"

QG.11.Airline Comments

- False warnings.
- Not applicable - not interested in application
- Potentially issues similar to TCAS RA with false warnings.QG.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in SURF-IA.

QG.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in SURF-IA.

	Count	Percentage
Strongly Disagree	1	17%
Disagree	0	0%
Somewhat Disagree	1	17%
Neither	1	17%
Somewhat Agree	3	50%
Agree	0	0%
Strongly Agree	0	0%
N	6	
% Agreement	3	50%
% Disagreement	2	33%

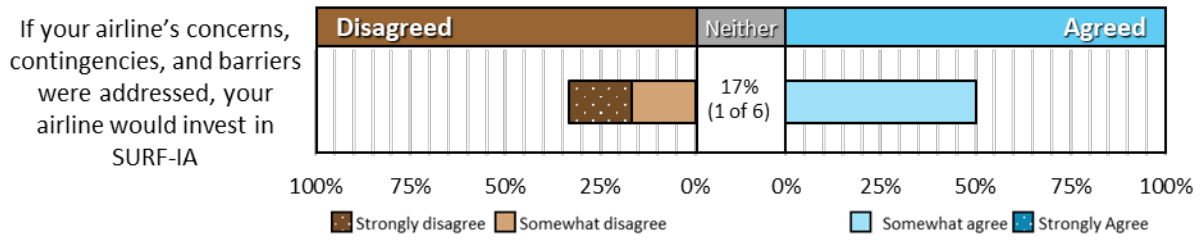


Figure G-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in SURF-IA."

QG.12.Airline Comments

- difficult to ID a justifiable benefit at this time; collateral benefit only
- Not applicable - not interested in application

QG.13. When would your airline expect to equip with SURF-IA?

	Count	Percentage
In our first implementation of ADS-B In applications	0	0%
In a later implementation of ADS-B In applications	4	57%
Other	2	29%
Never	1	14%
N	7	

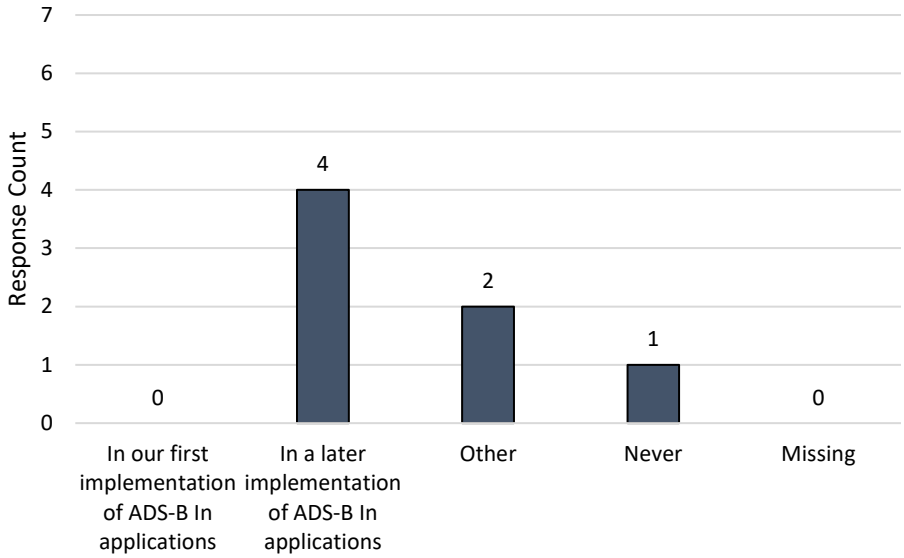


Figure G-11. Responses to "When would your airline expect to equip with SURF-IA?"

QG.13.Airline Comments

- Investment unlikely
- Needed ROI
- Later because there is no timeline on when this will be available.

QG.14. Do you have any additional thoughts for the NAC to share with the FAA related to SURF-IA?

- As with previous, hard to sell a safety feature without and [sic] identified and acknowledged risk

Flight-deck-based Interval Management (FIM) – Same Corner Post Arrivals

QH.3. My airline is interested in FIM - Same Corner Post Arrivals.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	2	29%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	5	71%
% Disagreement	0	0%

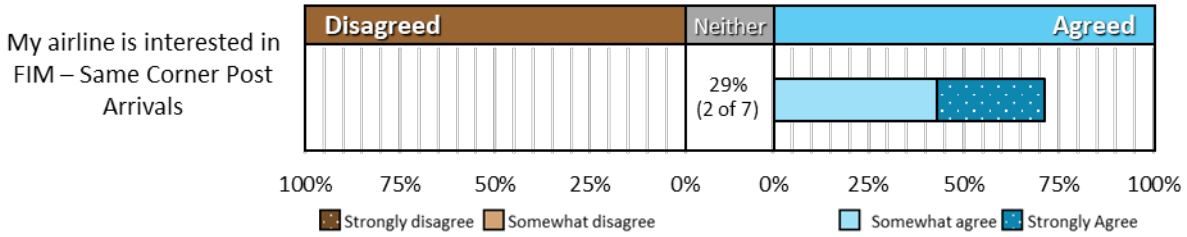


Figure H-1. Responses to "My airline is interested in FIM - Same Corner Post Arrivals."

QH.4. Rate your priority for FIM - Same Corner Post Arrivals amongst the set of ADS-B In applications.

	Count	Percentage
Low	2	29%
Medium	2	29%
High	3	43%
N	7	

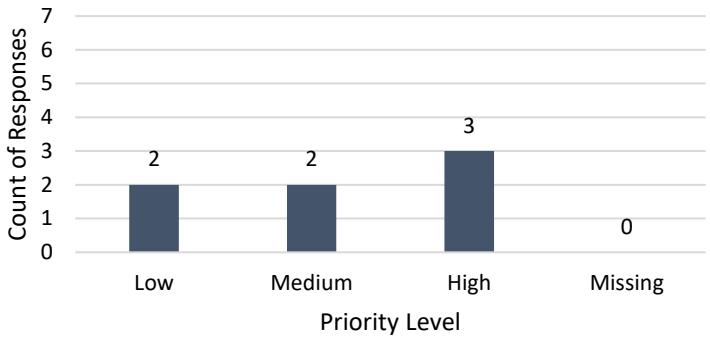


Figure H-2. Responses to "Rate your priority for FIM - Same Corner Post Arrivals amongst the set of ADS-B In applications."

QH.4.Airline Comments

- Pending further development of the concept.

QH.5. What is it about FIM - Same Corner Post Arrivals that interests your airline?

Benefits	7	100%	0	0%	0	0%
Low Cost	1	14%	3	43%	1	14%
Applicability at enough locations where we operate	5	71%	1	14%	0	0%
Other	0	0%	0	0%	1	14%
Nothing interests	0	0%				
N	7					

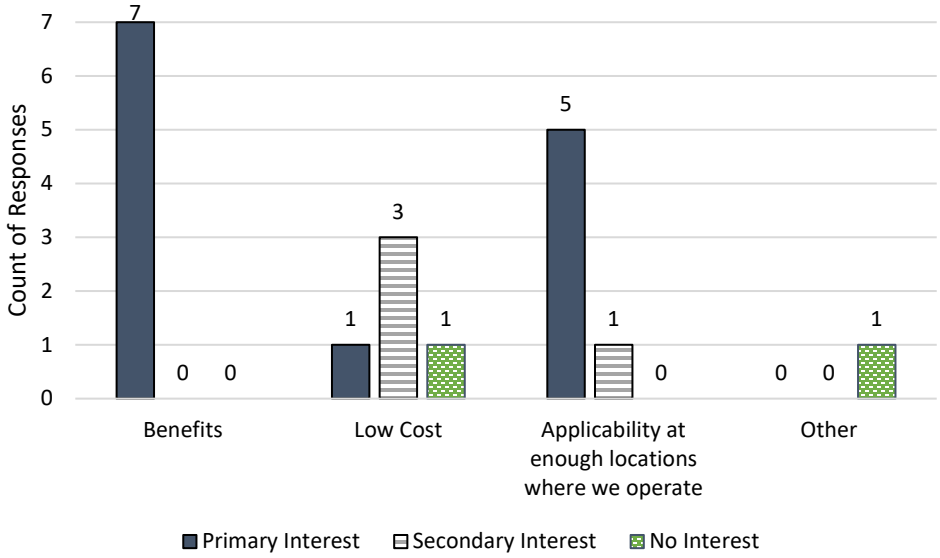


Figure H-3. Responses to "What is it about FIM - Same Corner Post Arrivals that interests your airline?"

QH.5.Airline Comments

- Not a low cost application. Would be a retrofit and high-cost application.

QH.6. Describe how your airline believes FIM - Same Corner Post Arrivals can bring benefit to your operation.

Increased capacity/throughput	3	43%	0	0%	0	0%	0	0%
Reduced fuel burn	2	29%	4	57%	0	0%	0	0%
Reduced time in air	3	43%	3	43%	0	0%	0	0%
Reduced gate time	0	0%	1	14%	1	14%	4	57%
More predictable block times leading to schedule improvements	1	14%	4	57%	1	14%	1	14%
Reduced communications	1	14%	1	14%	2	29%	2	29%
Increased flexibility	0	0%	4	57%	1	14%	1	14%
Increased access	1	14%	2	29%	3	43%	0	0%
Increased pilot traffic awareness	3	43%	4	57%	0	0%	0	0%
Increased safety	2	29%	3	43%	0	0%	0	0%
Increased passenger satisfaction	1	14%	1	14%	2	29%	2	29%
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

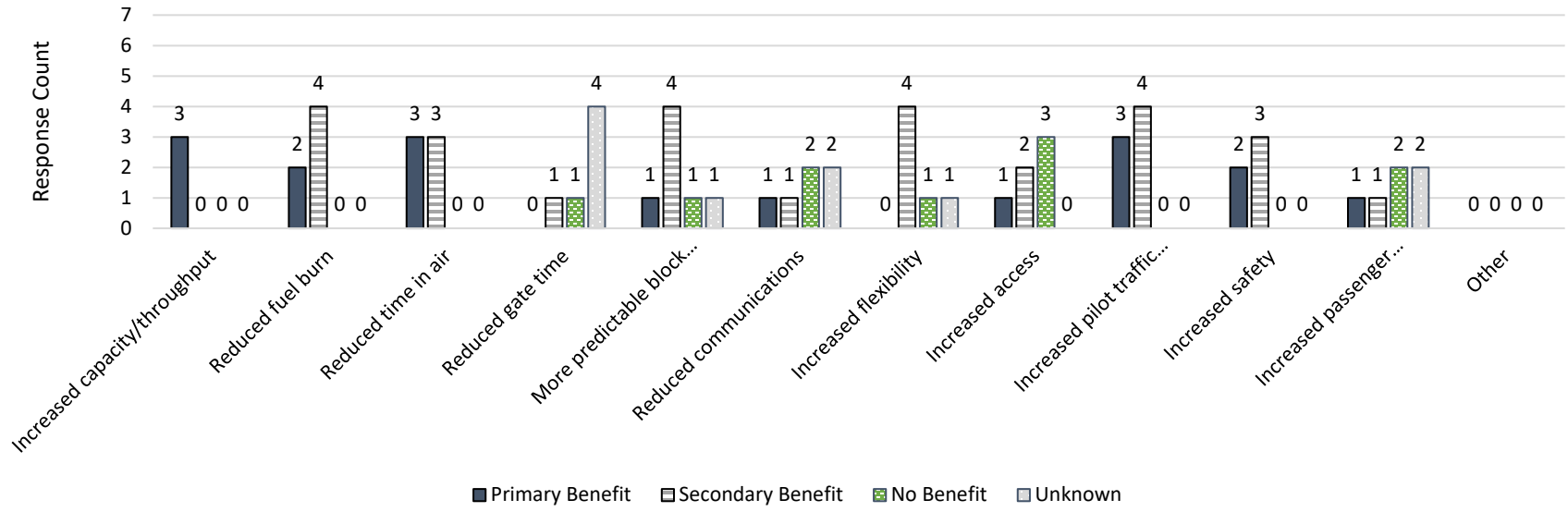


Figure H-4. Responses to "Describe how your airline believes FIM - Same Corner Post Arrivals can bring benefit to your operation."

QH.6.Airline Comments

- None

QH.7. What is it about FIM - Same Corner Post Arrivals that concerns your airline?

Benefits	4	57%	0	0%	1	14%
Cost	4	57%	2	29%	0	0%
Not applicable at enough locations where we operate	3	43%	0	0%	3	43%
General concept	1	14%	2	29%	3	43%
Concept complexity	3	43%	2	29%	1	14%
Necessary procedural changes	3	43%	2	29%	1	14%
Necessary controller automation	4	57%	0	0%	2	29%
Training Cost	1	14%	3	43%	2	29%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

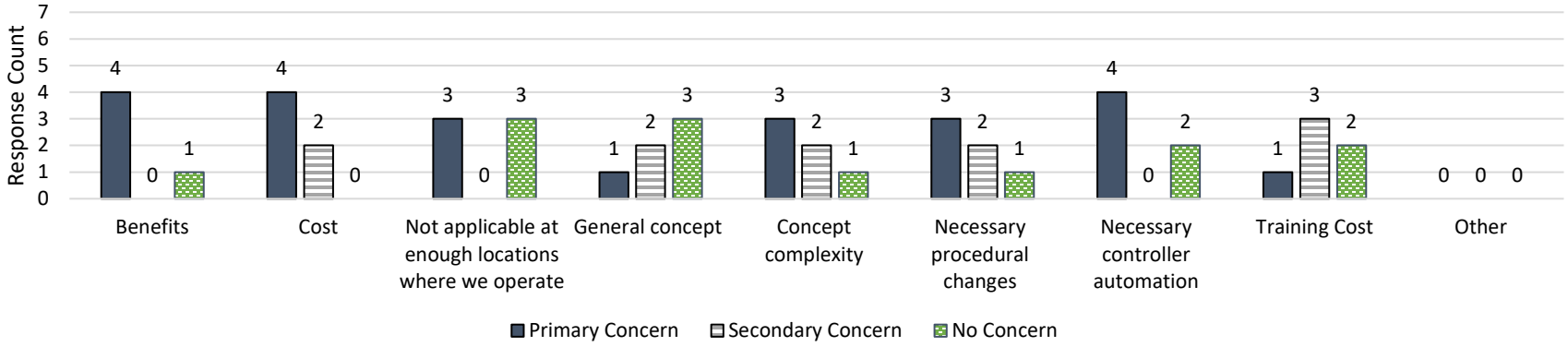


Figure H-5. Responses to "What is it about FIM - Same Corner Post Arrivals that concerns your airline?"

QH.7.Airline Comments

- Cost is our primary concern, along with maturity of solution (thus uncertainty about the cost).
- Still unclear if it will be used vs TBO and if so, will controllers accept it.

QH.8. If your airline is interested in FIM - Same Corner Post Arrivals, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	1	14%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	2	29%	2	29%	2	29%
Additional information on avionics costs	2	29%	3	43%	1	14%
Additional information on installation and training costs	2	29%	2	29%	2	29%
Additional information on flight deck integration	3	43%	1	14%	2	29%
Other airline investment	1	14%	2	29%	3	43%
Additional field demonstration data	3	43%	2	29%	2	29%
Other	1	14%	0	0%	0	0%
No contingencies	0	0%				
N	7					

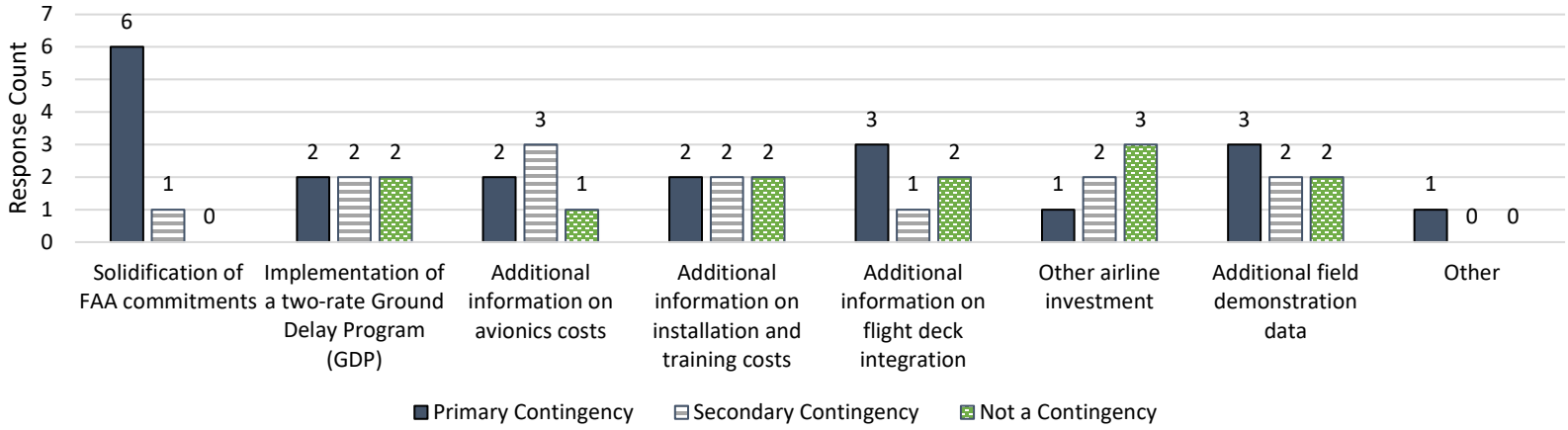


Figure H-6. Responses to "If your airline is interested in FIM - Same Corner Post Arrivals, are there contingencies on an investment?"

QH.8.Airline Comments

- Acceptance by ATC.

QH.9. If your airline is interested but not willing to commit to an investment in FIM - Same Corner Post Arrivals, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	17%	4	67%
Insufficient understanding of the ADS-B In application benefits	0	0%	2	33%	3	50%
Insufficient understanding of technical changes necessary on the aircraft	1	17%	1	17%	3	50%
Insufficient funds	3	50%	2	33%	1	17%
Lack of benefits data	2	33%	2	33%	1	17%
Lack of field demonstration data	2	33%	2	33%	2	33%
Unclear FAA commitments on automation investments	3	50%	2	33%	1	17%
Unclear FAA commitments on necessary procedural changes	3	50%	1	17%	2	33%
Lack of information on avionics costs	2	33%	3	50%	1	17%
Lack of information on avionics installation requirements	1	17%	3	50%	2	33%
Pilot acceptability issues	0	0%	3	50%	3	50%
Controller acceptability issues	3	50%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	3	50%	3	50%
Training costs	1	17%	3	50%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

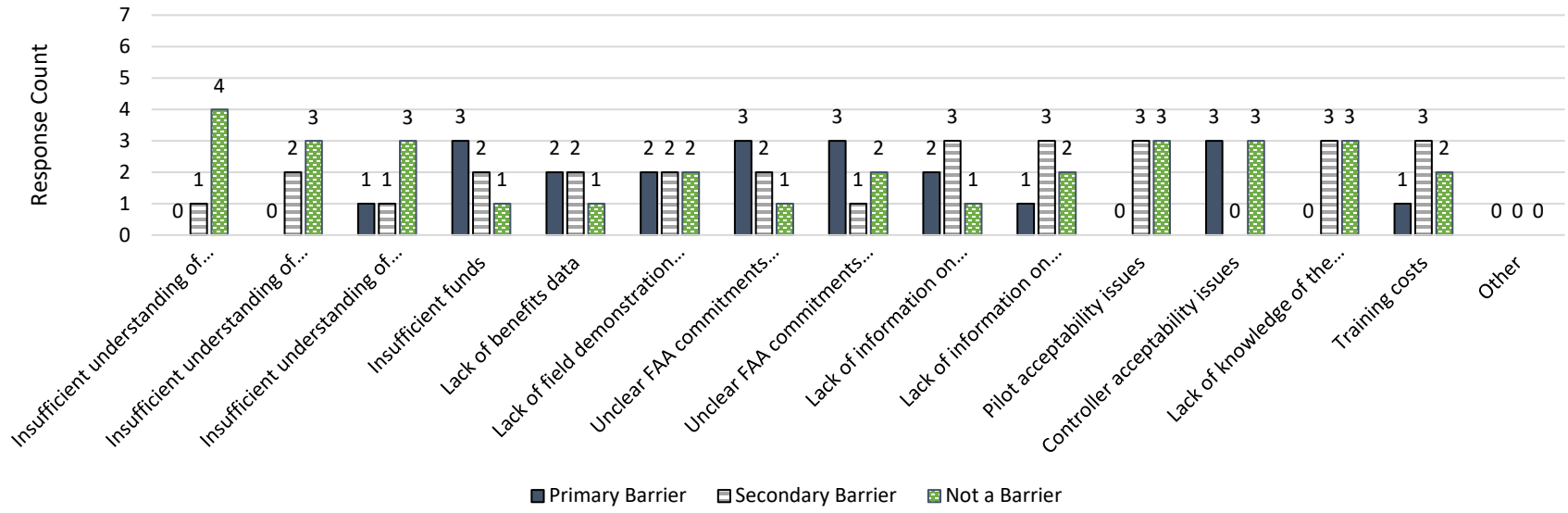


Figure H-7. Responses to "If your airline is interested but not willing to commit to an investment in FIM - Same Corner Post Arrivals, what barriers could be removed to incentivize your airline to invest?"

QH.9.Airline Comments

- None

QH.10. What barriers related to FIM - Same Corner Post Arrivals do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	29%
Responsibility issues	5	71%
Equipment issues	1	14%
Complexity issues	5	71%
Cultural change	4	57%
Other	0	0%
None	0	0%
N	7	

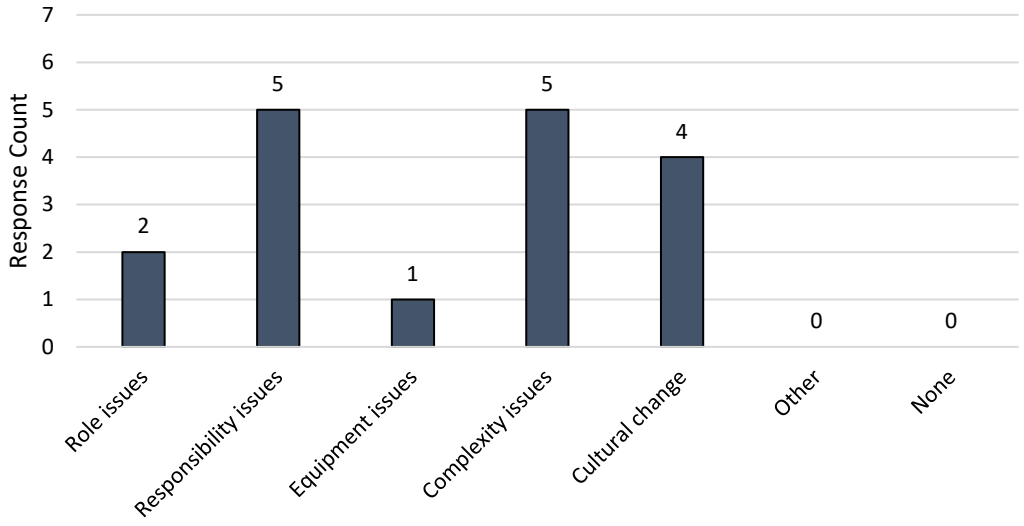


Figure H-8. Responses to "What barriers related to FIM - Same Corner Post Arrivals do you see from a line pilot's perspective that would need to be addressed?"

QH.10.Airline Comments

- None

QH.11. What barriers related to FIM - Same Corner Post Arrivals do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	29%
Responsibility issues	4	57%
Equipment issues	2	29%
Complexity issues	5	71%
Cultural change	4	57%
Other	0	0%
None	0	0%
N	7	

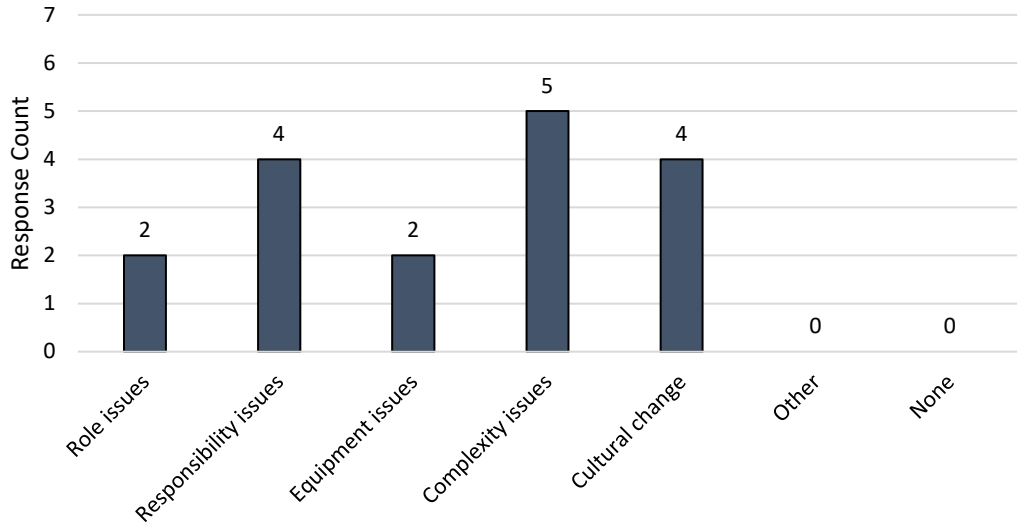


Figure H-9. Responses to "What barriers related to FIM - Same Corner Post Arrivals do you see from an air traffic controller's perspective that would need to be addressed?"

QH.11.Airline Comments

- Need ATC buy in.

QH.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - Same Corner Post Arrivals.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	14%
Somewhat Agree	4	57%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	6	86%
% Disagreement	0	0%

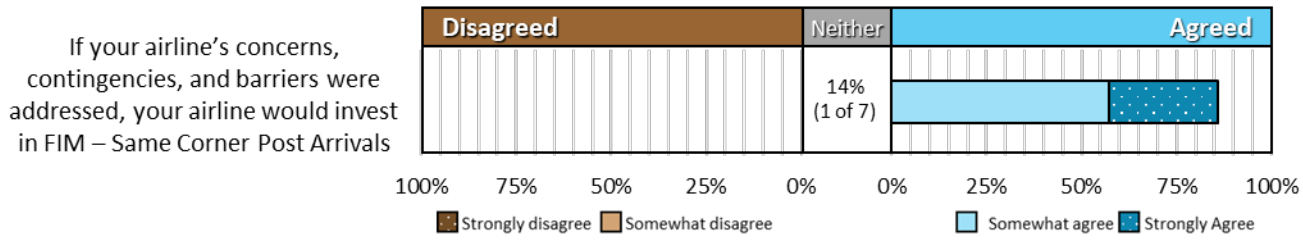


Figure H-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - Same Corner Post Arrivals."

QH.12.Airline Comments

- If potential benefits prove out
- Pending further development of the concept.

QH.13. When would your airline expect to equip with FIM - Same Corner Post Arrivals?

	Count	Percentage
In our first implementation of ADS-B In applications	2	29%
In a later implementation of ADS-B In applications	3	43%
Other	2	29%
Never	0	0%
N	7	

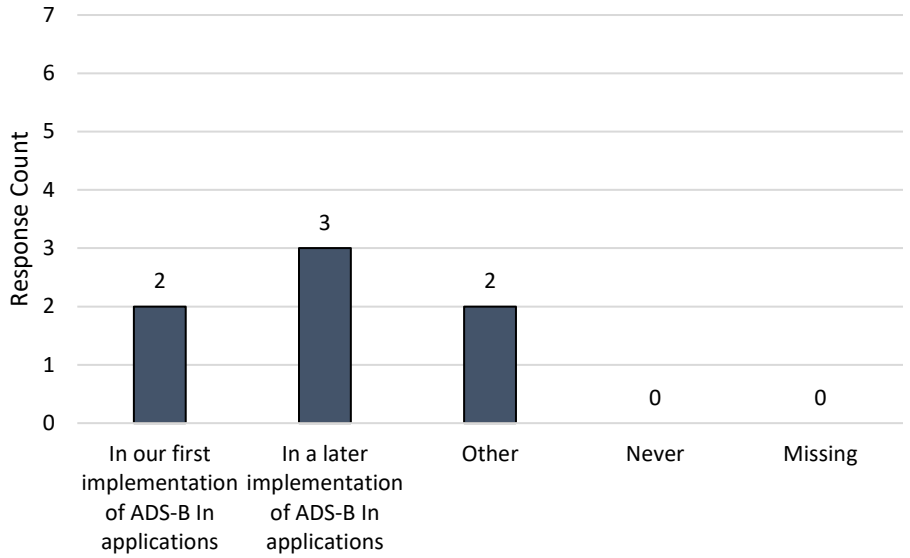


Figure H-11. Responses to "When would your airline expect to equip with FIM - Same Corner Post Arrivals?"

QH.13.Airline Comments

- Unknown: depends on COVID rcvy, financial health, availability of ops data
- "FIM needs the most work to properly integrate in the NAS, focus on easier applications like CAS first and get experience to make FIM better

QH.14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - Same Corner Post Arrivals?

- There is always room for improvement in operational efficiency. just need to gauge *how much* in our operation for this application
- Potential benefits are intriguing but costs are high and applicability to the Northeast is uncertain (if not unlikely).
- We are interested in [airport] being a key site.

Flight-deck-based Interval Management (FIM) – IM.308 Approach

QI.3. My airline is interested in FIM - IM.308 Approach.

		Percentage
Strongly Disagree	1	14%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	4	57%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	6	86%
% Disagreement	1	14%

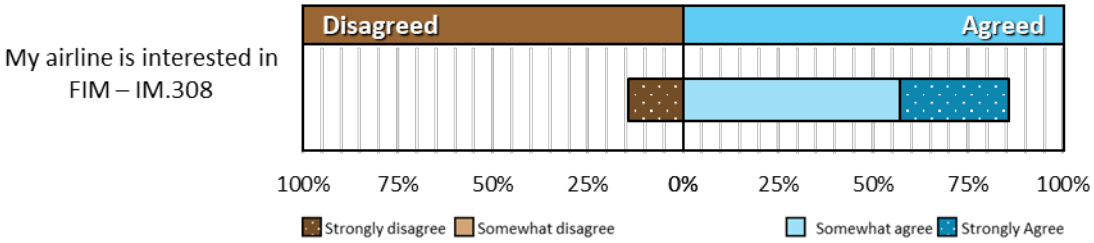


Figure I-1. Responses to "My airline is interested in FIM - IM.308 Approach."

QI.4. Rate your priority for FIM - IM.308 Approach amongst the set of ADS-B In applications.

	Count	Percentage
Low	1	14%
Medium	3	43%
High	3	43%
N	7	

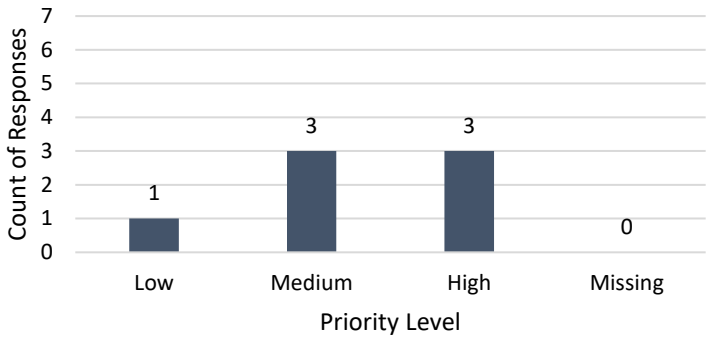


Figure I-2. Responses to "Rate your priority for FIM - IM.308 Approach amongst the set of ADS-B In applications."

QI.4.Airline Comments

- Pending further development of the concept.

QI.5. What is it about FIM - IM.308 Approach that interests your airline?

Benefits	6	86%	0	0%	0	0%
Low Cost	1	14%	2	29%	1	14%
Applicability at enough locations where we operate	3	43%	2	29%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

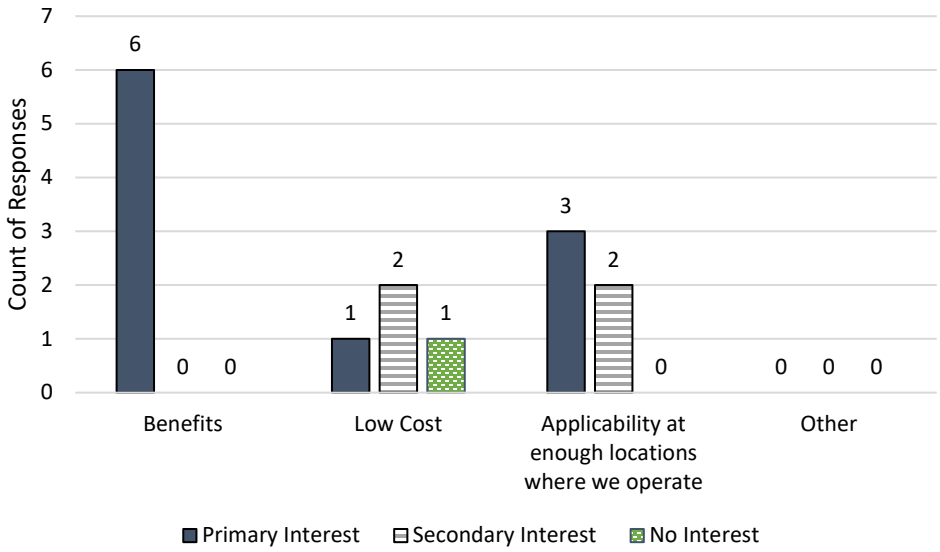


Figure I-3. Responses to "What is it about FIM - IM.308 Approach that interests your airline?"

QI.5.Airline Comments

- Nothing about FIM - IM.308 Approach interests my airline
- minimal benefit
- Not low cost

QI.6. Describe how your airline believes FIM - IM.308 Approach can bring benefit to your operation.

Increased capacity/throughput	6	86%	0	0%	0	0%	0	0%
Reduced fuel burn	1	14%	4	57%	0	0%	0	0%
Reduced time in air	2	29%	3	43%	0	0%	0	0%
Reduced gate time	0	0%	1	14%	1	14%	3	43%
More predictable block times leading to schedule improvements	2	29%	3	43%	0	0%	1	14%
Reduced communications	1	14%	1	14%	2	29%	1	14%
Increased flexibility	1	14%	2	29%	1	14%	1	14%
Increased access	0	0%	3	43%	2	29%	0	0%
Increased pilot traffic awareness	3	43%	2	29%	0	0%	0	0%
Increased safety	3	43%	2	29%	0	0%	0	0%
Increased passenger satisfaction	3	43%	0	0%	2	29%	1	14%
Other	2	29%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

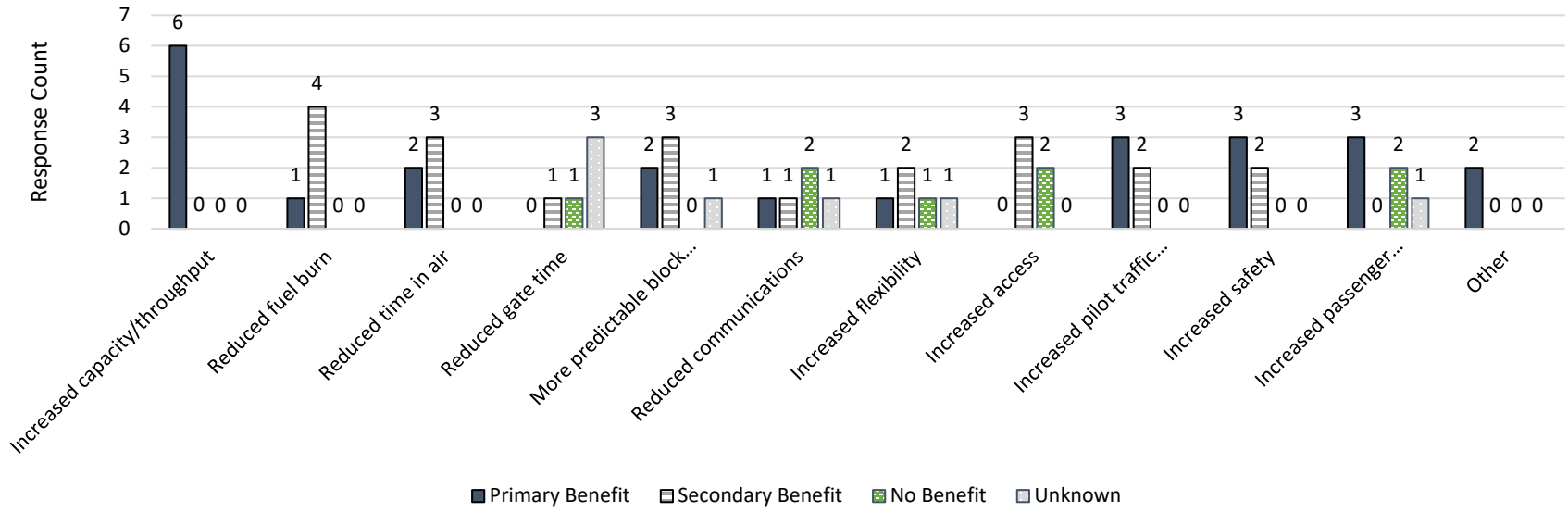


Figure I-4. Responses to "Describe how your airline believes FIM - IM.308 Approach can bring benefit to your operation."

QI.6.Airline Comments

- Significantly reduced GDPs.
- Reduced cancelations.
- FIM - IM.308 Approach does not bring benefit
- First bullet is intended to mean closer to Visual Approach arrival rates in less than Visual Approach conditions.

QI.7. What is it about FIM - IM.308 Approach that concerns your airline?

Benefits	4	57%	0	0%	1	14%
Cost	4	57%	1	14%	1	14%
Not applicable at enough locations where we operate	4	57%	1	14%	1	14%
General concept	0	0%	3	43%	3	43%
Concept complexity	2	29%	4	57%	0	0%
Necessary procedural changes	3	43%	2	29%	1	14%
Necessary controller automation	4	57%	0	0%	2	29%
Training Cost	1	14%	3	43%	2	29%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

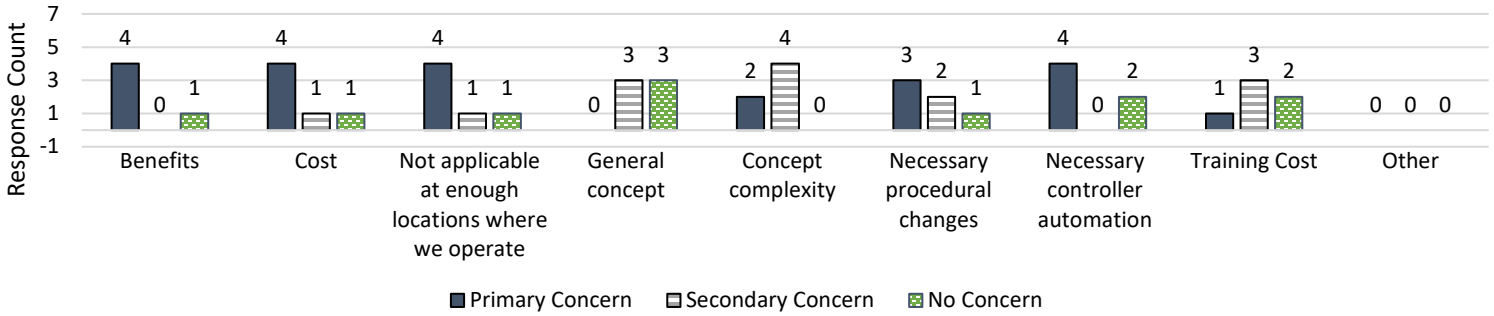


Figure I-5. Responses to "What is it about FIM - IM.308 Approach that concerns your airline?"

QI.7.Airline Comments

- Cost is our primary concern, along with maturity of solution (thus uncertainty about the cost).
- A two rate GDP (or GDP exemption when equipage is low) is needed to attain benefits.

QI.8. If your airline is interested in FIM - IM.308 Approach, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	0	0%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	4	57%	2	29%	0	0%
Additional information on avionics costs	2	29%	1	14%	1	14%
Additional information on installation and training costs	1	14%	3	43%	1	14%
Additional information on flight deck integration	2	29%	2	29%	1	14%
Other airline investment	2	29%	1	14%	2	29%
Additional field demonstration data	0	0%	3	43%	1	14%
Other	0	0%	0	0%	0	0%
No contingencies	1	14%				
N	7					

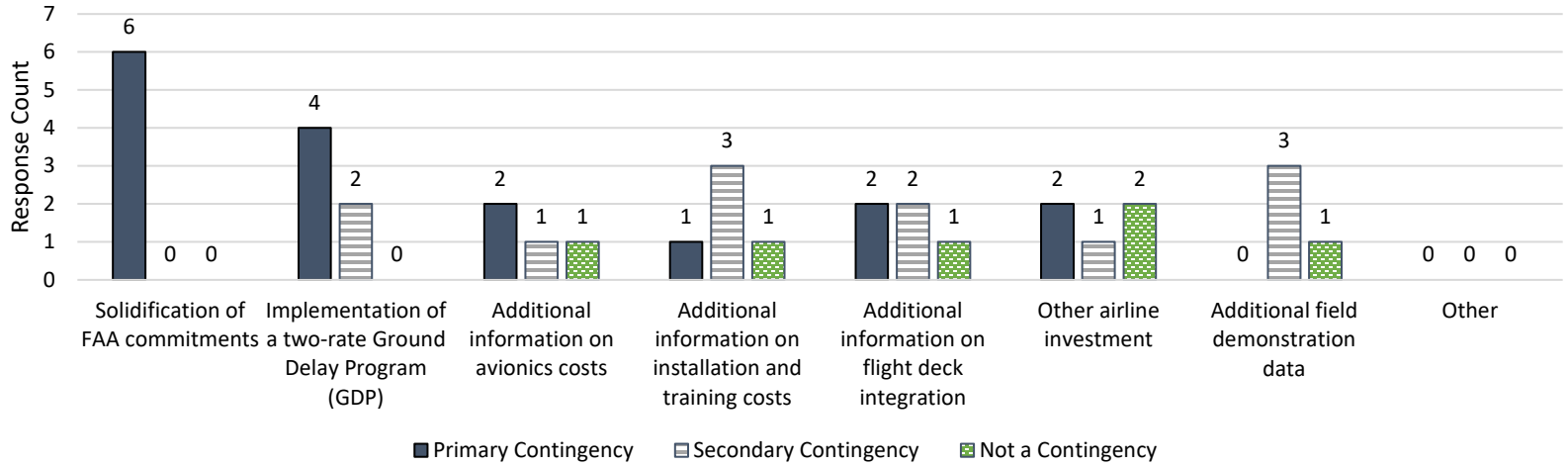


Figure I-6. Responses to "If your airline is interested in FIM - IM.308 Approach, are there contingencies on an investment?"

QI.8.Airline Comments

- None

QI.9. If your airline is interested but not willing to commit to an investment in FIM - IM.308 Approach, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	2	33%	1	17%
Insufficient understanding of the ADS-B In application benefits	0	0%	1	17%	2	33%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	17%	2	33%
Insufficient funds	2	33%	1	17%	1	17%
Lack of benefits data	1	17%	3	50%	0	0%
Lack of field demonstration data	0	0%	2	33%	1	17%
Unclear FAA commitments on automation investments	4	67%	1	17%	0	0%
Unclear FAA commitments on necessary procedural changes	4	67%	1	17%	0	0%
Lack of information on avionics costs	1	17%	2	33%	1	17%
Lack of information on avionics installation requirements	1	17%	2	33%	1	17%
Pilot acceptability issues	0	0%	2	33%	2	33%
Controller acceptability issues	2	33%	1	17%	2	33%
Lack of knowledge of the future operation of the airline	0	0%	3	50%	2	33%
Training costs	1	17%	3	50%	1	17%
Other	0	0%	0	0%	0	0%
Nothing can motivate	1	17%				
N	6					

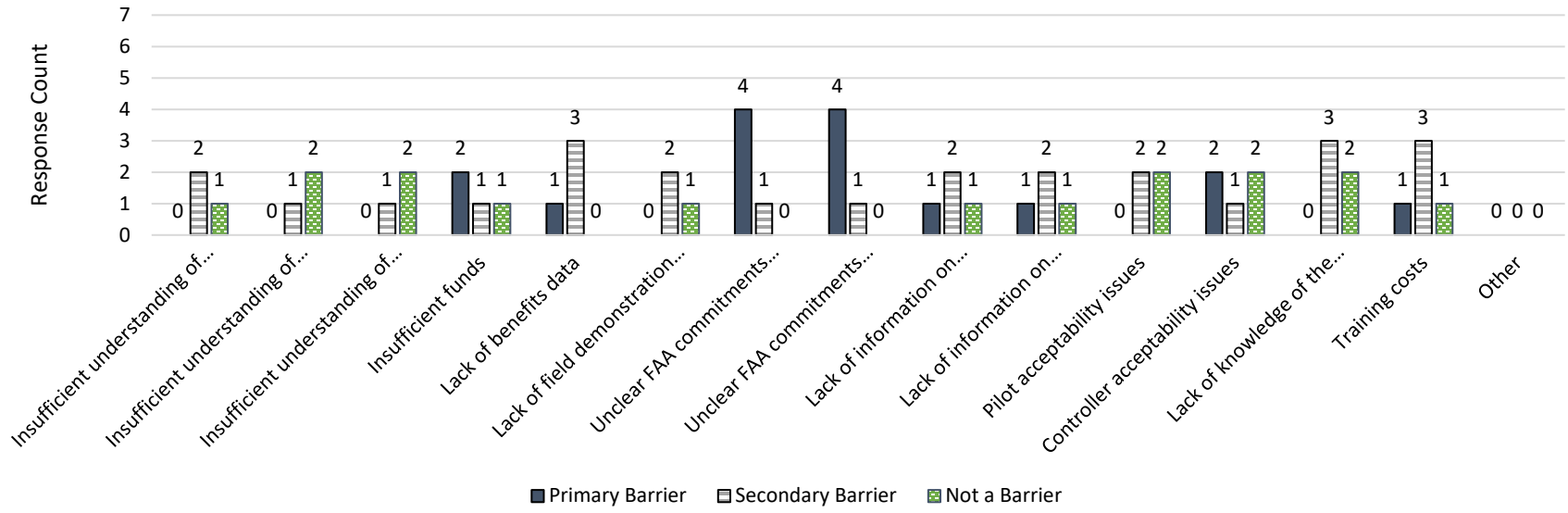


Figure I-7. Responses to "If your airline is interested but not willing to commit to an investment in FIM - IM.308 Approach, what barriers could be removed to incentivize your airline to invest?"

QI.9.Airline Comments

- Nothing can motivate investment
- no indications of probably [sic] investment at this time

QI.10. What barriers related to FIM - IM.308 Approach do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	4	57%
Responsibility issues	4	57%
Equipment issues	1	14%
Complexity issues	4	57%
Cultural change	4	57%
Other	0	0%
None	1	14%
N	7	

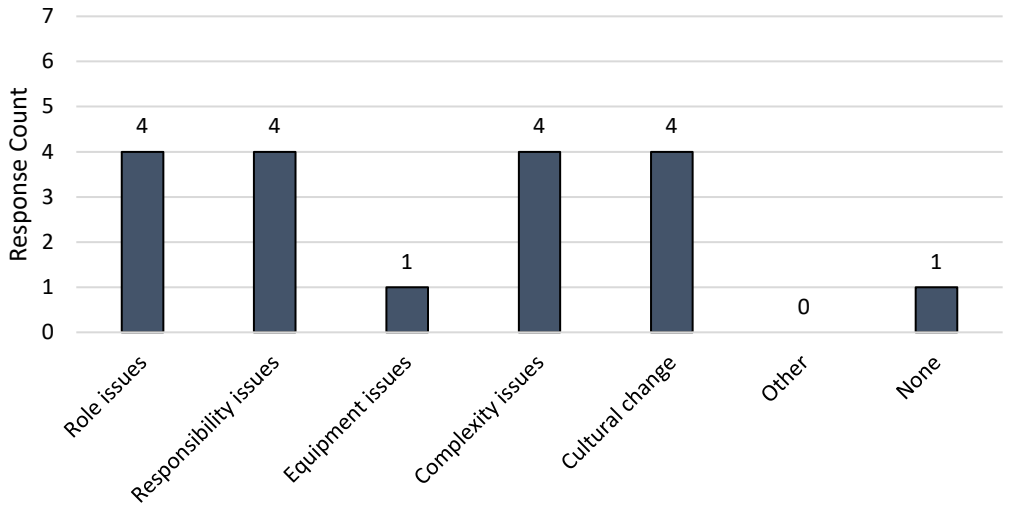


Figure I-8. Responses to "What barriers related to FIM - IM.308 Approach do you see from a line pilot's perspective that would need to be addressed?"

QI.10.Airline Comments

- None

QI.11. What barriers related to FIM - IM.308 Approach do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	4	57%
Equipment issues	1	14%
Complexity issues	5	71%
Cultural change	4	57%
Other	0	0%
None	1	14%
N	7	

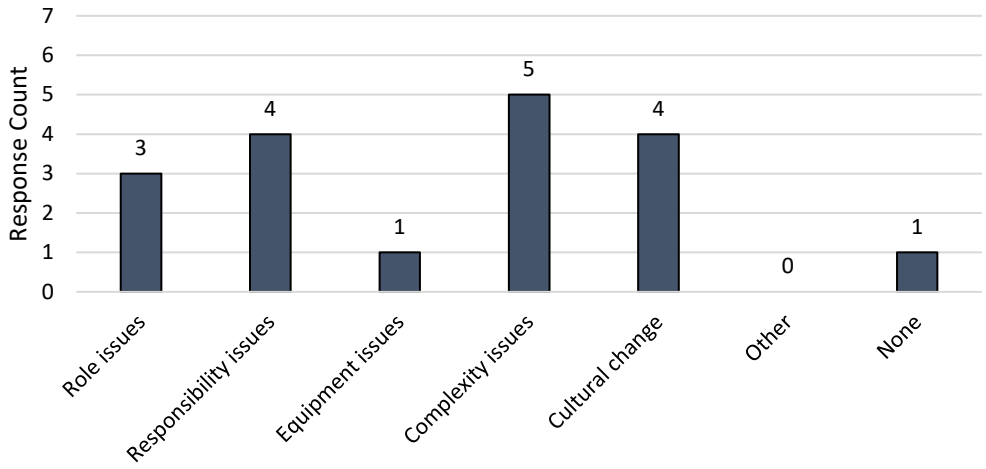


Figure I-9. Responses to "What barriers related to FIM - IM.308 Approach do you see from an air traffic controller's perspective that would need to be addressed?"

QI.11.Airline Comments

- Will this increase controller workload?

QI.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - IM.308 Approach.

	Count	Percentage
Strongly Disagree	1	14%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	14%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	5	71%
% Disagreement	1	14%

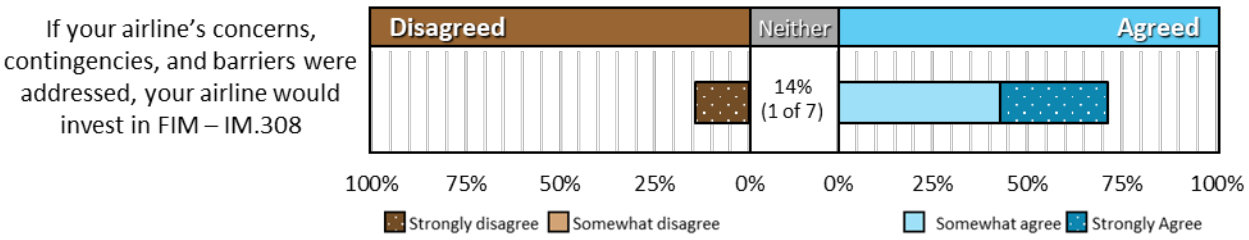


Figure I-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - IM.308 Approach."

QI.12.Airline Comments

- Simply don't see significant benefit in our operation
- Pending further development of the concept.

QI.13. When would your airline expect to equip with FIM - IM.308 Approach?

	Count	Percentage
In our first implementation of ADS-B In applications	2	29%
In a later implementation of ADS-B In applications	4	57%
Other	1	14%
Never	0	0%
N	7	

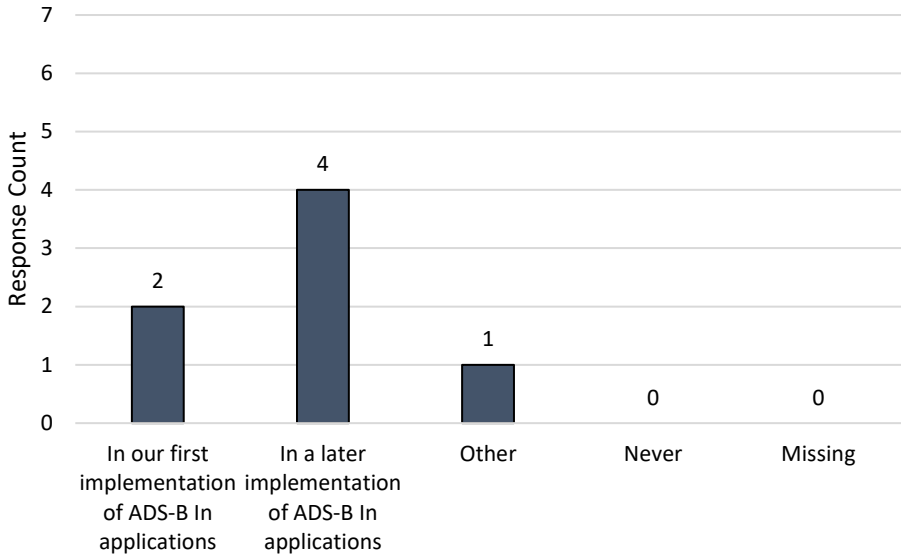


Figure I-11. Responses to "When would your airline expect to equip with FIM - IM.308 Approach?"

QI.13.Airline Comments

- Investment not probable

QI.14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - IM.308 Approach?

- .308 application seems limited overall....
- Potential benefits are intriguing but costs are high and applicability to the Northeast is a necessity for significant value to us.
- Until a two rate GDP system can be implemented, equipped airplanes should be exempted from GDP's [sic].

Flight-deck-based Interval Management (FIM) – Multiple Corner Post Arrivals

QJ.3. My airline is interested in FIM - Multiple Corner Post Arrivals.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	2	29%
Somewhat Agree	4	57%
Agree	0	0%
Strongly Agree	1	14%
N	7	
% Agreement	5	71%
% Disagreement	0	0%

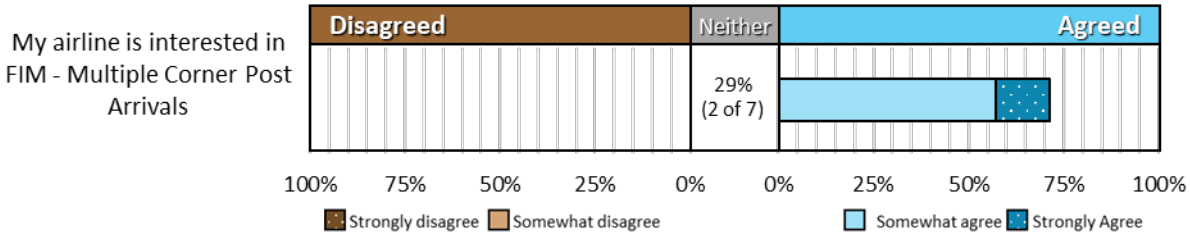


Figure J-1. Responses to "My airline is interested in FIM - Multiple Corner Post Arrivals."

QJ.4. Rate your priority for FIM - Multiple Corner Post Arrivals amongst the set of ADS-B In applications.

	Count	Percentage
Low	2	29%
Medium	3	43%
High	2	29%
N	7	

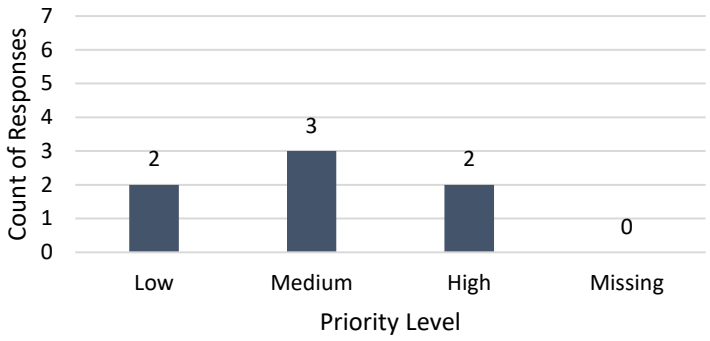


Figure J-2. Responses to "Rate your priority for FIM - Multiple Corner Post Arrivals amongst the set of ADS-B In applications."

QJ.4.Airline Comments

- other apps promise more initial benefit
- Pending further development of the concept.

QJ.5. What is it about FIM - Multiple Corner Post Arrivals that interests your airline?

Benefits	5	71%	1	14%	0	0%
Low Cost	1	14%	1	14%	1	14%
Applicability at enough locations where we operate	3	43%	2	29%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

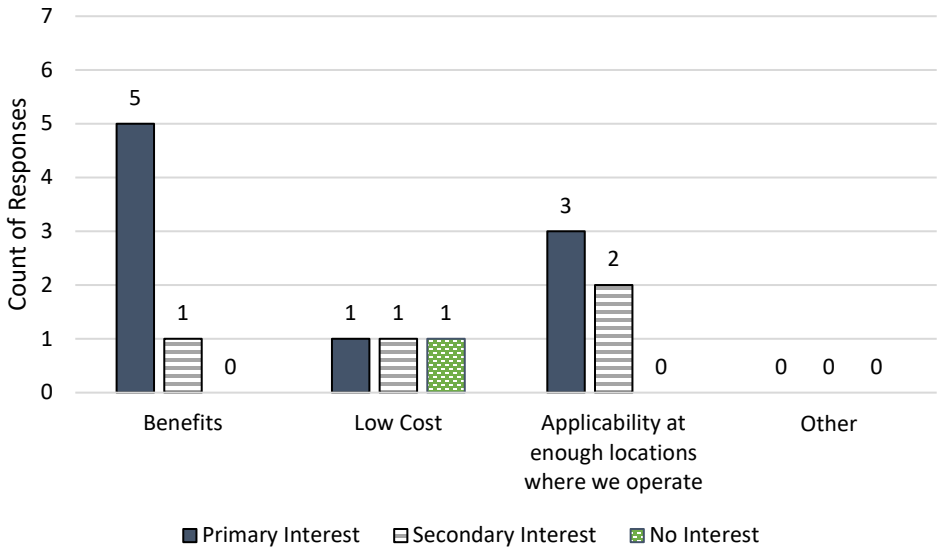


Figure J-3. Responses to "What is it about FIM - Multiple Corner Post Arrivals that interests your airline?"

QJ.5.Airline Comments

- Nothing about FIM - Multiple Corner Post Arrivals interests my airline

QJ.6. Describe how your airline believes FIM - Multiple Corner Post Arrivals can bring benefit to your operation.

Increased capacity/throughput	6	86%	0	0%	0	0%	1	14%
Reduced fuel burn	1	14%	3	43%	0	0%	1	14%
Reduced time in air	2	29%	2	29%	0	0%	1	14%
Reduced gate time	0	0%	0	0%	1	14%	4	57%
More predictable block times leading to schedule improvements	2	29%	2	29%	0	0%	2	29%
Reduced communications	1	14%	1	14%	2	29%	2	29%
Increased flexibility	0	0%	3	43%	1	14%	1	14%
Increased access	1	14%	1	14%	2	29%	1	14%
Increased pilot traffic awareness	3	43%	4	57%	0	0%	0	0%
Increased safety	3	43%	3	43%	0	0%	0	0%
Increased passenger satisfaction	2	29%	0	0%	1	14%	2	29%
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

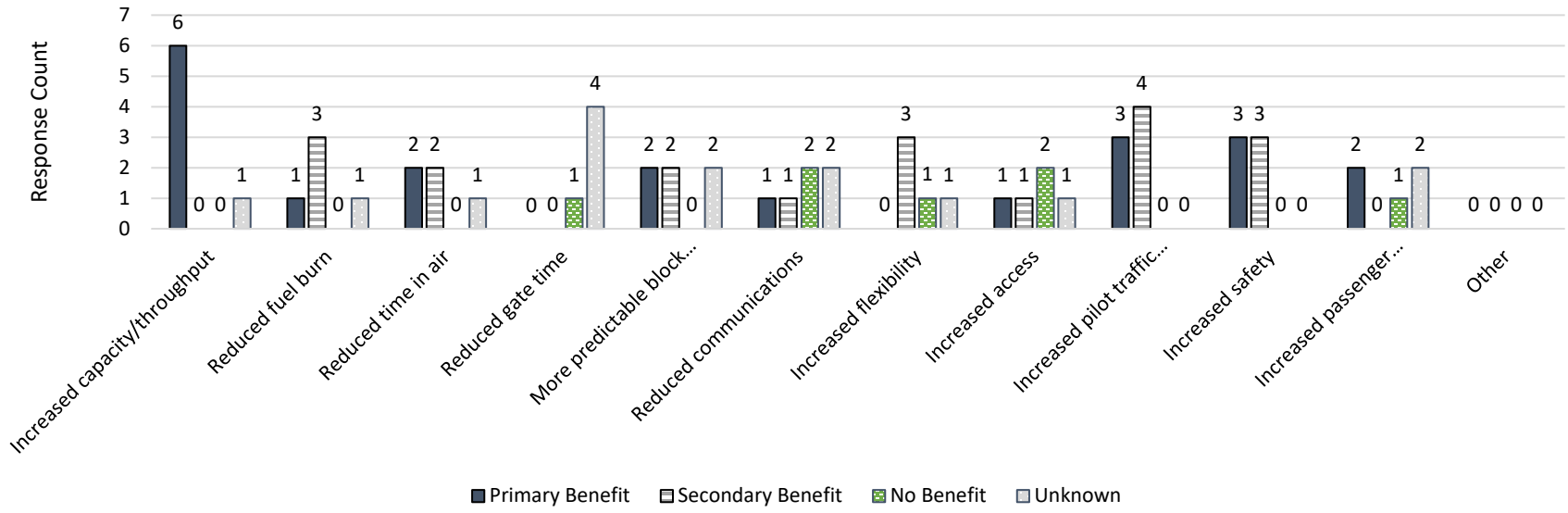


Figure J-4. Responses to "Describe how your airline believes FIM - Multiple Corner Post Arrivals can bring benefit to your operation."

QJ.6.Airline Comments

- None

QJ.7. What is it about FIM - Multiple Corner Post Arrivals that concerns your airline?

Benefits	4	57%	1	14%	0	0%
Cost	5	71%	1	14%	0	0%
Not applicable at enough locations where we operate	3	43%	0	0%	2	29%
General concept	0	0%	2	29%	3	43%
Concept complexity	4	57%	2	29%	0	0%
Necessary procedural changes	3	43%	2	29%	0	0%
Necessary controller automation	4	57%	1	14%	1	14%
Training Cost	1	14%	3	43%	1	14%
Other	1	14%	0	0%	0	0%
No concerns	0	0%				
N	7					

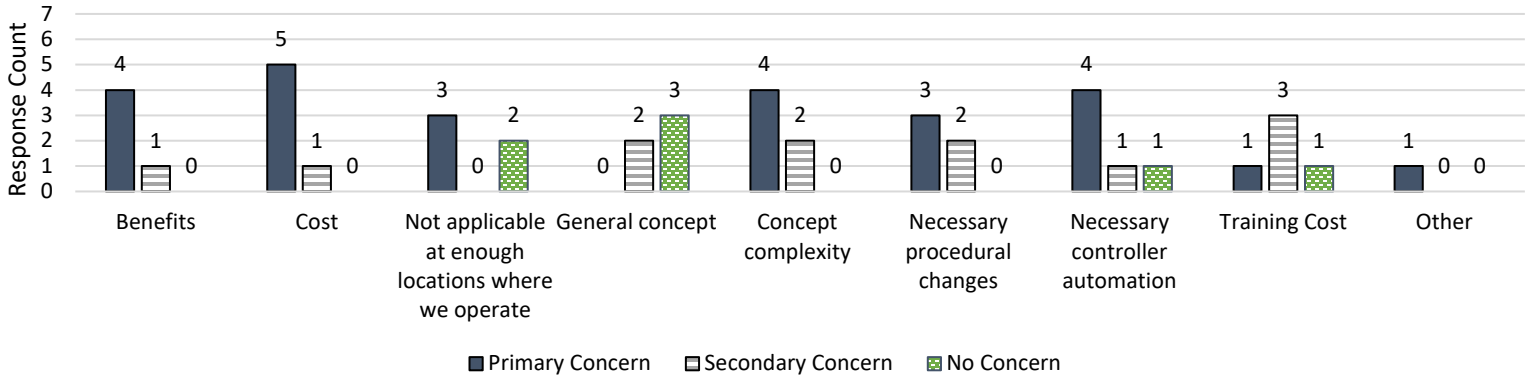


Figure J-5. Responses to "What is it about FIM - Multiple Corner Post Arrivals that concerns your airline?"

QJ.7.Airline Comments

- Acceptance by ATC.
- Cost is our primary concern, along with maturity of solution (thus uncertainty about the cost).

QJ.8. If your airline is interested in FIM - Multiple Corner Post Arrivals, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	0	0%	1	14%
Implementation of a two-rate Ground Delay Program (GDP)	2	29%	2	29%	2	29%
Additional information on avionics costs	2	29%	2	29%	1	14%
Additional information on installation and training costs	1	14%	3	43%	1	14%
Additional information on flight deck integration	3	43%	1	14%	1	14%
Other airline investment	1	14%	1	14%	3	43%
Additional field demonstration data	4	57%	2	29%	1	14%
Other	1	14%	0	0%	0	0%
No contingencies	0	0%				
N	7					

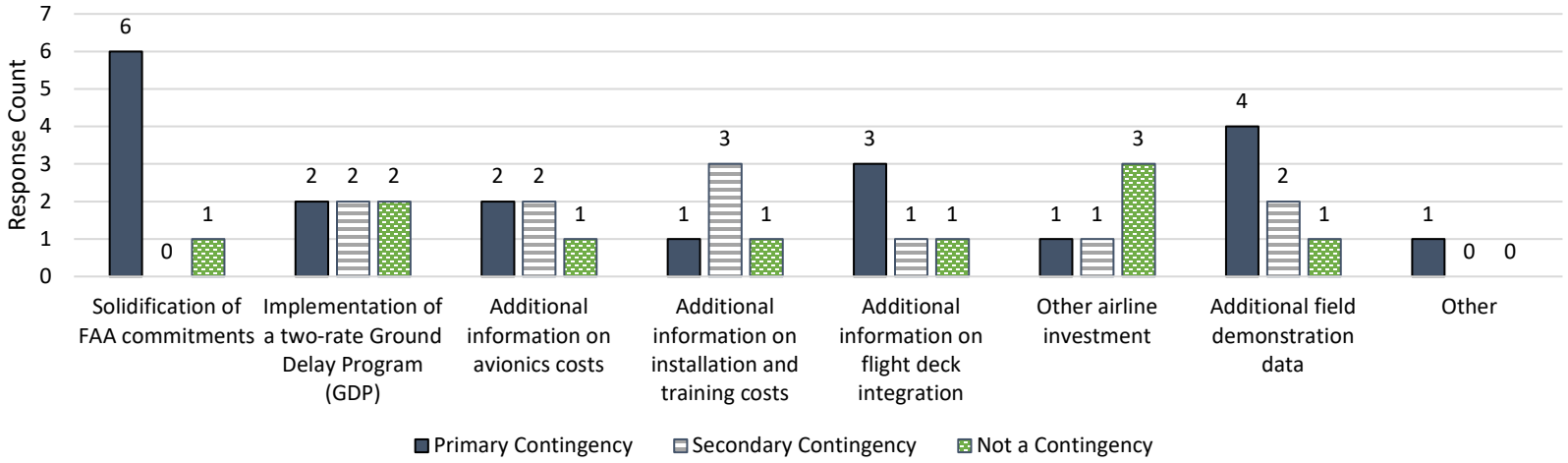


Figure J-6. Responses to "If your airline is interested in FIM - Multiple Corner Post Arrivals, are there contingencies on an investment?"

QJ.8.Airline Comments

- Acceptance by ATC.

QJ.9. If your airline is interested but not willing to commit to an investment in FIM - Multiple Corner Post Arrivals, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	4	67%
Insufficient understanding of the ADS-B In application benefits	0	0%	2	33%	2	33%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	2	33%	2	33%
Insufficient funds	3	50%	2	33%	0	0%
Lack of benefits data	2	33%	3	50%	0	0%
Lack of field demonstration data	2	33%	3	50%	1	17%
Unclear FAA commitments on automation investments	4	67%	1	17%	1	17%
Unclear FAA commitments on necessary procedural changes	4	67%	1	17%	1	17%
Lack of information on avionics costs	2	33%	3	50%	1	17%
Lack of information on avionics installation requirements	1	17%	4	67%	1	17%
Pilot acceptability issues	1	17%	2	33%	2	33%
Controller acceptability issues	3	50%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	3	50%	3	50%
Training costs	1	17%	2	33%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

Appendix E: Mainline Operator Questionnaire De-identified Responses

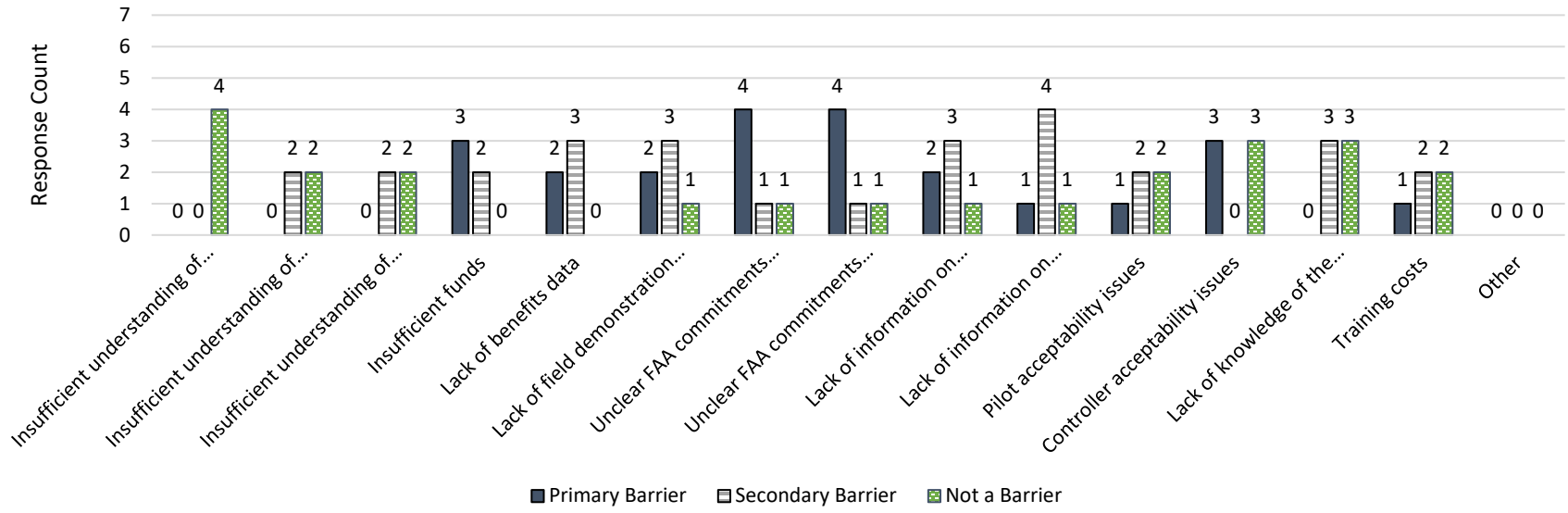


Figure J-7. Responses to "If your airline is interested but not willing to commit to an investment in FIM - Multiple Corner Post Arrivals, what barriers could be removed to incentivize your airline to invest?"

QJ.9.Airline Comments

- None

QJ.10. What barriers related to FIM - Multiple Corner Post Arrivals do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	4	57%
Responsibility issues	5	71%
Equipment issues	1	14%
Complexity issues	6	86%
Cultural change	5	71%
Other	0	0%
None	0	0%
N	7	

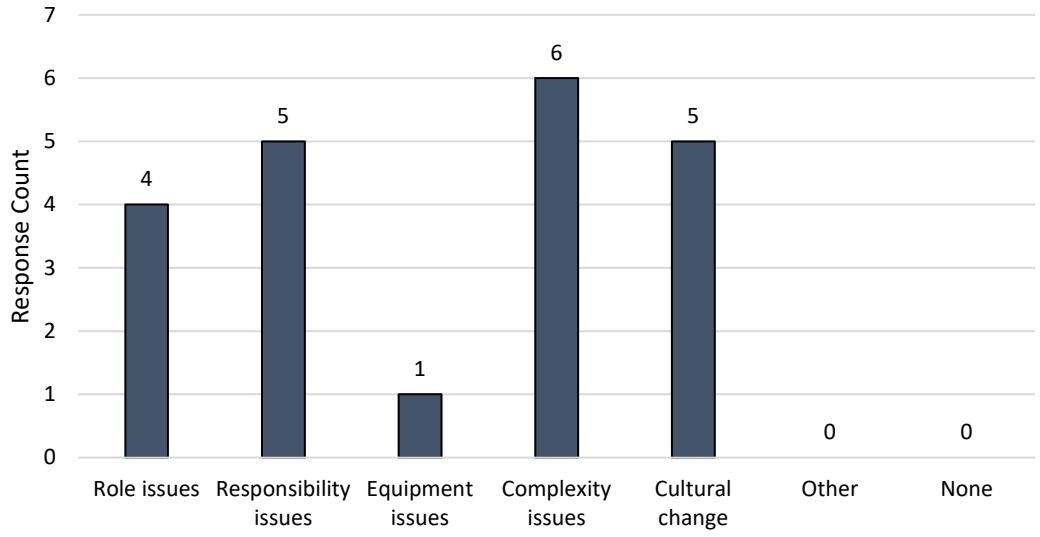


Figure J-8. Responses to "What barriers related to FIM - Multiple Corner Post Arrivals do you see from a line pilot's perspective that would need to be addressed?"

QJ.10.Airline Comments

- None

QJ.11. What barriers related to FIM - Multiple Corner Post Arrivals do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	5	71%
Equipment issues	3	43%
Complexity issues	6	86%
Cultural change	5	71%
Other	0	0%
None	0	0%
N	7	

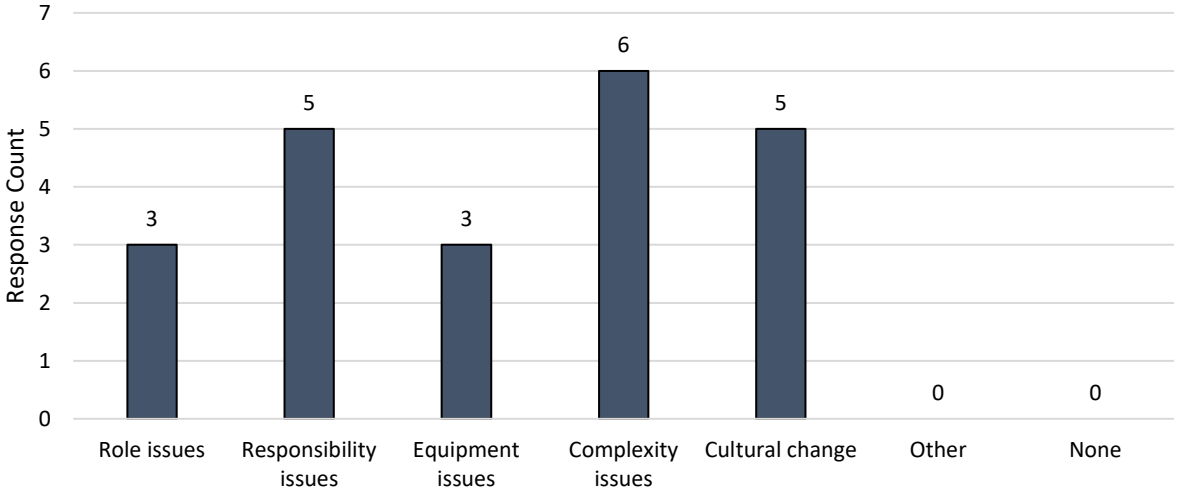


Figure J-9. Responses to "What barriers related to FIM - Multiple Corner Post Arrivals do you see from an air traffic controller's perspective that would need to be addressed?"

QJ.11.Airline Comments

- Need ATC buy in.

QJ.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - Multiple Corner Post Arrivals.

	Count	**Percentage**
Strongly Disagree	1	14%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	14%
Somewhat Agree	4	57%

Agree	0	0%
Strongly Agree	1	14%
N	7	
% Agreement	5	71%
% Disagreement	1	14%

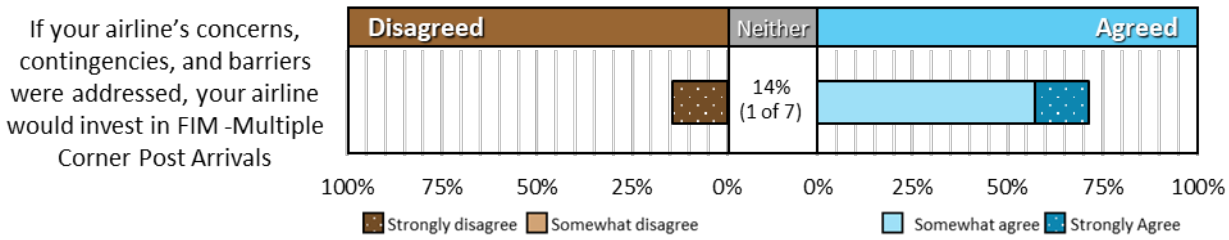


Figure J-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - Multiple Corner Post Arrivals."

QJ.12.Airline Comments

- Simply don't see significant applied benefit at this time
- Pending further development of the concept.

QJ.13. When would your airline expect to equip with FIM - Multiple Corner Post Arrivals?

	Count	Percentage
In our first implementation of ADS-B In applications	1	14%
In a later implementation of ADS-B In applications	4	57%
Other	2	29%
Never	0	0%
N	7	

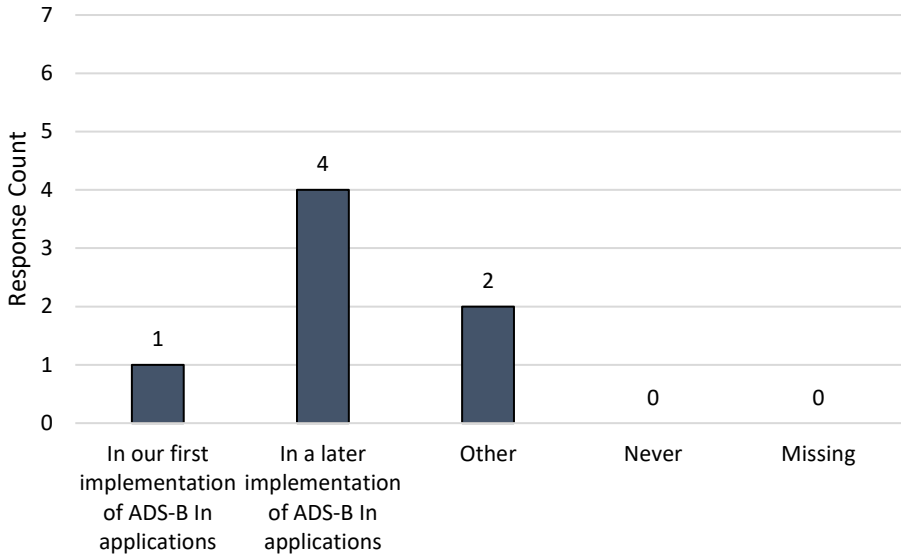


Figure J-11. Responses to "When would your airline expect to equip with FIM - Multiple Corner Post Arrivals?"

QJ.13.Airline Comments

- investment unlikely
- "FIM needs the most work to properly integrate in the NAS, focus on easier applications like CAS first and get experience to make FIM better

QJ.14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - Multiple Corner Post Arrivals?

- Concerned over complexity and inability to manage those complexities
- Potential benefits are intriguing but costs are high.

Flight-deck-based Interval Management (FIM) – Converging/Crossing Runways (DCCR) Arrival

QK.3. My airline is interested in FIM - DCCR.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	3	43%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	1	14%
N	7	
% Agreement	4	57%
% Disagreement	0	0%

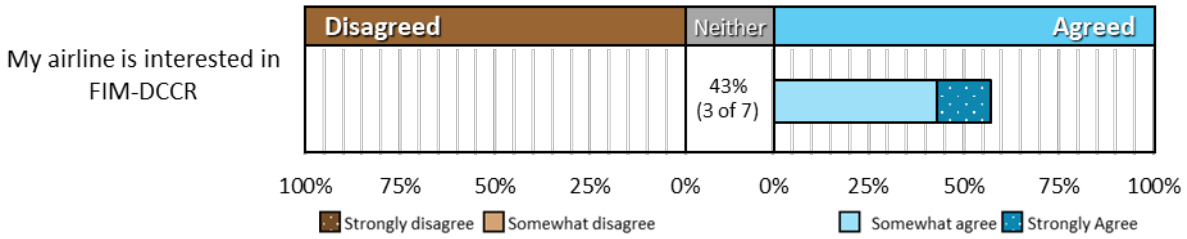


Figure K-1. Responses to "My airline is interested in FIM - DCCR."

QK.4. Rate your priority for FIM - DCCR amongst the set of ADS-B In applications.

	Count	Percentage
Low	3	43%
Medium	2	29%
High	2	29%
N	7	

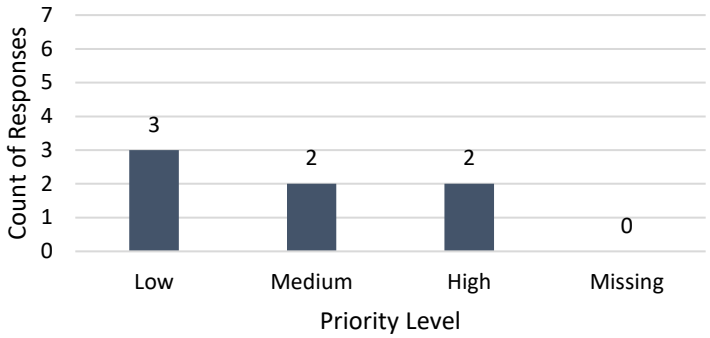


Figure K-2. Responses to "Rate your priority for FIM - DCCR amongst the set of ADS-B In applications."

QK.4.Airline Comments

- Pending further development of the concept.

QK.5. What is it about FIM - DCCR that interests your airline?

Benefits	6	86%	0	0%	0	0%
Low Cost	1	14%	2	29%	1	14%
Applicability at enough locations where we operate	3	43%	3	43%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

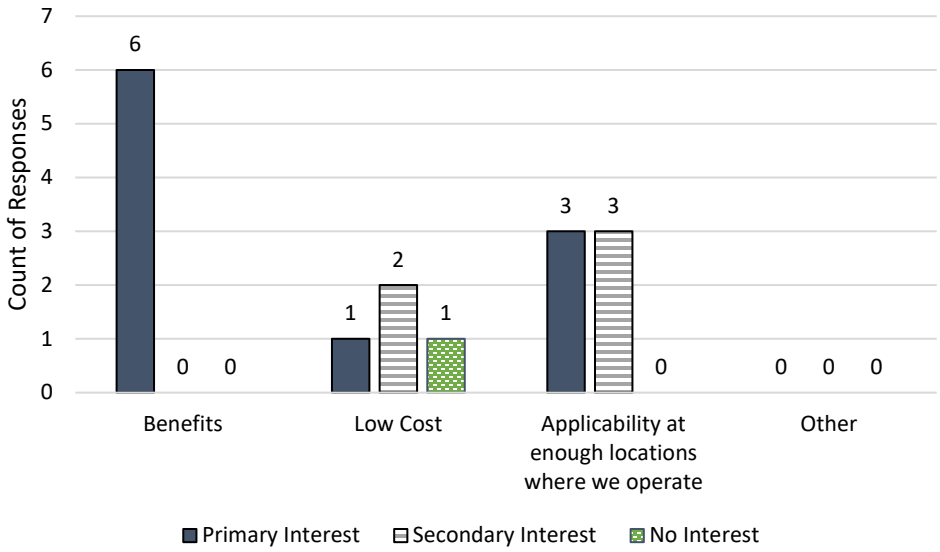


Figure K-3. Responses to "What is it about FIM - DCCR that interests your airline?"

QK.5.Airline Comments

- Not a low cost application
- Few of our primary airports would use this.

QK.6. Describe how your airline believes FIM - DCCR can bring benefit to your operation.

Increased capacity/throughput	7	100%	0	0%	0	0%	0	0%
Reduced fuel burn	1	14%	5	71%	0	0%	0	0%
Reduced time in air	2	29%	3	43%	0	0%	0	0%
Reduced gate time	0	0%	0	0%	1	14%	4	57%
More predictable block times leading to schedule improvements	2	29%	2	29%	0	0%	2	29%
Reduced communications	0	0%	1	14%	2	29%	2	29%
Increased flexibility	0	0%	3	43%	1	14%	1	14%
Increased access	1	14%	1	14%	2	29%	1	14%
Increased pilot traffic awareness	2	29%	3	43%	0	0%	0	0%
Increased safety	3	43%	3	43%	0	0%	0	0%
Increased passenger satisfaction	2	29%	0	0%	0	0%	3	43%
Other	0	0%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

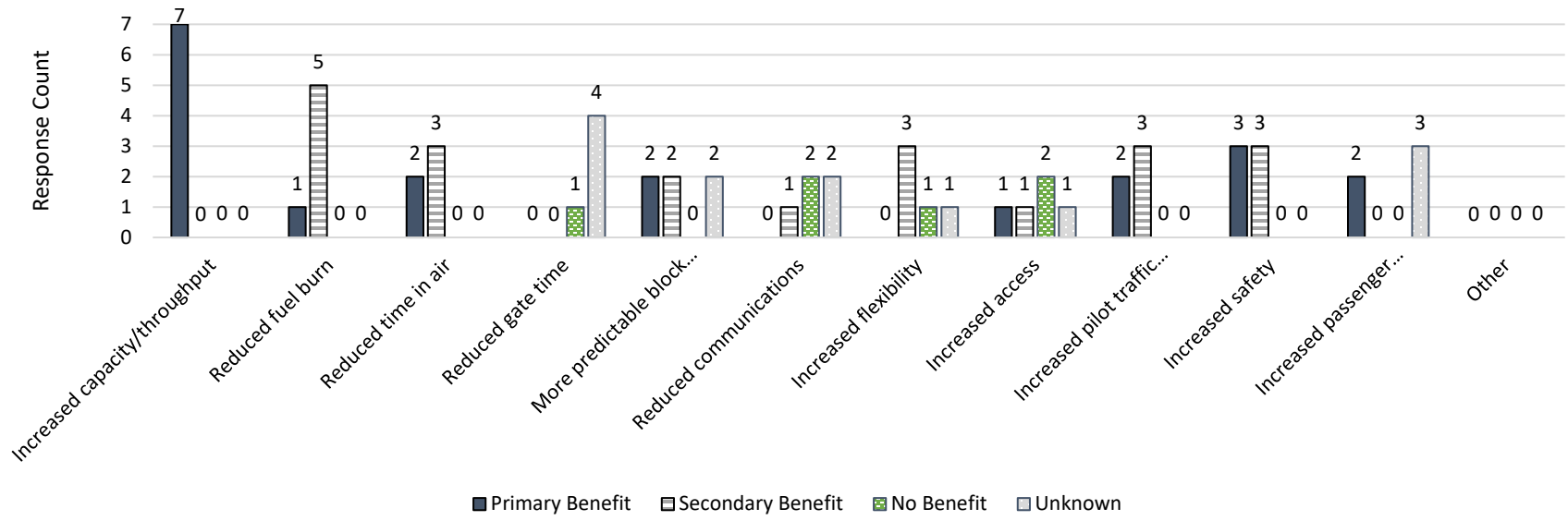


Figure K-4. Responses to "Describe how your airline believes FIM - DCCR can bring benefit to your operation."

QK.6.Airline Comments

- None

QK.7. What is it about FIM - DCCR that concerns your airline?

Benefits	4	57%	0	0%	1	14%
Cost	4	57%	1	14%	0	0%
Not applicable at enough locations where we operate	4	57%	2	29%	1	14%
General concept	0	0%	1	14%	4	57%
Concept complexity	2	29%	3	43%	1	14%
Necessary procedural changes	2	29%	2	29%	1	14%
Necessary controller automation	3	43%	2	29%	1	14%
Training Cost	1	14%	3	43%	1	14%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

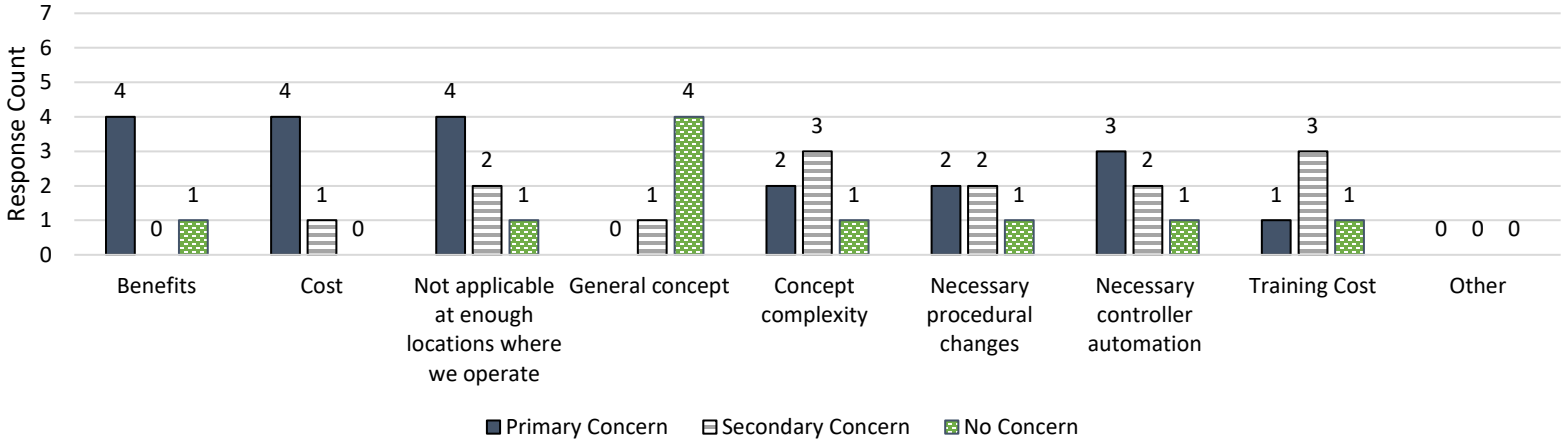


Figure K-5. Responses to "What is it about FIM - DCCR that concerns your airline?"

QK.7.Airline Comments

- Cost is our primary concern, along with maturity of solution (thus uncertainty about the cost).

QK.8. If your airline is interested in FIM - DCCR, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	1	14%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	2	29%	2	29%	2	29%
Additional information on avionics costs	1	14%	4	57%	1	14%
Additional information on installation and training costs	1	14%	3	43%	1	14%
Additional information on flight deck integration	2	29%	2	29%	1	14%
Other airline investment	1	14%	2	29%	2	29%
Additional field demonstration data	2	29%	3	43%	1	14%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
N	7					

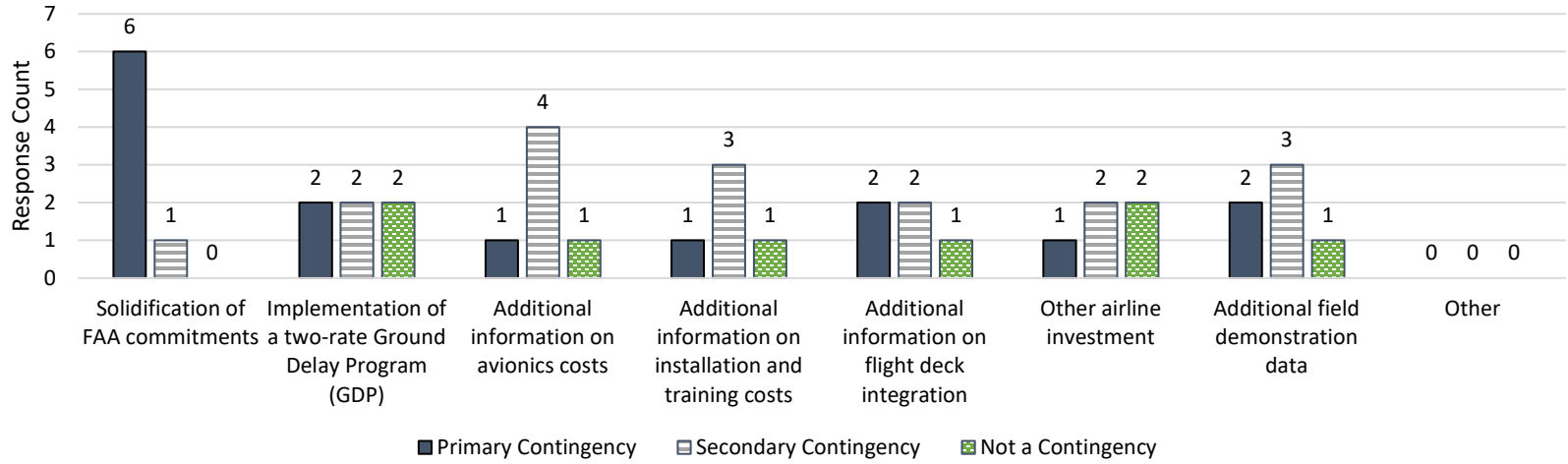


Figure K-6. Responses to "If your airline is interested in FIM - DCCR, are there contingencies on an investment?"

QK.8.Airline Comments

- Simply need to gauge benefits in our operation

QK.9. If your airline is interested but not willing to commit to an investment in FIM - DCCR, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	17%	3	50%
Insufficient understanding of the ADS-B In application benefits	1	17%	0	0%	3	50%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	4	67%
Insufficient funds	4	67%	2	33%	0	0%
Lack of benefits data	2	33%	3	50%	0	0%
Lack of field demonstration data	2	33%	3	50%	1	17%
Unclear FAA commitments on automation investments	4	67%	1	17%	1	17%
Unclear FAA commitments on necessary procedural changes	4	67%	1	17%	1	17%
Lack of information on avionics costs	1	17%	4	67%	1	17%
Lack of information on avionics installation requirements	1	17%	4	67%	1	17%
Pilot acceptability issues	0	0%	4	67%	2	33%
Controller acceptability issues	3	50%	1	17%	2	33%
Lack of knowledge of the future operation of the airline	0	0%	3	50%	3	50%
Training costs	1	17%	3	50%	2	33%
Other	1	17%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

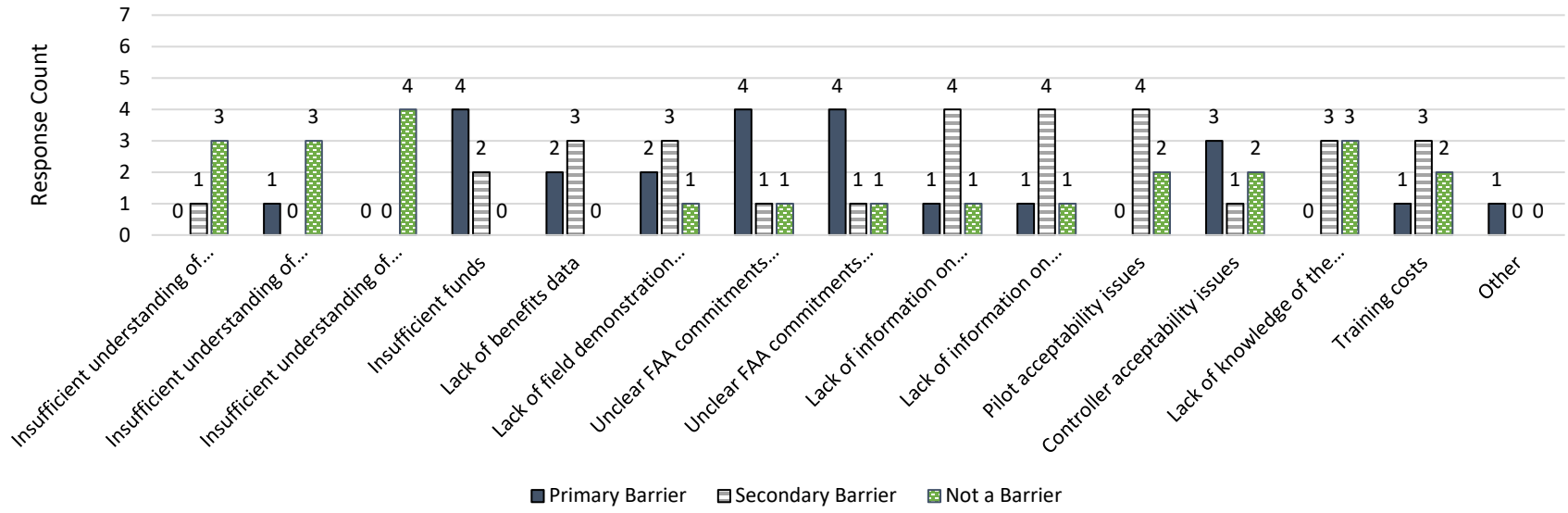


Figure K-7. Responses to "If your airline is interested but not willing to commit to an investment in FIM - DCCR, what barriers could be removed to incentivize your airline to invest?"

QK.9.Airline Comments

- Is benefit enough to justify investment?

QK.10. What barriers related to FIM - DCCR do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	4	57%
Responsibility issues	4	57%
Equipment issues	2	29%
Complexity issues	6	86%
Cultural change	4	57%
Other	0	0%
None	0	0%
N	7	

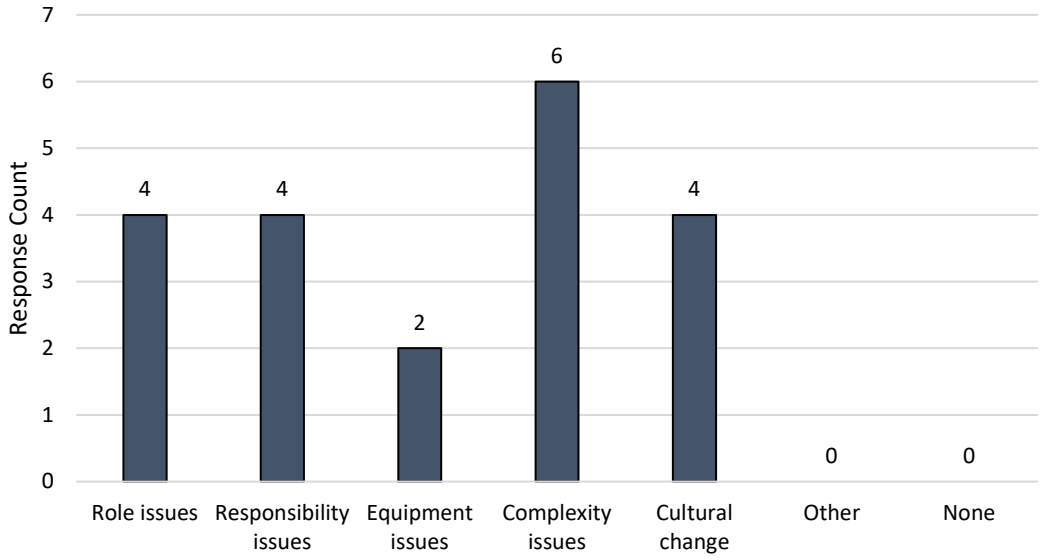


Figure K-8. Responses to "What barriers related to FIM - DCCR do you see from a line pilot's perspective that would need to be addressed?"

QK.10.Airline Comments

- None

QK.11. What barriers related to FIM - DCCR do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	2	29%
Responsibility issues	4	57%
Equipment issues	3	43%
Complexity issues	4	57%
Cultural change	3	43%
Other	0	0%
None	0	0%
N	7	

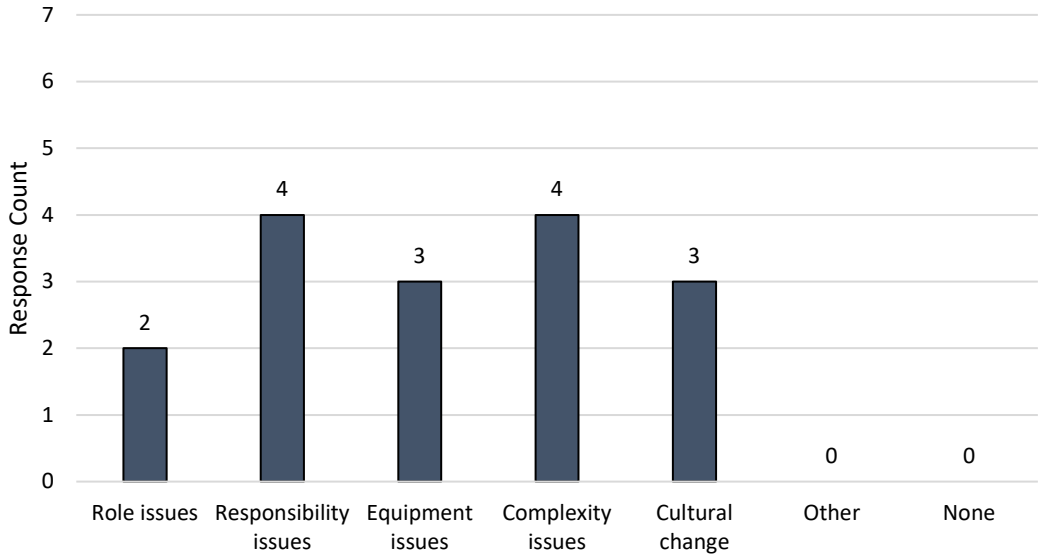


Figure K-9. Responses to "What barriers related to FIM - DCCR do you see from an air traffic controller's perspective that would need to be addressed?"

QK.11.Airline Comments

- Need ATC buy in.

QK.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - DCCR.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	2	29%
Somewhat Agree	4	57%
Agree	0	0%
Strongly Agree	1	14%
N	7	
% Agreement	5	71%
% Disagreement	0	0%

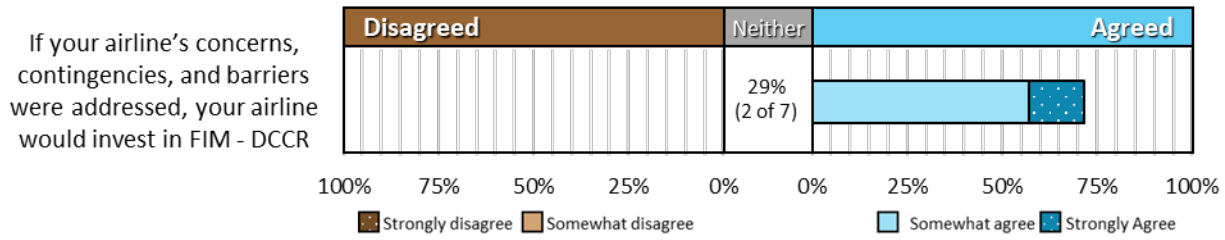


Figure K-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - DCCR."

QK.12.Airline Comments

- Minimal application for us; hard to gauge benefit
- Pending further development of the concept.

QK.13. When would your airline expect to equip with FIM - DCCR?

	Count	Percentage
In our first implementation of ADS-B In applications	0	0%
In a later implementation of ADS-B In applications	5	71%
Other	2	29%
Never	0	0%
N	7	

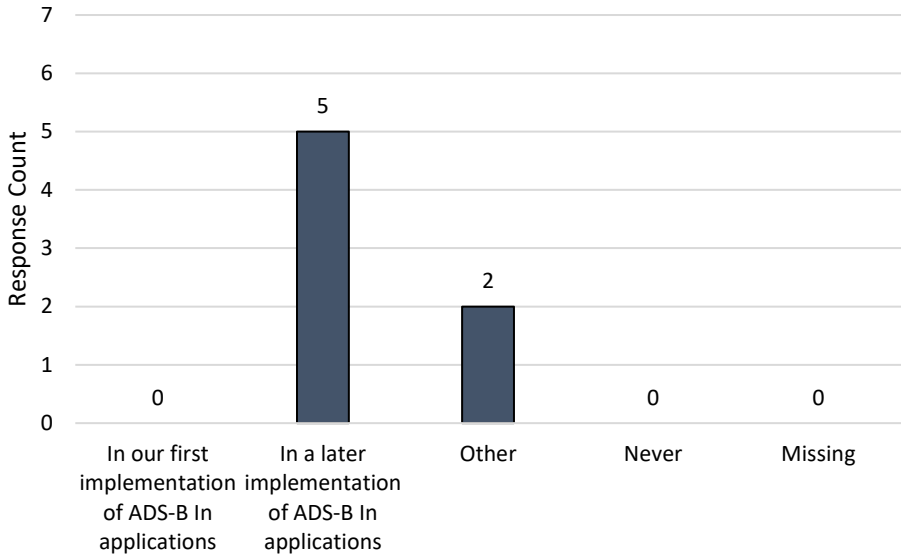


Figure K-11. Responses to "When would your airline expect to equip with FIM - DCCR?"

QK.13.Airline Comments

- investment questionable
- FIM needs the most work to properly integrate in the NAS, focus on easier applications like CAS first and get experience to make FIM better

QK.14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - DCCR?

- Minimal benefit exposure for us; possible collateral benefit if bundled with other more beneficial apps

Flight-deck-based Interval Management (FIM) – Dependent Staggered Approaches (DSA)

QL.3. My airline is interested in FIM - DSA.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	2	29%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	5	71%
% Disagreement	0	0%

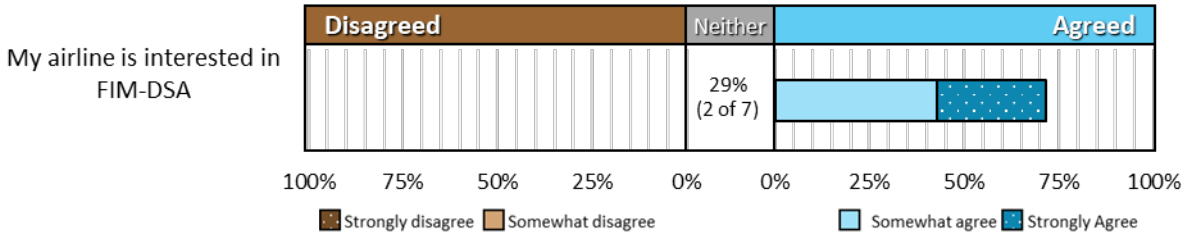


Figure L-1. Responses to "My airline is interested in FIM - DSA."

QL.4. Rate your priority for FIM - DSA amongst the set of ADS-B In applications.

	Count	Percentage
Low	3	43%
Medium	1	14%
High	3	43%
N	7	

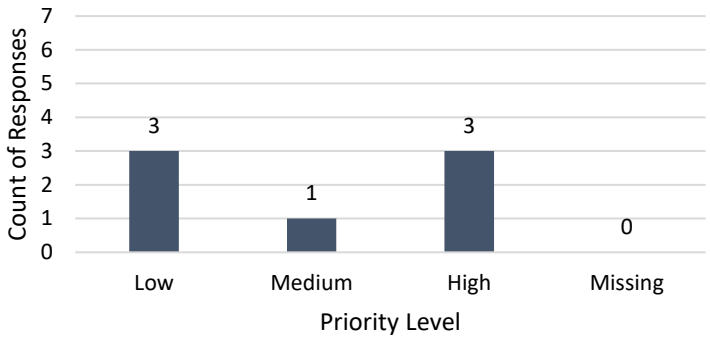


Figure L-2. Responses to "Rate your priority for FIM - DSA amongst the set of ADS-B In applications."

QL.4.Airline Comments

- Pending further development of the concept.

QL.5. What is it about FIM - DSA that interests your airline?

Benefits	7	100%	0	0%	0	0%
Low Cost	2	29%	2	29%	1	14%
Applicability at enough locations where we operate	4	57%	2	29%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

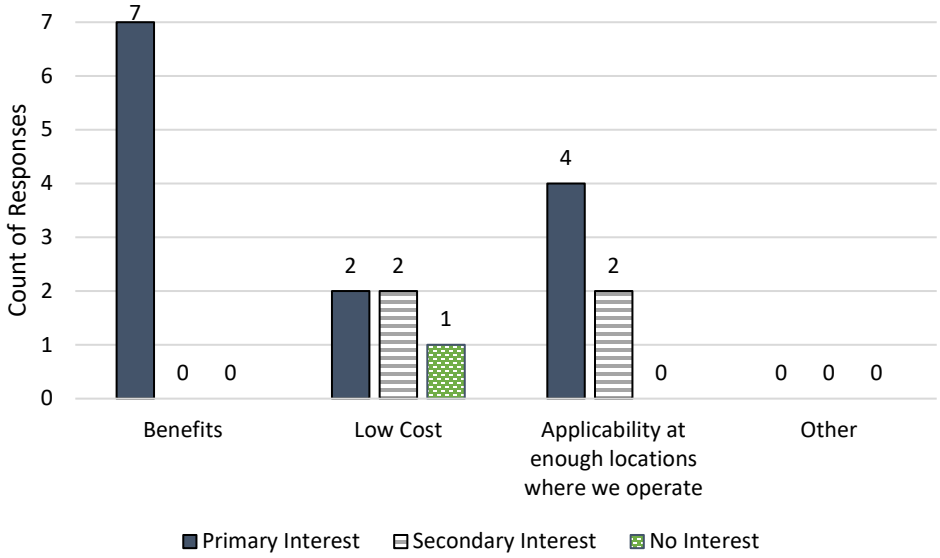


Figure L-3. Responses to "What is it about FIM - DSA that interests your airline?"

QL.5.Airline Comments

- Not a low cost application

QL.6. Describe how your airline believes FIM - DSA can bring benefit to your operation.

Increased capacity/throughput	5	71%	0	0%	0	0%	1	14%
Reduced fuel burn	1	14%	4	57%	0	0%	1	14%
Reduced time in air	2	29%	2	29%	0	0%	1	14%
Reduced gate time	0	0%	0	0%	1	14%	4	57%
More predictable block times leading to schedule improvements	3	43%	2	29%	0	0%	2	29%
Reduced communications	0	0%	1	14%	2	29%	2	29%
Increased flexibility	0	0%	3	43%	1	14%	1	14%
Increased access	1	14%	1	14%	2	29%	1	14%
Increased pilot traffic awareness	3	43%	3	43%	0	0%	0	0%
Increased safety	4	57%	2	29%	0	0%	0	0%
Increased passenger satisfaction	3	43%	0	0%	1	14%	2	29%
Other	2	29%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

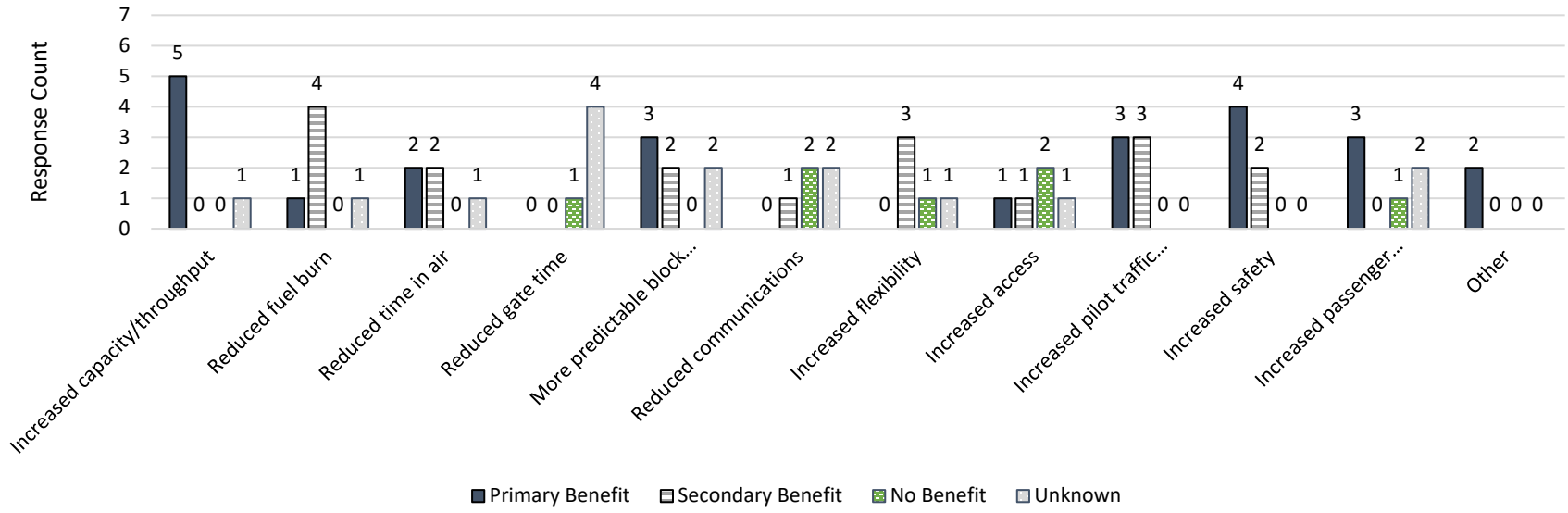


Figure L-4. Responses to "Describe how your airline believes FIM - DSA can bring benefit to your operation."

Ql.6.Airline Comments

- Significantly reduced GDPs.
- Reduced cancelations.
- First bullet is intended to mean closer to Visual Approach arrival rates in less than Visual Approach conditions.

QL.7. What is it about FIM - DSA that concerns your airline?

Benefits	4	57%	0	0%	1	14%
Cost	4	57%	1	14%	1	14%
Not applicable at enough locations where we operate	3	43%	0	0%	2	29%
General concept	0	0%	1	14%	4	57%
Concept complexity	2	29%	2	29%	2	29%
Necessary procedural changes	3	43%	1	14%	2	29%
Necessary controller automation	4	57%	0	0%	2	29%
Training Cost	1	14%	2	29%	2	29%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

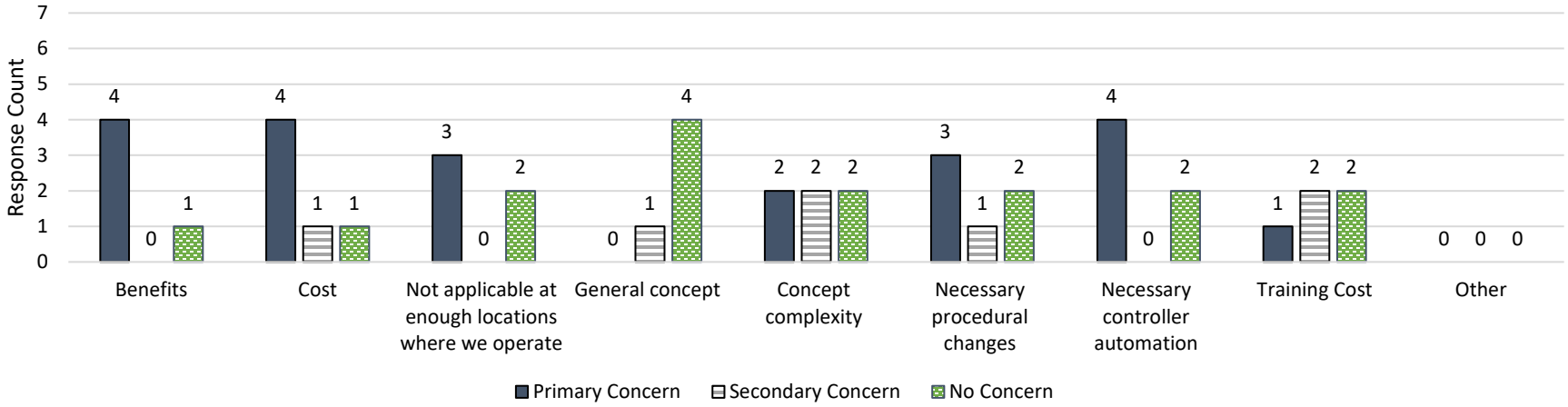


Figure L-5. Responses to "What is it about FIM - DSA that concerns your airline?"

QL.7.Airline Comments

- Cost is our primary concern, along with maturity of solution (thus uncertainty about the cost).
- Pending further development of the concept.

QL.8. If your airline is interested in FIM - DSA, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	0	0%	1	14%
Implementation of a two-rate Ground Delay Program (GDP)	3	43%	2	29%	2	29%
Additional information on avionics costs	1	14%	3	43%	1	14%
Additional information on installation and training costs	1	14%	2	29%	2	29%
Additional information on flight deck integration	2	29%	1	14%	2	29%
Other airline investment	1	14%	1	14%	3	43%
Additional field demonstration data	2	29%	3	43%	1	14%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
N	7					

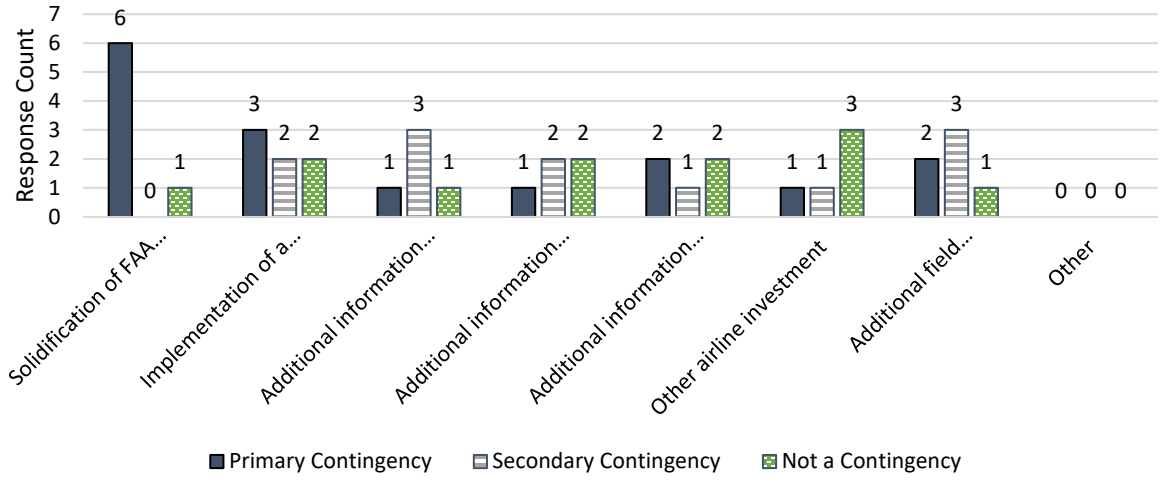


Figure L-6. Responses to "If your airline is interested in FIM - DSA, are there contingencies on an investment?"

QL.8.Airline Comments

- None

QL.9. If your airline is interested but not willing to commit to an investment in FIM - DSA, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	4	67%
Insufficient understanding of the ADS-B In application benefits	0	0%	3	50%	1	17%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	17%	3	50%
Insufficient funds	3	50%	2	33%	0	0%
Lack of benefits data	1	17%	3	50%	0	0%
Lack of field demonstration data	3	50%	2	33%	1	17%
Unclear FAA commitments on automation investments	4	67%	2	33%	0	0%
Unclear FAA commitments on necessary procedural changes	4	67%	2	33%	0	0%
Lack of information on avionics costs	2	33%	1	17%	2	33%
Lack of information on avionics installation requirements	1	17%	2	33%	2	33%
Pilot acceptability issues	0	0%	2	33%	3	50%
Controller acceptability issues	3	50%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	3	50%	3	50%
Training costs	1	17%	3	50%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

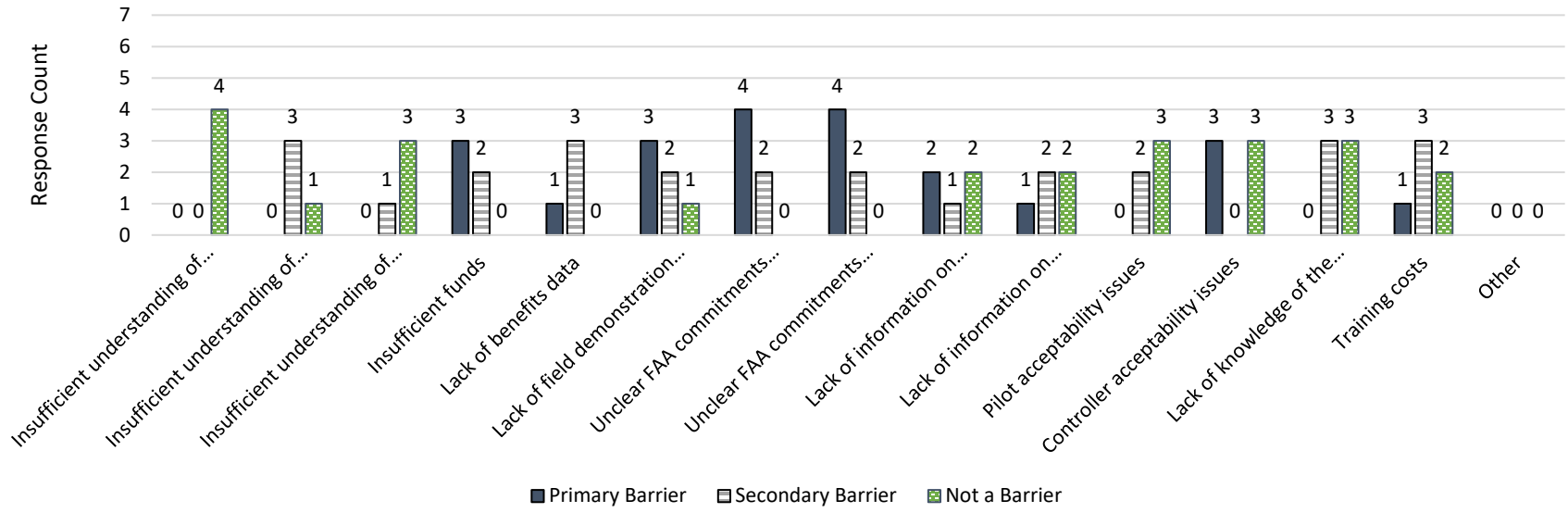


Figure L-7. Responses to "If your airline is interested but not willing to commit to an investment in FIM - DSA, what barriers could be removed to incentivize your airline to invest?"

QL.9.Airline Comments

- None

QL.10. What barriers related to FIM - DSA do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	3	43%
Equipment issues	2	29%
Complexity issues	4	57%
Cultural change	4	57%
Other	0	0%
None	1	14%
N	7	

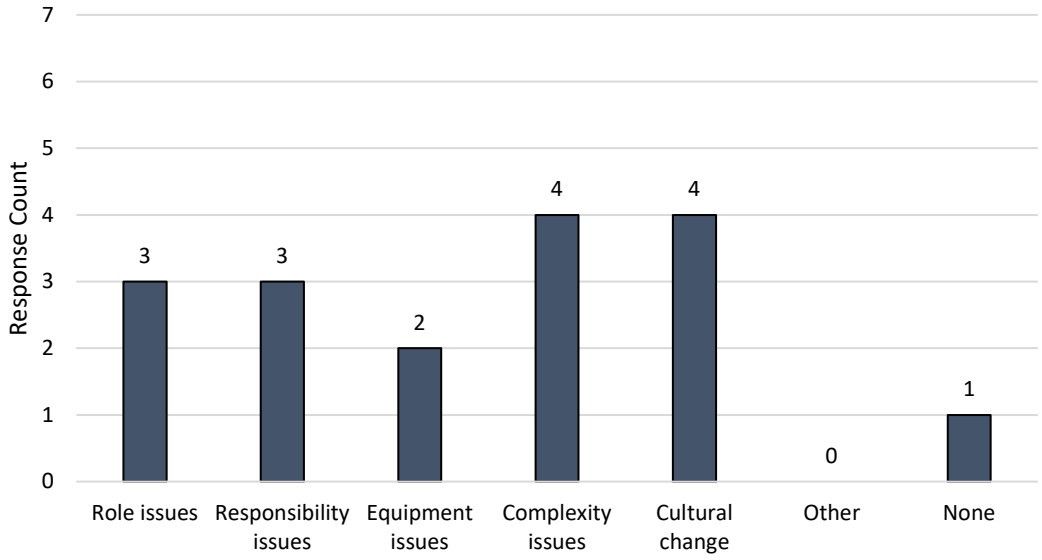


Figure L-8. Responses to "What barriers related to FIM - DSA do you see from a line pilot's perspective that would need to be addressed?"

QL.10.Airline Comments

- None

QL.11. What barriers related to FIM - DSA do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	0	0%
Equipment issues	2	29%
Complexity issues	4	57%
Cultural change	4	57%
Other	0	0%
None	1	14%
N	7	

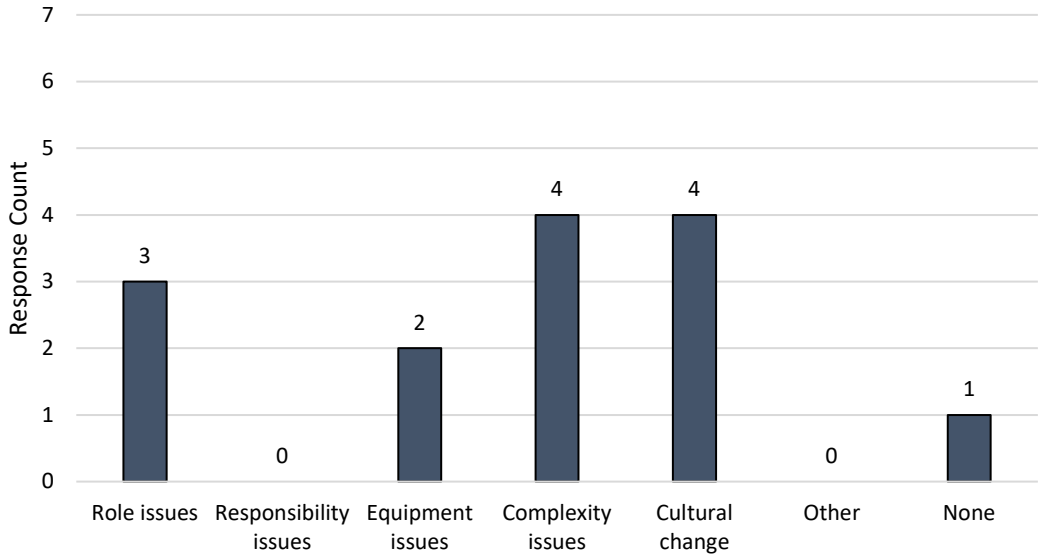


Figure L-9. Responses to "What barriers related to FIM - DSA do you see from an air traffic controller's perspective that would need to be addressed?"

QL.11.Airline Comments

- None

QL.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - DSA.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	1	14%
Neither	1	14%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	5	71%
% Disagreement	1	14%

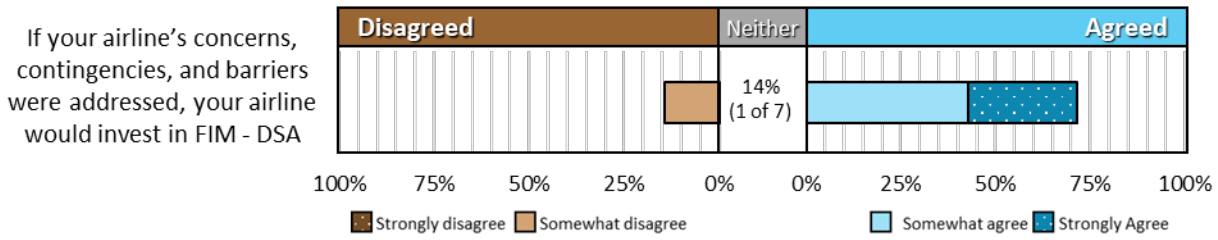


Figure L-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - DSA."

QL.12.Airline Comments

- At this point, our benefit exposure appears to be low; unlikely to invest as a primary app; possible collateral benefit
- Pending further development of the concept.

QL.13. When would your airline expect to equip with FIM - DSA?

	Count	Percentage
In our first implementation of ADS-B In applications	1	14%
In a later implementation of ADS-B In applications	4	57%
Other	2	29%
Never	0	0%
N	7	

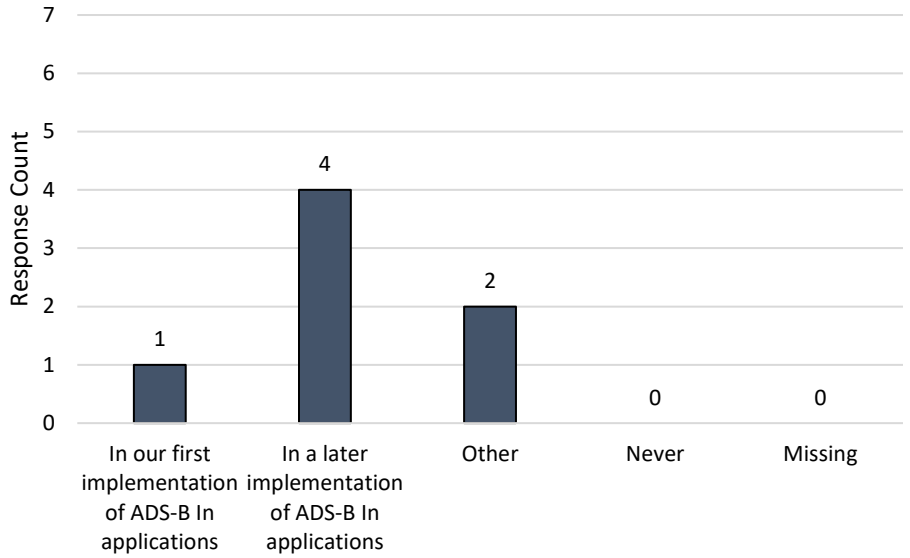


Figure L-11. Responses to "When would your airline expect to equip with FIM - DSA?"

QL.13.Airline Comments

- Unknown
- FIM needs the most work to properly integrate in the NAS, focus on easier applications like CAS first and get experience to make FIM better

QL.14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - DSA?

- Application benefit appears to be amongst the lowest in the app group
- Potential benefits are intriguing but costs are high. Implementation in the Northeast is uncertain (if not unlikely), but important for investment decision.
- Until a two rate GDP system can be implemented, equipped airplanes should be exempted from GDP's [sic].

Flight-deck-based Interval Management (FIM) – Paired Approach (PA)

QM.3. My airline is interested in FIM - PA.

		Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	3	43%
Somewhat Agree	2	29%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	4	57%
% Disagreement	0	0%

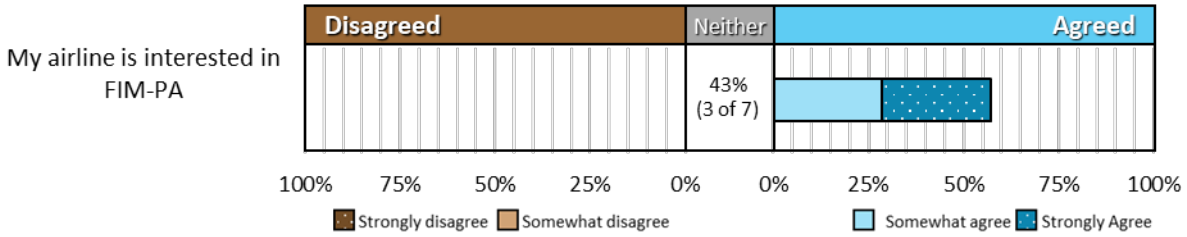


Figure M-1. Responses to "My airline is interested in FIM - PA."

QM.4. Rate your priority for FIM - PA amongst the set of ADS-B In applications.

	Count	Percentage
Low	1	14%
Medium	5	71%
High	1	14%
N	7	

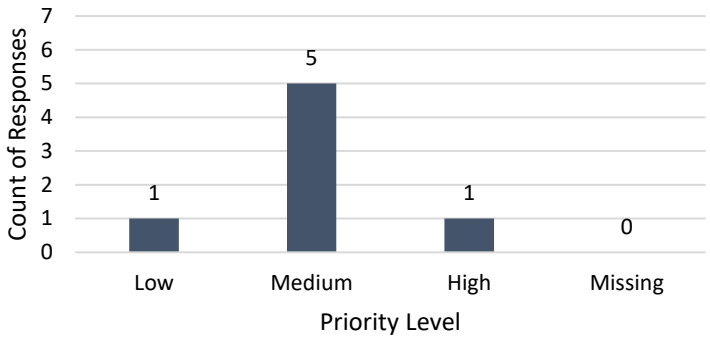


Figure M-2. Responses to "Rate your priority for FIM - PA amongst the set of ADS-B In applications."

QM.4.Airline Comments

- Pending further development of the concept.

QM.5. What is it about FIM - PA that interests your airline?

Benefits	7	100%	0	0%	0	0%
Low Cost	2	29%	1	14%	1	14%
Applicability at enough locations where we operate	3	43%	3	43%	0	0%
Other	0	0%	0	0%	0	0%
Nothing interests	0	0%				
N	7					

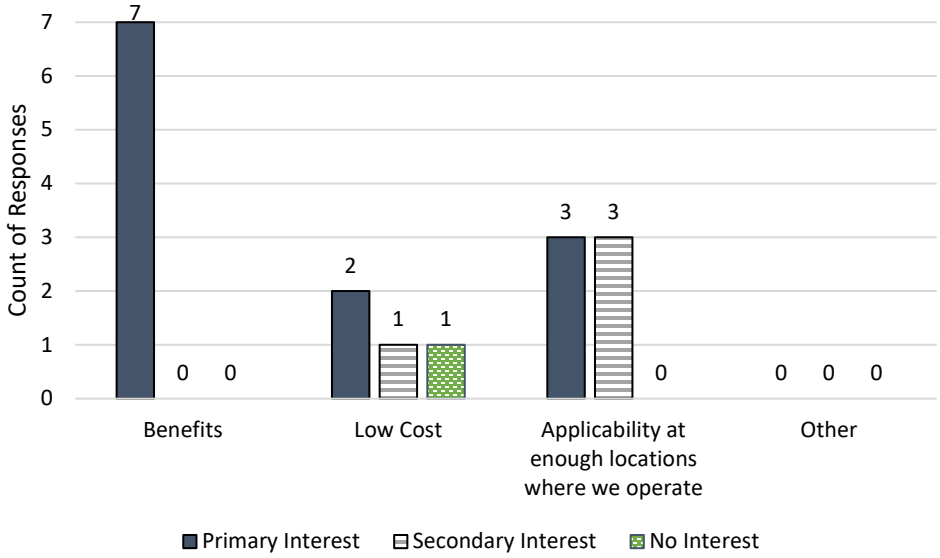


Figure M-3. Responses to "What is it about FIM - PA that interests your airline?"

QM.5.Airline Comments

- This is not a low cost application

QM.6. Describe how your airline believes FIM - PA can bring benefit to your operation.

Increased capacity/throughput	6	86%	0	0%	0	0%	1	14%
Reduced fuel burn	2	29%	3	43%	0	0%	1	14%
Reduced time in air	2	29%	2	29%	0	0%	1	14%
Reduced gate time	0	0%	0	0%	1	14%	4	57%
More predictable block times leading to schedule improvements	2	29%	2	29%	0	0%	2	29%
Reduced communications	0	0%	1	14%	2	29%	2	29%
Increased flexibility	0	0%	2	29%	1	14%	2	29%
Increased access	1	14%	1	14%	2	29%	1	14%
Increased pilot traffic awareness	2	29%	3	43%	0	0%	0	0%
Increased safety	3	43%	2	29%	0	0%	0	0%
Increased passenger satisfaction	3	43%	0	0%	1	14%	2	29%
Other	2	29%	0	0%	0	0%	0	0%
Does not bring benefit	0	0%						
N	7							

Appendix E: Mainline Operator Questionnaire De-identified Responses

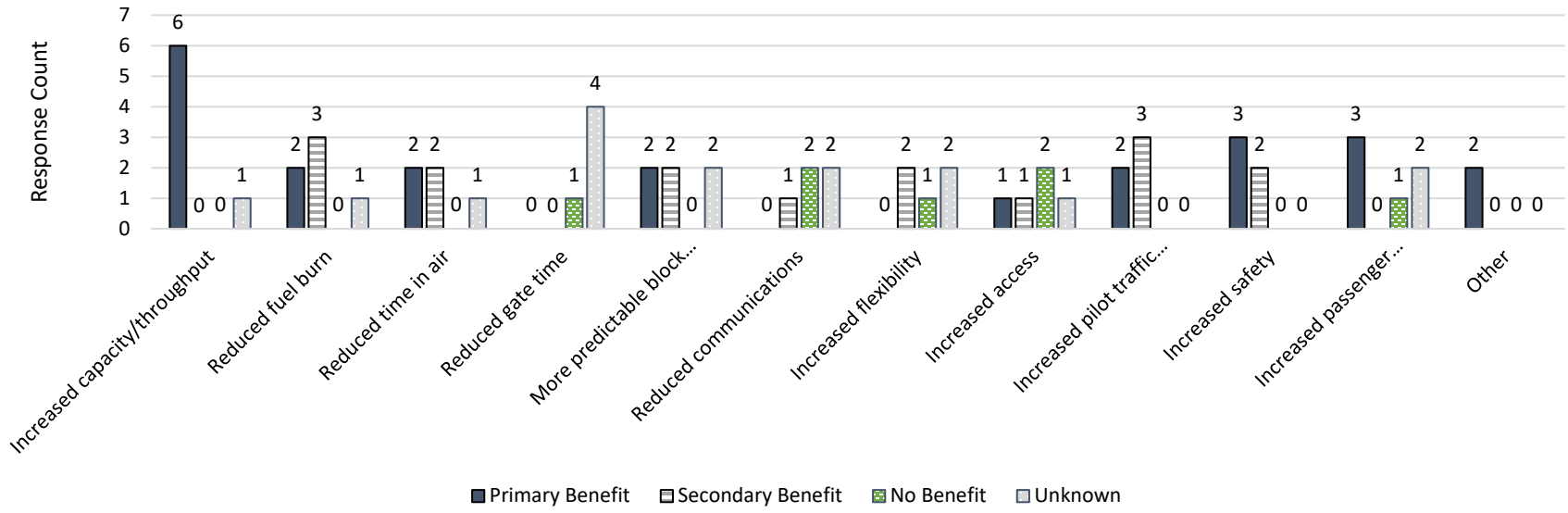


Figure M-4. Responses to "Describe how your airline believes FIM - PA can bring benefit to your operation."

QM.6.Airline Comments

- Significantly reduced GDPs.
- Reduced cancelations.
- First bullet is intended to mean closer to Visual Approach arrival rates in less than Visual Approach conditions.

QM.7. What is it about FIM - PA that concerns your airline?

Benefits	4	57%	0	0%	1	14%
Cost	4	57%	2	29%	0	0%
Not applicable at enough locations where we operate	4	57%	0	0%	2	29%
General concept	0	0%	2	29%	3	43%
Concept complexity	2	29%	1	14%	2	29%
Necessary procedural changes	2	29%	2	29%	1	14%
Necessary controller automation	5	71%	1	14%	1	14%
Training Cost	1	14%	2	29%	2	29%
Other	0	0%	0	0%	0	0%
No concerns	0	0%				
N	7					

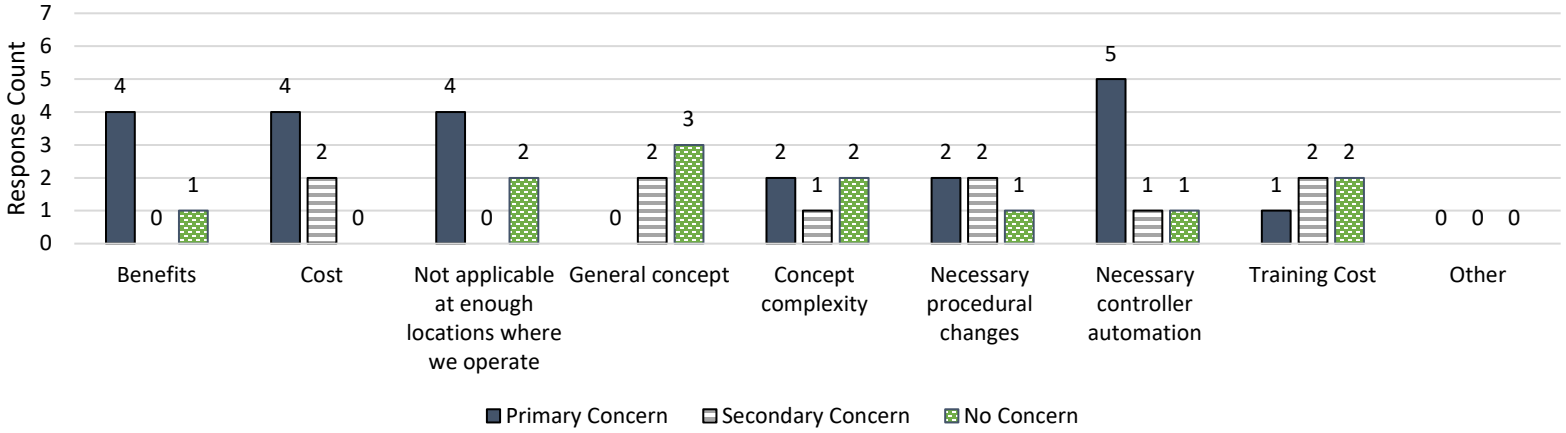


Figure M-5. Responses to "What is it about FIM - PA that concerns your airline?"

QM.7.Airline Comments

- None

QM.8. If your airline is interested in FIM - PA, are there contingencies on an investment?

Solidification of FAA commitments	6	86%	1	14%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)	3	43%	2	29%	2	29%
Additional information on avionics costs	2	29%	3	43%	0	0%
Additional information on installation and training costs	1	14%	2	29%	2	29%
Additional information on flight deck integration	2	29%	1	14%	2	29%
Other airline investment	1	14%	2	29%	2	29%
Additional field demonstration data	2	29%	3	43%	1	14%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
N	7					

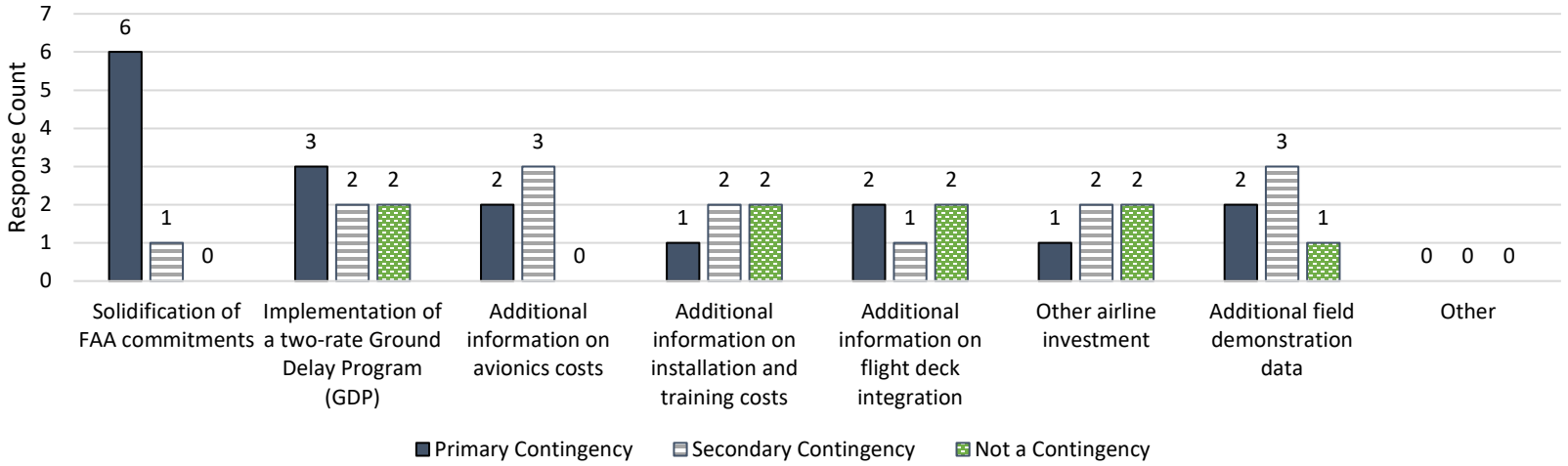


Figure M-6. Responses to "If your airline is interested in FIM - PA, are there contingencies on an investment?"

QM.8.Airline Comments

- None

QM.9. If your airline is interested but not willing to commit to an investment in FIM - PA, what barriers could be removed to incentivize your airline to invest?

Insufficient understanding of the ADS-B In application concepts	0	0%	1	17%	3	50%
Insufficient understanding of the ADS-B In application benefits	0	0%	2	33%	2	33%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	17%	3	50%
Insufficient funds	2	33%	3	50%	0	0%
Lack of benefits data	1	17%	3	50%	0	0%
Lack of field demonstration data	2	33%	2	33%	1	17%
Unclear FAA commitments on automation investments	4	67%	2	33%	0	0%
Unclear FAA commitments on necessary procedural changes	4	67%	2	33%	0	0%
Lack of information on avionics costs	2	33%	3	50%	0	0%
Lack of information on avionics installation requirements	1	17%	2	33%	2	33%
Pilot acceptability issues	0	0%	2	33%	3	50%
Controller acceptability issues	3	50%	0	0%	3	50%
Lack of knowledge of the future operation of the airline	0	0%	2	33%	3	50%
Training costs	1	17%	2	33%	2	33%
Other	0	0%	0	0%	0	0%
Nothing can motivate	0	0%				
N	6					

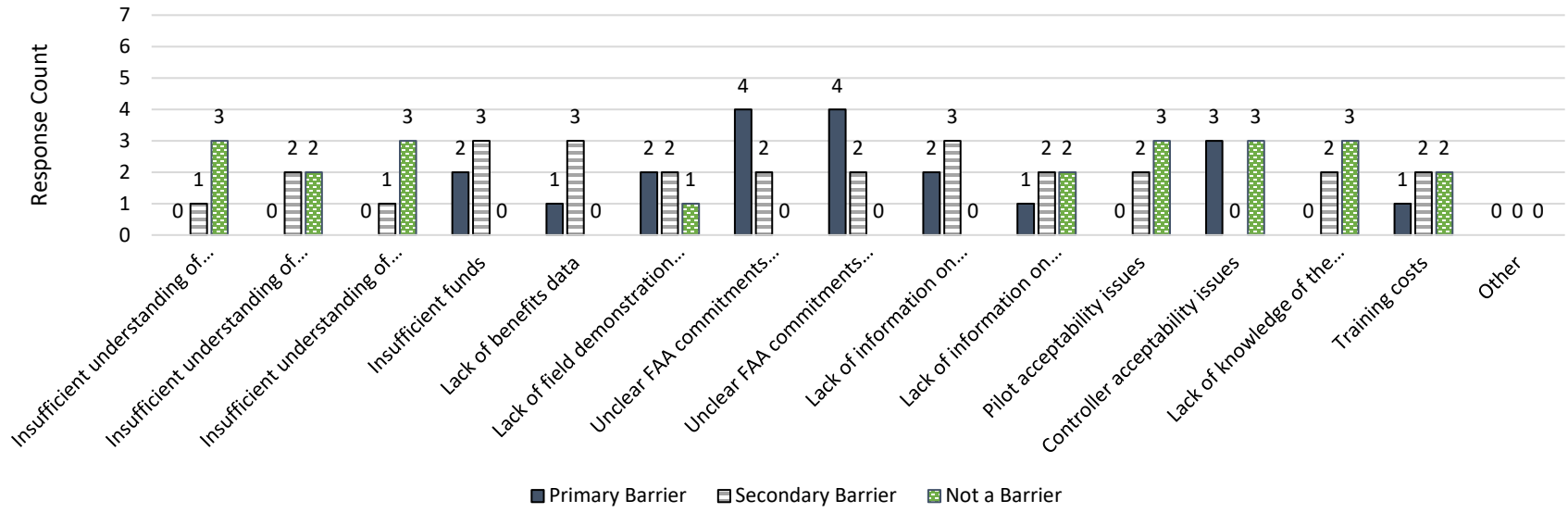


Figure M-7. Responses to "If your airline is interested but not willing to commit to an investment in FIM - PA, what barriers could be removed to incentivize your airline to invest?"

QM.9.Airline Comments

- None

QM.10. What barriers related to FIM - PA do you see from a line pilot's perspective that would need to be addressed?

	Count	Percentage
Role issues	4	57%
Responsibility issues	3	43%
Equipment issues	2	29%
Complexity issues	4	57%
Cultural change	4	57%
Other	0	0%
None	1	14%
N	7	

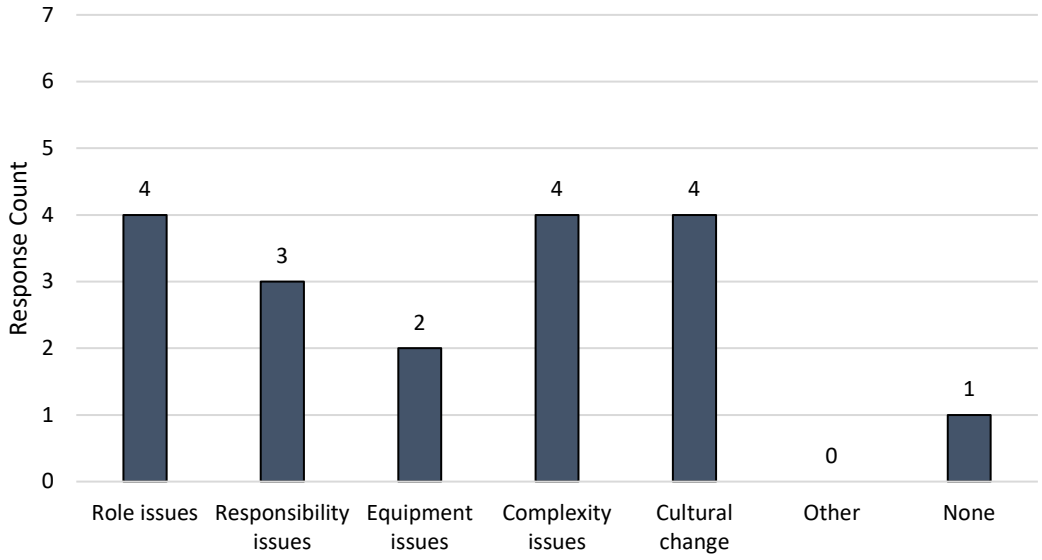


Figure M-8. Responses to "What barriers related to FIM - PA do you see from a line pilot's perspective that would need to be addressed?"

WM.10.Airline Comments

- None

QM.11. What barriers related to FIM - PA do you see from an air traffic controller's perspective that would need to be addressed?

	Count	Percentage
Role issues	3	43%
Responsibility issues	4	57%
Equipment issues	2	29%
Complexity issues	4	57%
Cultural change	4	57%
Other	0	0%
None	1	14%
N	7	

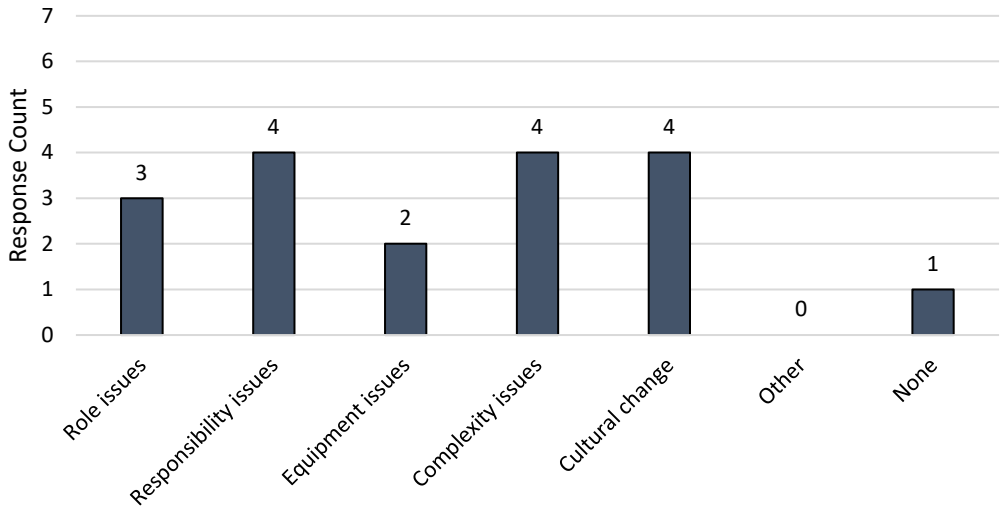


Figure M-9. Responses to "What barriers related to FIM - PA do you see from an air traffic controller's perspective that would need to be addressed?"

QM.11.Airline Comments

- Need ATC buy in

.

QM.12. If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - PA.

	Count	Percentage
Strongly Disagree	0	0%
Disagree	0	0%
Somewhat Disagree	0	0%
Neither	2	29%
Somewhat Agree	3	43%
Agree	0	0%
Strongly Agree	2	29%
N	7	
% Agreement	5	71%
% Disagreement	0	0%

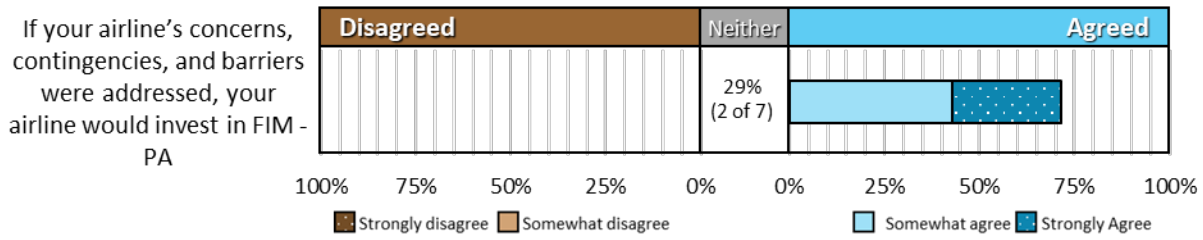


Figure M-10. Responses to "If your airline's concerns, contingencies, and barriers were addressed, your airline would invest in FIM - PA."

QM.12.Airline Comments

- Hard to say: need to ID benefit exposure
- Pending further development of the concept.

QM.13. When would your airline expect to equip with FIM - PA?

	Count	Percentage
In our first implementation of ADS-B In applications	1	14%
In a later implementation of ADS-B In applications	5	71%
Other	1	14%
Never	0	0%
N	7	

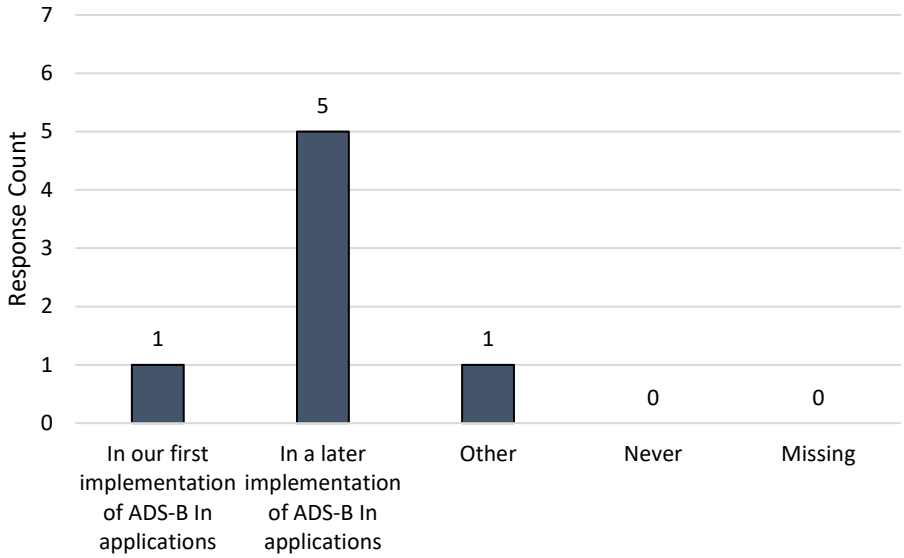


Figure M-11. Responses to "When would your airline expect to equip with FIM - PA?"

QM.13.Airline Comments

- Pending further development of the concept. Our desire is in our first implementation, but it planned for phase 2 which is later.

QM.14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - PA?

- Until a two rate GDP system can be implemented, equipped airplanes should be exempted from GDP's [sic].

Final Comments

15. Do you have any final comments or thoughts for the NAC to share with the FAA? (e.g., any other uses of ADS-B In that have not been mentioned)

- This survey has been structured to consider the individual applications separately. Our investment case will be built on what the *additive* benefit of the most relevant applications to our operation will be (CAVS, CAS, FIM-Single Corner). Many of the other apps would be useful for added safety or limited exposure at non-hub airports in the NAS, but could not add justification to the business case as a primary contributor. Need to dig more to ID benefit on some apps.
- Great systems and capabilities. However unless regulatorially [sic] mandated or the overall cost of equipage is significantly reduced these initiatives will remain as a difficult sell to senior management.
- FAA operational buy-in (controllers) is not clear on many applications (e.g. FIM). FAA commitment to move forward is critical point that will tie into our investment plans. Given COVID circumstances, airline priorities will be focused on increasing operations safely. Discretionary modernization will need strong business case that includes clear FAA commitment to implementation and utilization for applications in our primary operations areas (e.g. northeast). Clearer connection of benefits to airlines goals (like sustainability) will be needed as well as more detailed and accurate modeling results, or better yet field demonstrations.
- Ultimately with the data available, our airline is cautiously optimistic about the value of ADS-B In applications. We feel it is best to start work on the applications with the best bang-for-the-buck like CAS. Also, while there are benefits for the FIM applications, it is unclear whether the benefits will outweigh the cost and complexity FIM currently seems to impose. We did think fondly however of IM.308 and Paired Approach as airports with closely spaced runways seem to suffer the most in the NAS during IMC conditions and therefore garner the most to be gained from improvement. ITP was also seen in a positive light, but there are concerns over competing technologies here like Space Based ADS-B. With the current information available about ITP and the unknowing of whether Spaced Based ADS-B will be implemented makes this a hard one to forecast benefits.

Appendix F: Aircraft and Avionics OEM Questionnaire De-identified Responses

Primary Questions

Q1. My company will likely offer at least one ADS-B In application

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	0	0%
Strongly Agree	5	100%
N	5	
Total Agreement	5	100%
Total Disagreement	0	0%

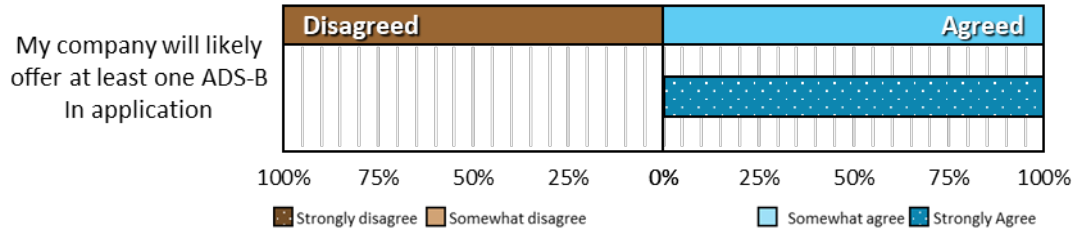


Figure 1-1. Responses to "My company will likely offer at least one ADS-B In application"

Q1.a. If your company decides to offer at least one ADS-B In application, what type of installations would you expect?

	Count*	Percentage*
Forward-fit	5	100%
Retrofit by Aircraft OEM Service Bulletin	4	80%
Retrofit by STC with avionics OEM solutions	3	60%
N	5	

*Note that respondents could choose more than one option

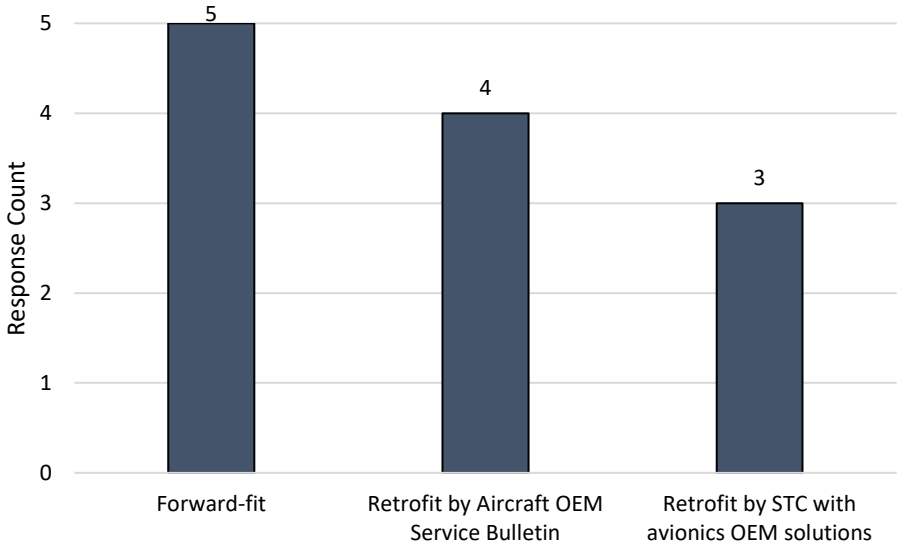


Figure 1-2. Responses to "If your company decides to offer at least one ADS-B In application, what type of installations would you expect?" *

*Note that respondents could choose more than one option

Q2. My company is interested in participating in the FAA's operational benefits validation field activities of ADS-B In

	Phase 1 – FIM Same Corner Post Arrivals		Phase 2 – FIM DSA and DCCR		Phase 3 – FIM PA	
	Count	**Percentage**	**Count**	**Percentage**	**Count**	**Percentage**
Strongly Disagree	0	0%	0	0%	0	0%
Somewhat Disagree	0	0%	0	0%	0	0%
Neither	1	20%	1	20%	1	20%
Somewhat Agree	1	20%	1	20%	1	20%
Strongly Agree	3	60%	3	60%	3	60%
N	5		5		5	
Total Agreement	4	80%	4	80%	4	80%
Total Disagreement	0	0%	0	0%	0	0%

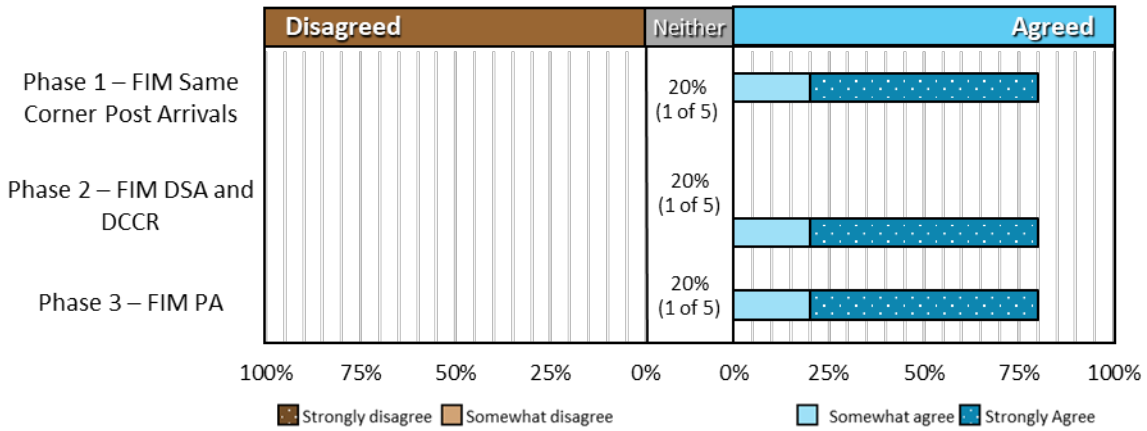
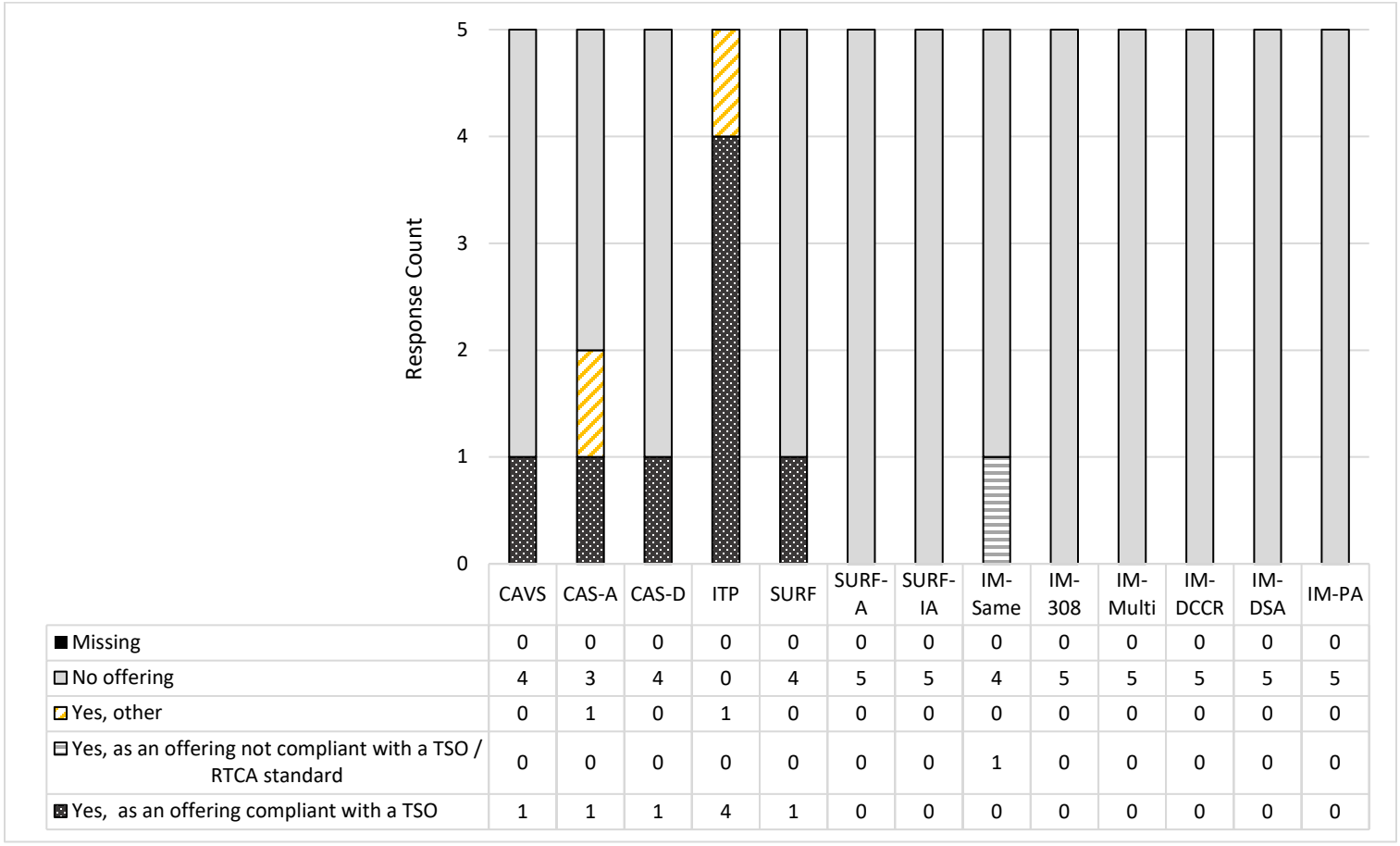


Figure 1-3. Responses to "My company is interested in participating in the FAA's operational benefits validation field activities of ADS-B In"

Q.2.OEM Comments

- Phase 1 – Same Corner Post IM
  - My company is interested in participating in operational benefits validation and will evaluate each opportunity on a case-by-case basis.
  - Near term financial and resource constraints.
  - See comment below that applies to all three Phases.
  - "Initial Interval Management" application has been certified via FAA Issue Paper and is currently available via retrofit STC. This application is not DO- 361A compliant but does support Phase 1 Same Corner Post FIM operations
- Phase 2 – IM with DSA and DCCR
  - Understanding the requirements and expectations in a timely manner to enable the appropriate level of review and approval internally prior to participation.
  - Near term financial and resource constraints.
  - See comment below that applies to all three Phases.
  - Business Case in support of development effort would need to be substantiated.
- Phase 3 – FIM – Paired Approach
  - Understanding the requirements and expectations in a timely manner to enable the appropriate level of review and approval internally prior to participation.
  - Near term financial and resource constraints.
  - See comment below that applies to all three Phases.
  - Business Case in support of development effort would need to be substantiated.
- What barriers exist for your participation?
  - Company is part of SETIS which can provide a framework for such activities
  - [OEM] would likely agree to start FIM product development and certification to achieve an entry into service date to support the operational benefits validations if: (1) The FAA makes a positive investment decision for development of FIM ground infrastructure and operational procedures, and (2) The FAA or airlines provide development funding offsets to mitigate against the risk that market demand for the product doesn't develop. Otherwise, [OEM] is likely to await FAA ground infrastructure and operational procedure deployment and sufficient market demand before committing to product development and certification.

Between Application Comparisons



	CAVS	CAS-A	CAS-D	ITP	SURF	SURF-A	SURF-IA	IM-Same	IM-308	IM-Multi	IM-DCCR	IM-DSA	IM-PA
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0
No offering	4	3	4	0	4	5	5	4	5	5	5	5	5
Yes, other	0	1	0	1	0	0	0	0	0	0	0	0	0
Yes, as an offering not compliant with a TSO / RTCA standard	0	0	0	0	0	0	0	1	0	0	0	0	0
Yes, as an offering compliant with a TSO	1	1	1	4	1	0	0	0	0	0	0	0	0

Figure 2-1. Combined Responses to "Does your company currently offer [application name]?" by application

Figure 2-2. Ranked Combined Responses to "My company is interested in offering [application name]" by application

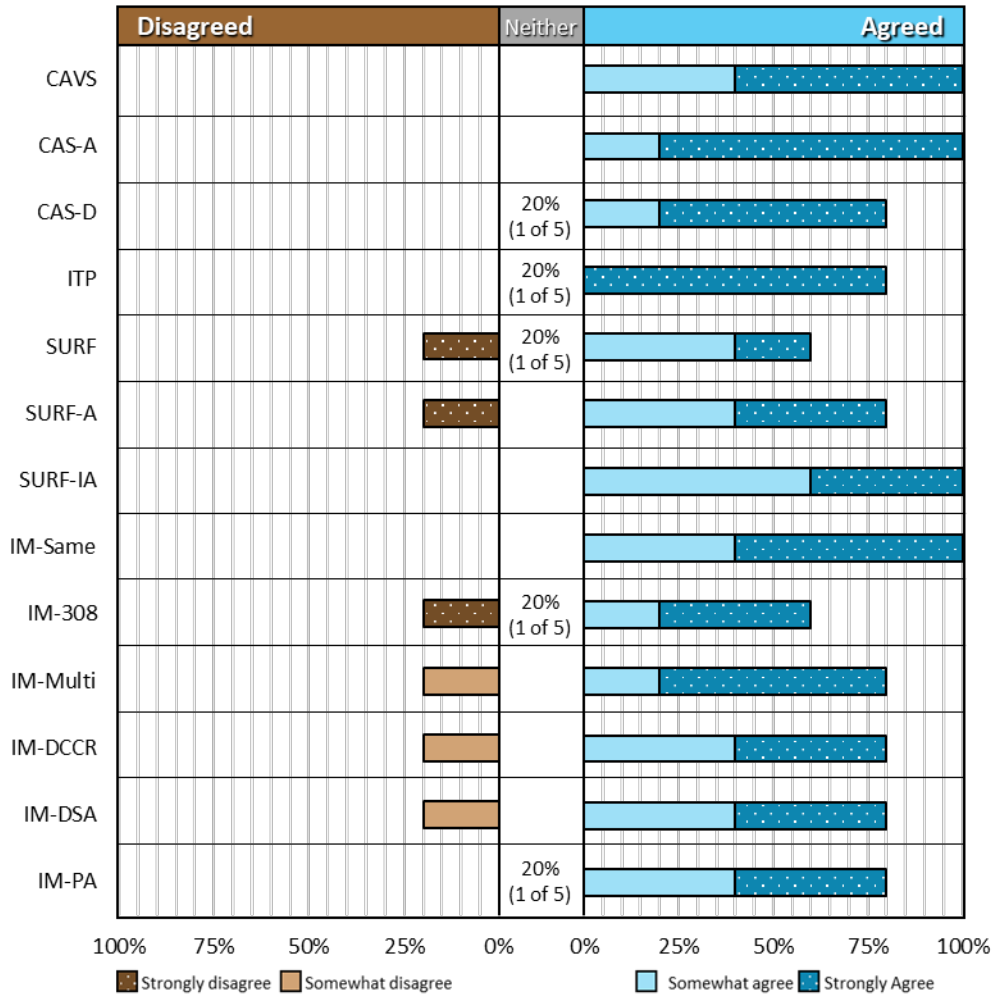


Figure 2-3. Combined Responses to "My company is interested in offering [application name]" by application

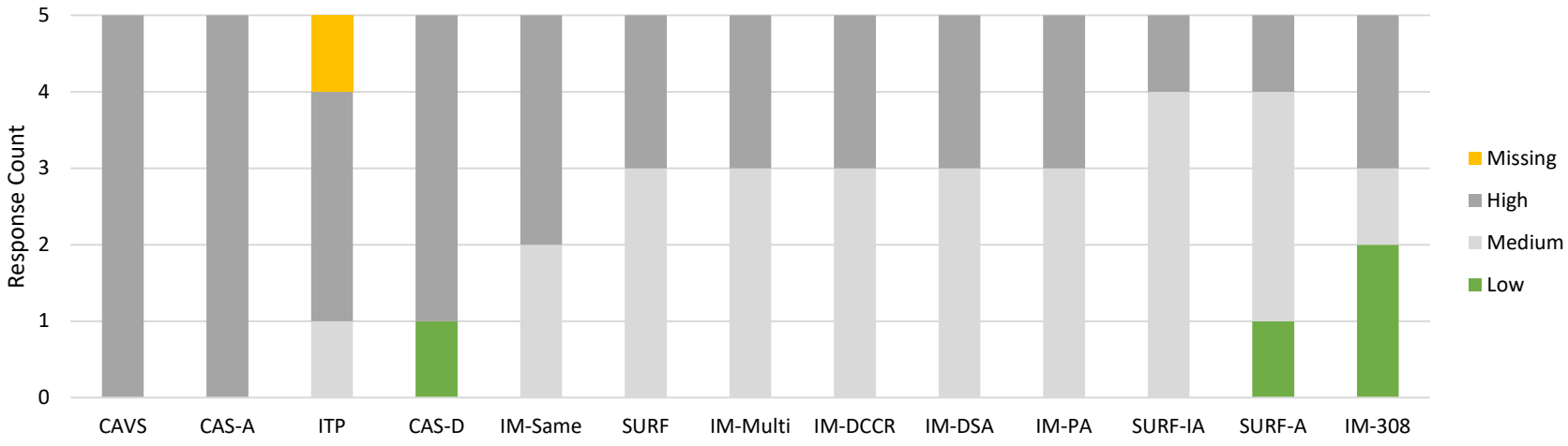


Figure 2-4. Ranked Combined Responses to "Rate your company's priority for [application name] amongst the set of ADS-B In applications" by application

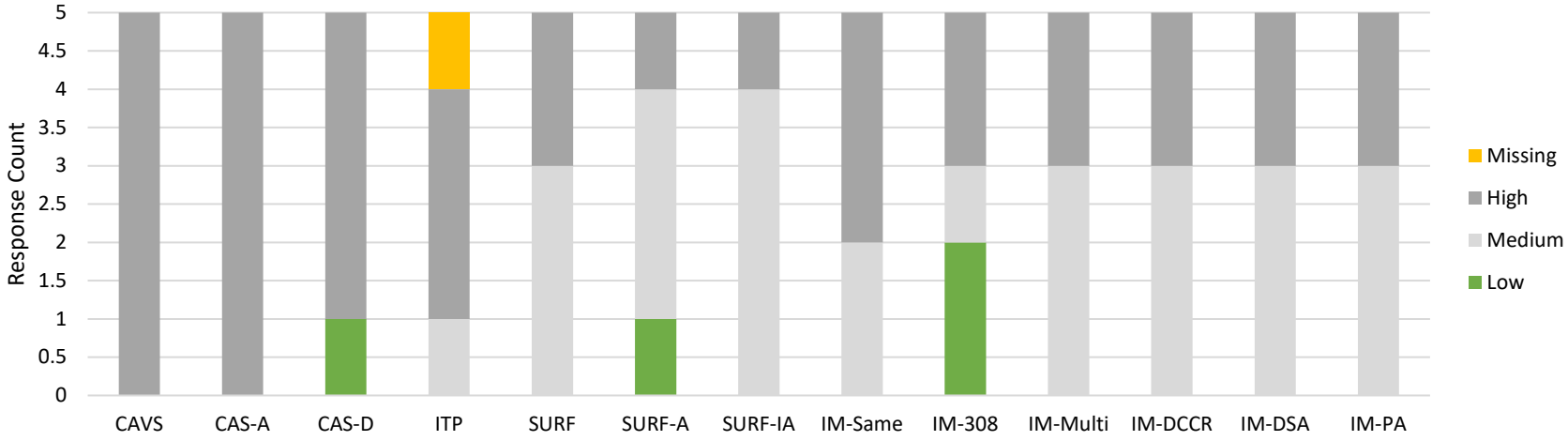
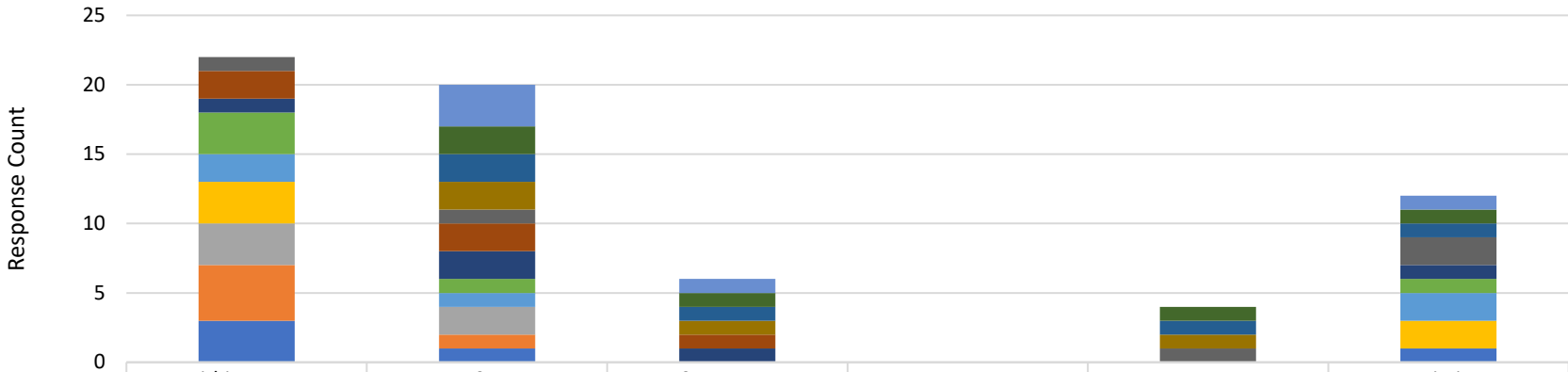
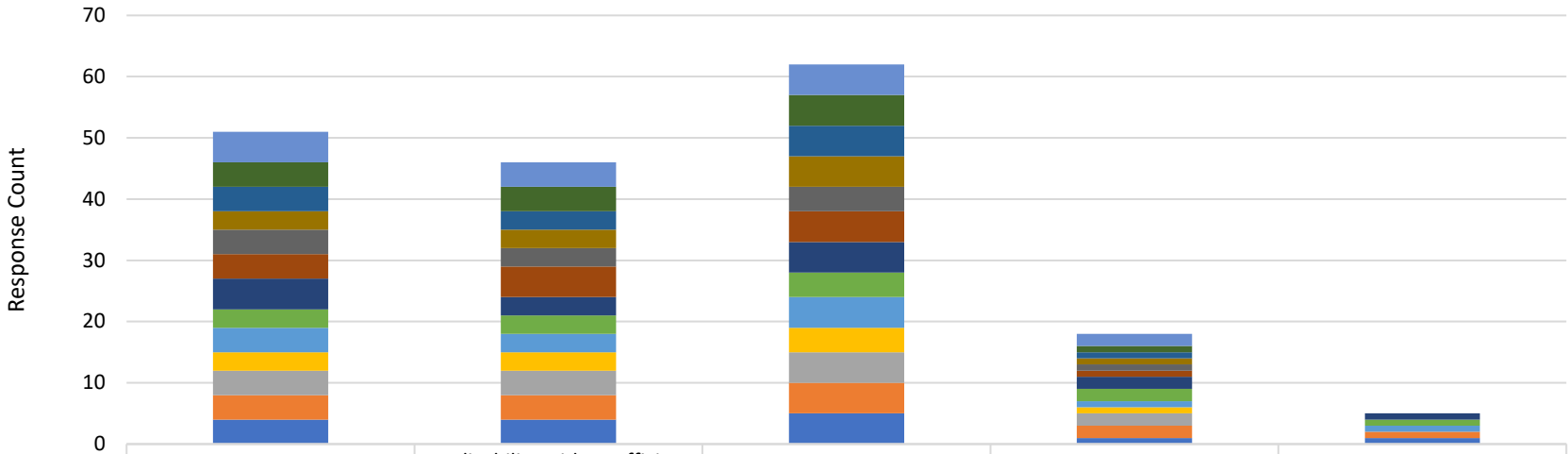


Figure 2-5. Combined Responses to "Rate your company's priority for [application name] amongst the set of ADS-B In applications" by application



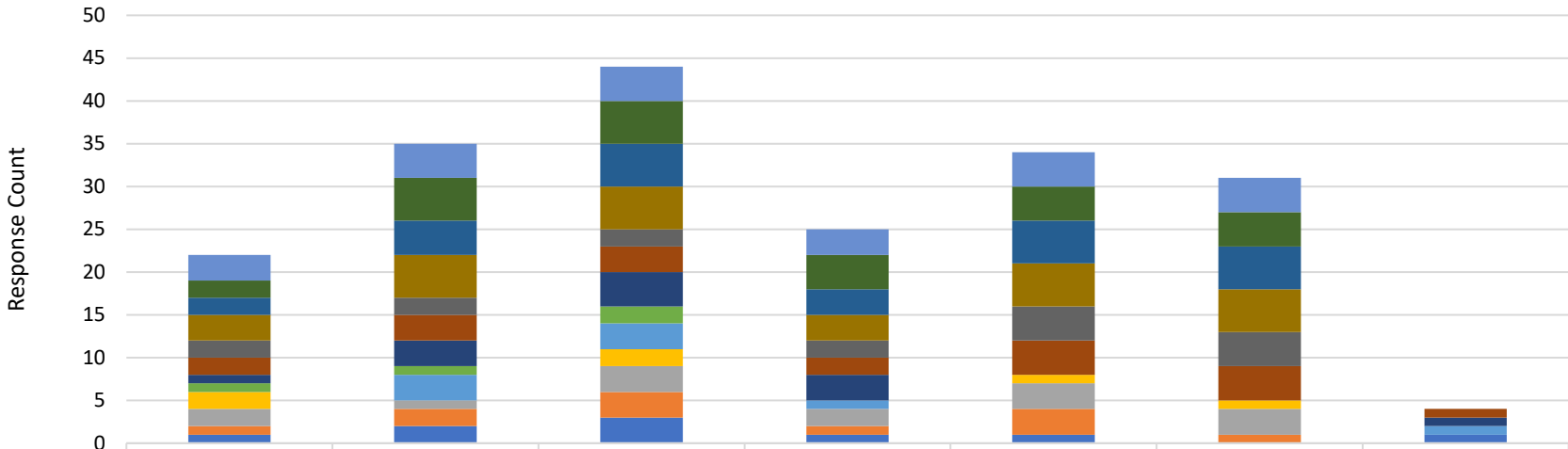
	Within 5 years	5 - 10 years	10 - 15 years	> 15 years	NA	Missing
IM-PA	0	3	1	0	0	1
IM-DSA	0	2	1	0	1	1
IM-DCCR	0	2	1	0	1	1
IM-Multi	0	2	1	0	1	0
IM-308	1	1	0	0	1	2
IM-Same	2	2	1	0	0	0
SURF-IA	1	2	1	0	0	1
SURF-A	3	1	0	0	0	1
SURF	2	1	0	0	0	2
ITP	3	0	0	0	0	2
CAS-D	3	2	0	0	0	0
CAS-A	4	1	0	0	0	0
CAVS	3	1	0	0	0	1

Figure 2-6. Combined Responses to "If your company decides to offer [application name], in what timeframe do you expect to offer it?" by application



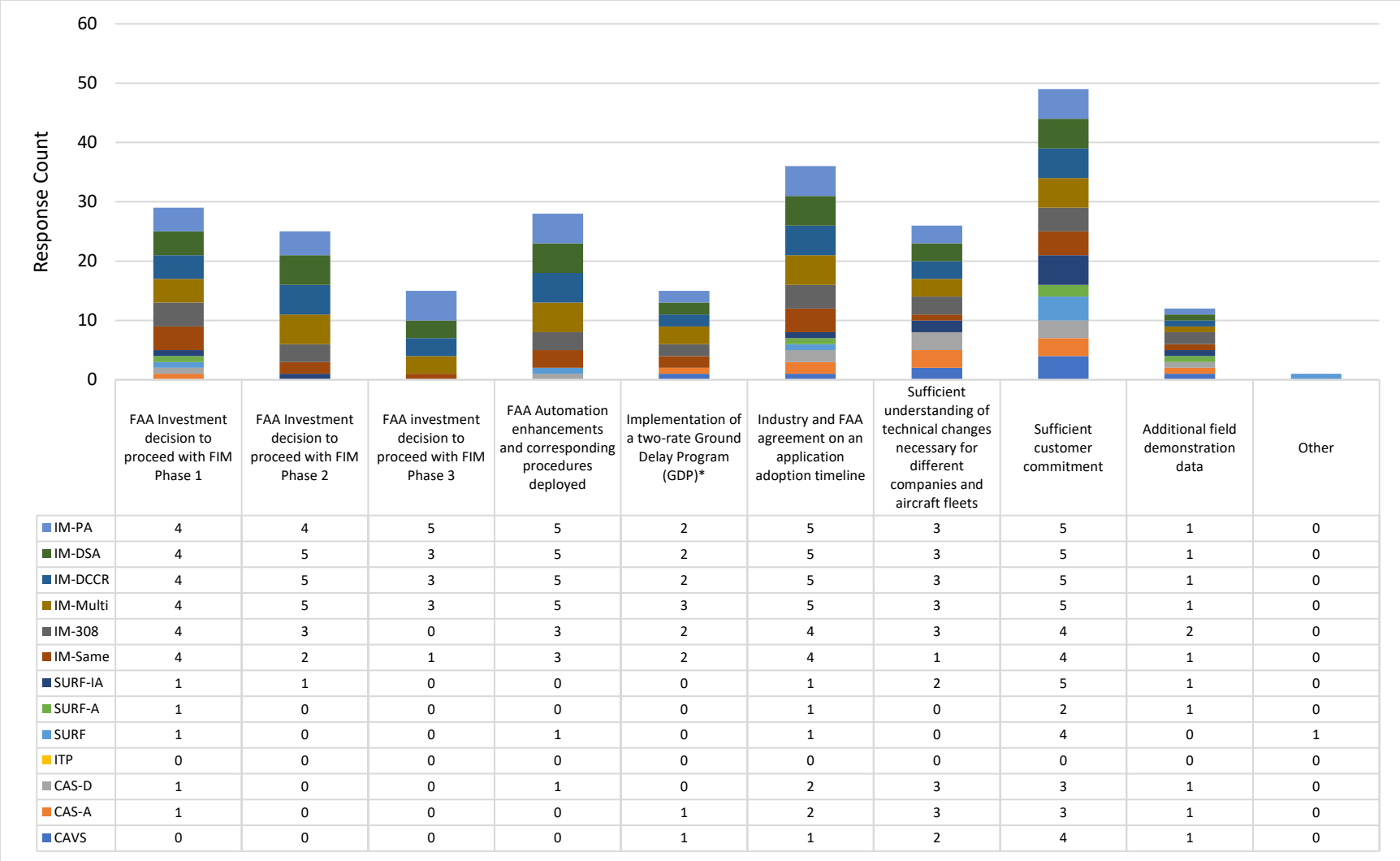
	Expressed customer interest	Applicability with a sufficient number of customers	Increase new aircraft/avionics sales	Concept	Other
IM-PA	5	4	5	2	0
IM-DSA	4	4	5	1	0
IM-DCCR	4	3	5	1	0
IM-Multi	3	3	5	1	0
IM-308	4	3	4	1	0
IM-Same	4	5	5	1	0
SURF-IA	5	3	5	2	1
SURF-A	3	3	4	2	1
SURF	4	3	5	1	1
ITP	3	3	4	1	0
CAS-D	4	4	5	2	0
CAS-A	4	4	5	2	1
CAVS	4	4	5	1	1

Figure 2-7. Combined Primary and Secondary Responses to "What is it about [application name] that interests your company??" by application



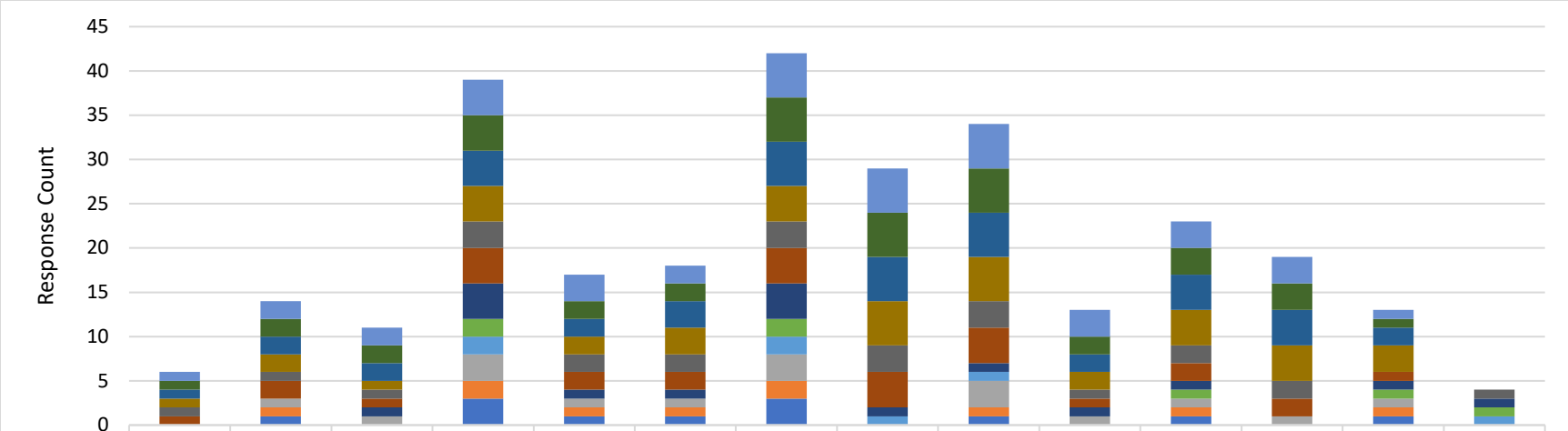
	Benefits	Cost	Insufficient customer interest	Concept complexity	Necessary procedural changes	Necessary controller automation	Other
IM-PA	3	4	4	3	4	4	0
IM-DSA	2	5	5	4	4	4	0
IM-DCCR	2	4	5	3	5	5	0
IM-Multi	3	5	5	3	5	5	0
IM-308	2	2	2	2	4	4	0
IM-Same	2	3	3	2	4	4	1
SURF-IA	1	3	4	3	0	0	1
SURF-A	1	1	2	0	0	0	0
SURF	0	3	3	1	0	0	1
ITP	2	0	2	0	1	1	0
CAS-D	2	1	3	2	3	3	0
CAS-A	1	2	3	1	3	1	0
CAVS	1	2	3	1	1	0	1

Figure 2-8. Combined Primary and Secondary Responses to "What is it about [application name] that concerns your company?" by application



	FAA Investment decision to proceed with FIM Phase 1	FAA Investment decision to proceed with FIM Phase 2	FAA investment decision to proceed with FIM Phase 3	FAA Automation enhancements and corresponding procedures deployed	Implementation of a two-rate Ground Delay Program (GDP)*	Industry and FAA agreement on an application adoption timeline	Sufficient understanding of technical changes necessary for different companies and aircraft fleets	Sufficient customer commitment	Additional field demonstration data	Other
IM-PA	4	4	5	5	2	5	3	5	1	0
IM-DSA	4	5	3	5	2	5	3	5	1	0
IM-DCCR	4	5	3	5	2	5	3	5	1	0
IM-Multi	4	5	3	5	3	5	3	5	1	0
IM-308	4	3	0	3	2	4	3	4	2	0
IM-Same	4	2	1	3	2	4	1	4	1	0
SURF-IA	1	1	0	0	0	1	2	5	1	0
SURF-A	1	0	0	0	0	1	0	2	1	0
SURF	1	0	0	1	0	1	0	4	0	1
ITP	0	0	0	0	0	0	0	0	0	0
CAS-D	1	0	0	1	0	2	3	3	1	0
CAS-A	1	0	0	0	1	2	3	3	1	0
CAVS	0	0	0	0	1	1	2	4	1	0

Figure 2-9. Combined Primary and Secondary Responses to "If your company is interested in [application name], are there contingencies on an investment?" by application



	Insufficient understanding of the ADS-B In application concepts	Insufficient understanding of the ADS-B In application benefits	Insufficient understanding of technical changes necessary on the aircraft	Insufficient funds	Lack of benefits data	Lack of field demonstration data	Unclear interest from customers	Unclear FAA commitments on automation investments	Unclear FAA commitments on necessary procedural changes	Lack of information on avionics installation requirements	Pilot acceptability issues	Controller acceptability issues	Lack of knowledge of the future operation of the customers / companies	Other
IM-PA	1	2	2	4	3	2	5	5	5	3	3	3	1	0
IM-DSA	1	2	2	4	2	2	5	5	5	2	3	3	1	0
IM-DCCR	1	2	2	4	2	3	5	5	5	2	4	4	2	0
IM-Multi	1	2	1	4	2	3	4	5	5	2	4	4	3	0
IM-308	1	1	1	3	2	2	3	3	3	1	2	2	0	1
IM-Same	1	2	1	4	2	2	4	4	4	1	2	2	1	0
SURF-IA	0	0	1	4	1	1	4	1	1	1	1	0	1	1
SURF-A	0	0	0	2	0	0	2	0	0	0	1	0	1	1
SURF	0	0	0	2	0	0	2	1	1	0	0	0	0	1
ITP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAS-D	0	1	1	3	1	1	3	0	3	1	1	1	1	0
CAS-A	0	1	0	2	1	1	2	0	1	0	1	0	1	0
CAVS	0	1	0	3	1	1	3	0	1	0	1	0	1	0

Figure 2-10. Combined Primary and Secondary Responses to "If your company is interested but not willing to commit to an investment in [application name], what barriers could be removed to incentivize your company to invest?" by application

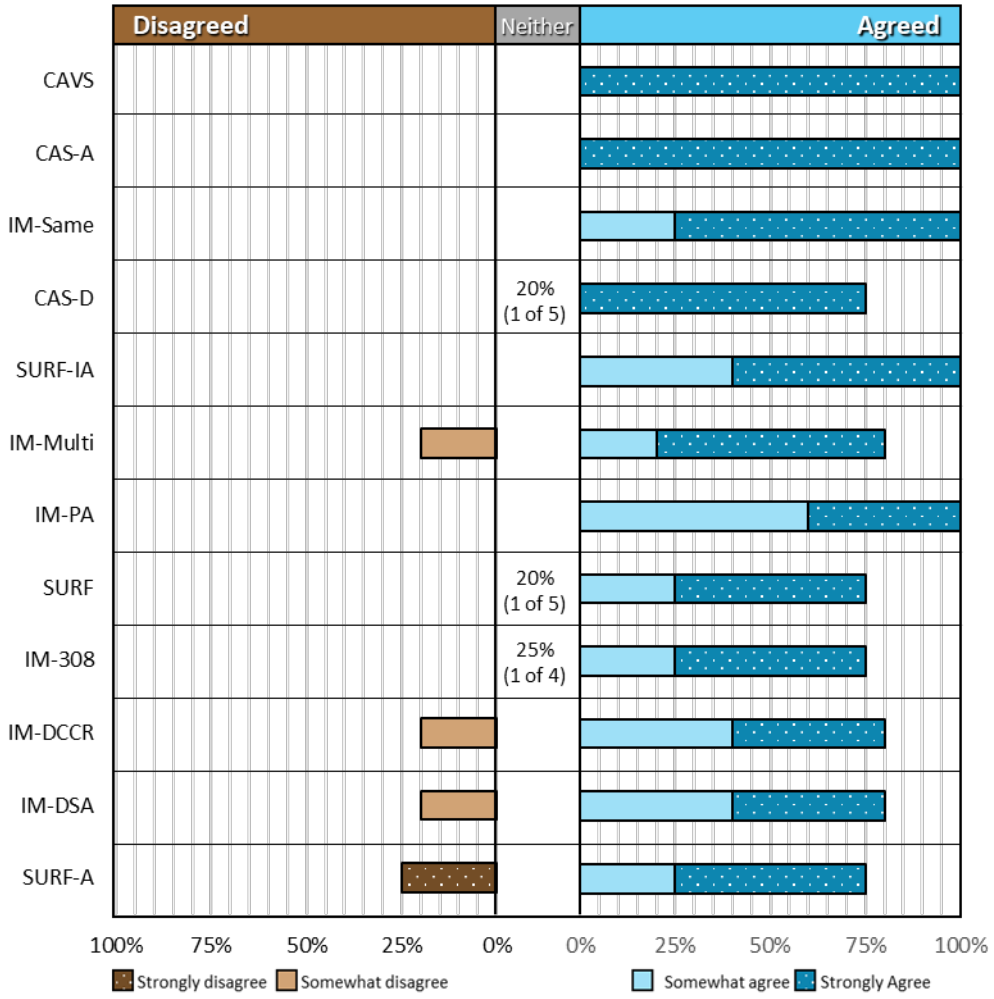


Figure 2-11. Combined Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in [application name]." by application

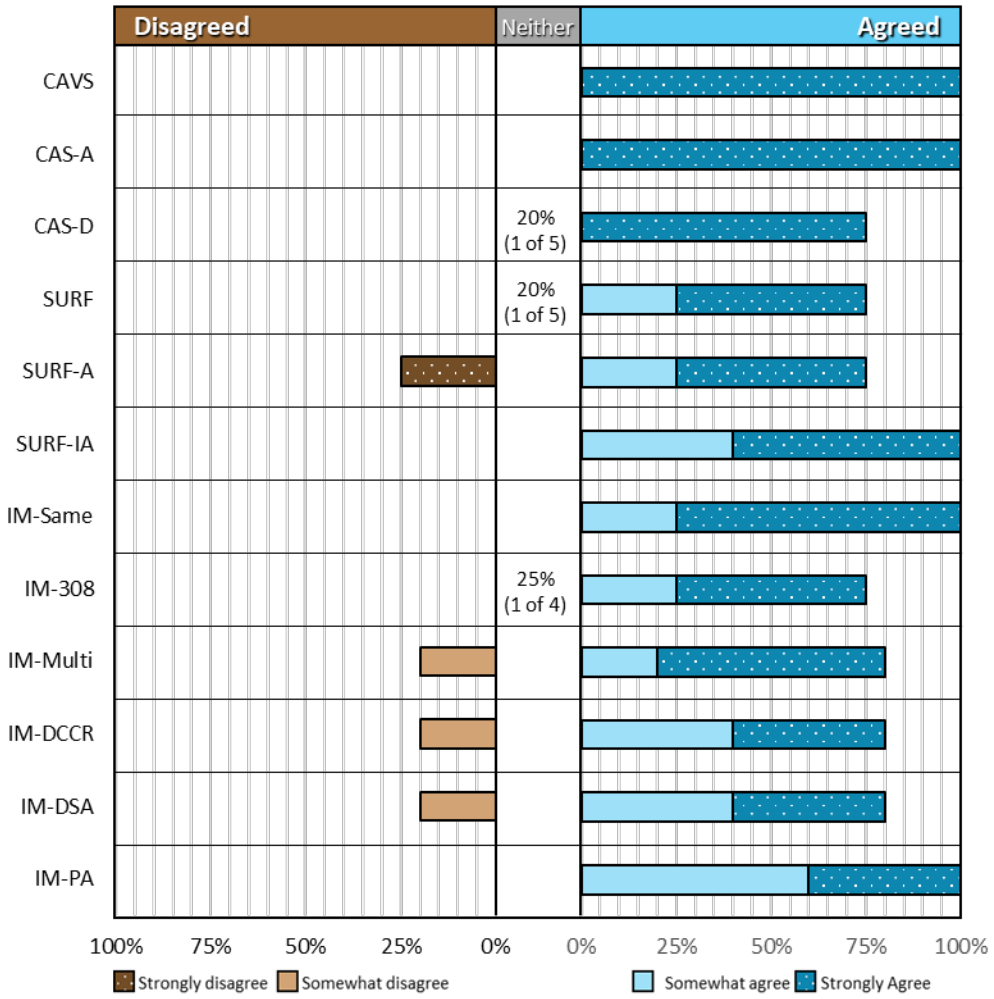
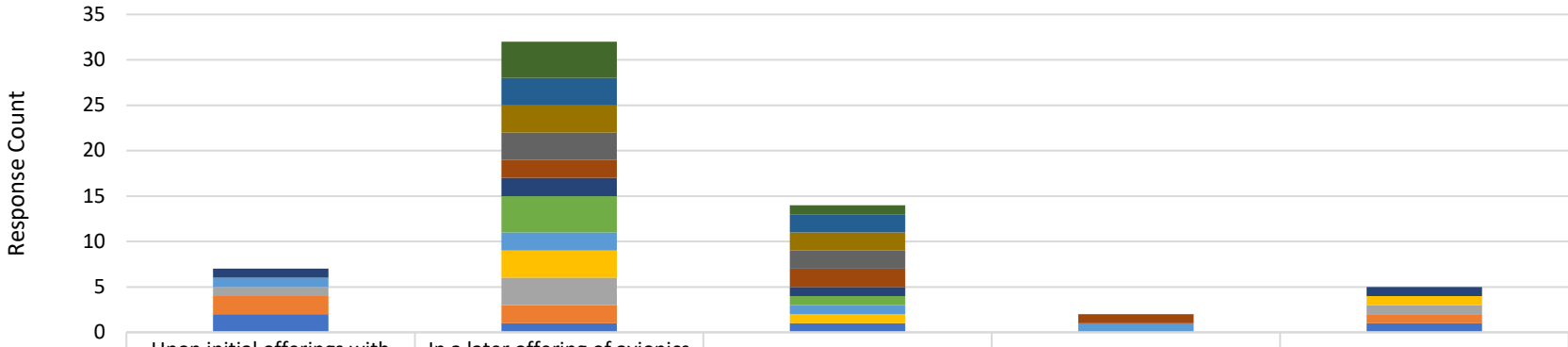


Figure 2-12. Combined Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in [application name]." by application



	Upon initial offerings with avionics providing this ADS-B In application	In a later offering of avionics providing ADS-B In applications	Other	Never	NA
IM-PA	0	4	1	0	0
IM-DSA	0	3	2	0	0
IM-DCCR	0	3	2	0	0
IM-Multi	0	3	2	0	0
IM-308	0	2	2	1	0
IM-Same	1	2	1	0	1
SURF-IA	0	4	1	0	0
SURF-A	1	2	1	1	0
SURF	0	3	1	0	1
CAS-D	1	3	0	0	1
CAS-A	2	2	0	0	1
CAVS	2	1	1	0	1

Figure 2-13. Combined Responses to "When would your company expect to offer [application name]?" by application

CDTI-Assisted Visual Separation (CAVS)

QA.3. Does your company currently offer CAVS?

	Count	Percentage
Yes, as an offering compliant with a TSO	1	20%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	4	80%
Missing	0	
N	5	

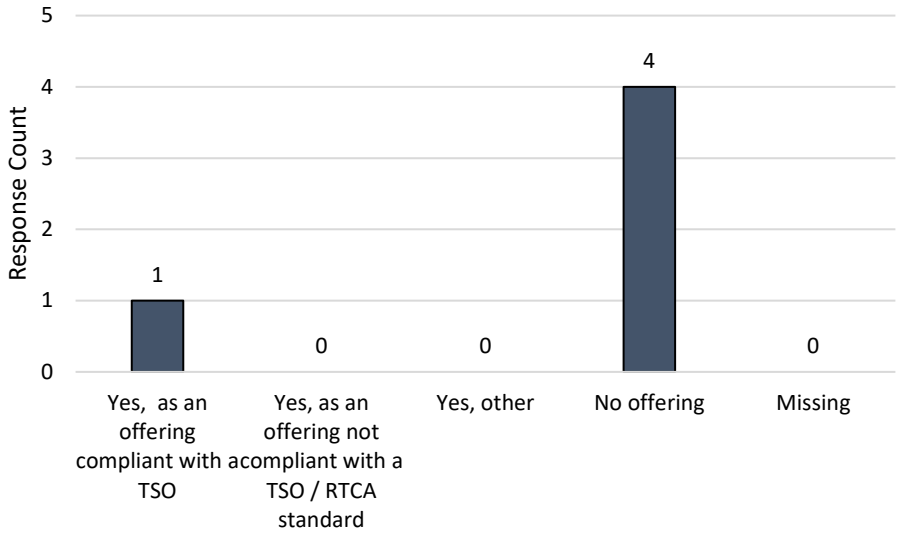


Figure A-1. Responses to "Does your company currently offer CAVS?"

QA.3.OEM Comments

- None

QA.4. My company is interested in offering CAVS.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	3	60%
N	5	
Total Agreement	5	100%
Total Disagreement	0	0%

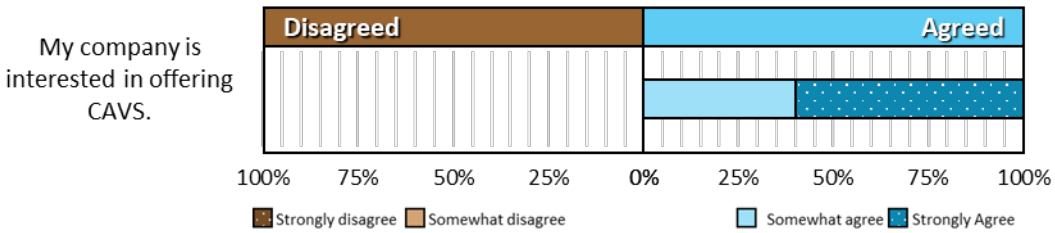


Figure A-2. Responses to "My company is interested in offering CAVS."

QA. 4.OEM Comments

- None

QA.5. Rate your company's priority for CAVS amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	0	0%
High	5	100%
Missing	0	
N	5	

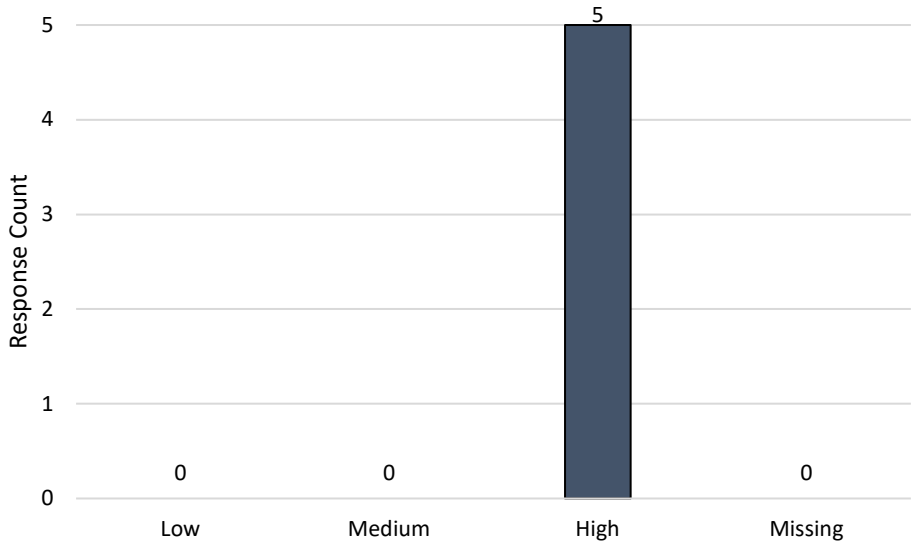


Figure A-3. Rate your company's priority for CAVS amongst the set of ADS-B In applications

QA.5.OEM Comments

- None

QA.6. If your company decides to offer CAVS, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	3	75%
5 - 10 years	1	25%
10 - 15 years	0	0%
> 15 years	0	0%
NA	0	0%
Missing	1	
N	4	

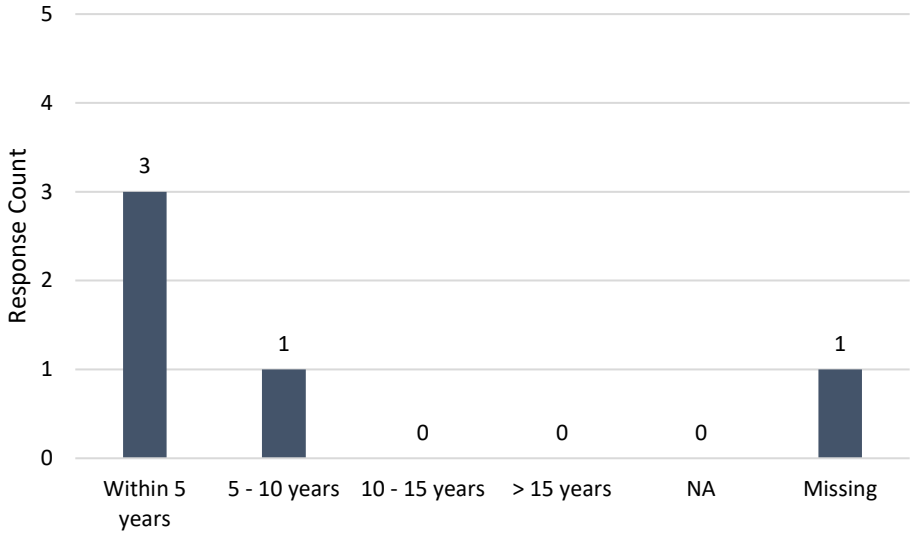


Figure A-4. Responses to " If your company decides to offer CAVS, in what timeframe do you expect to offer it?"

QA.6.OEM Comments

- None

QA.7. What is it about CAVS that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	4	80%	0	0%	1	20%
Applicability with a sufficient number of customers	4	80%	0	0%	1	20%
Increase new aircraft/avionics sales	3	60%	2	40%	0	0%
Concept	1	20%	0	0%	1	20%
Other	1	20%	0	0%	0	0%
Nothing about CAVS interests my company	0	0%				
N	5					

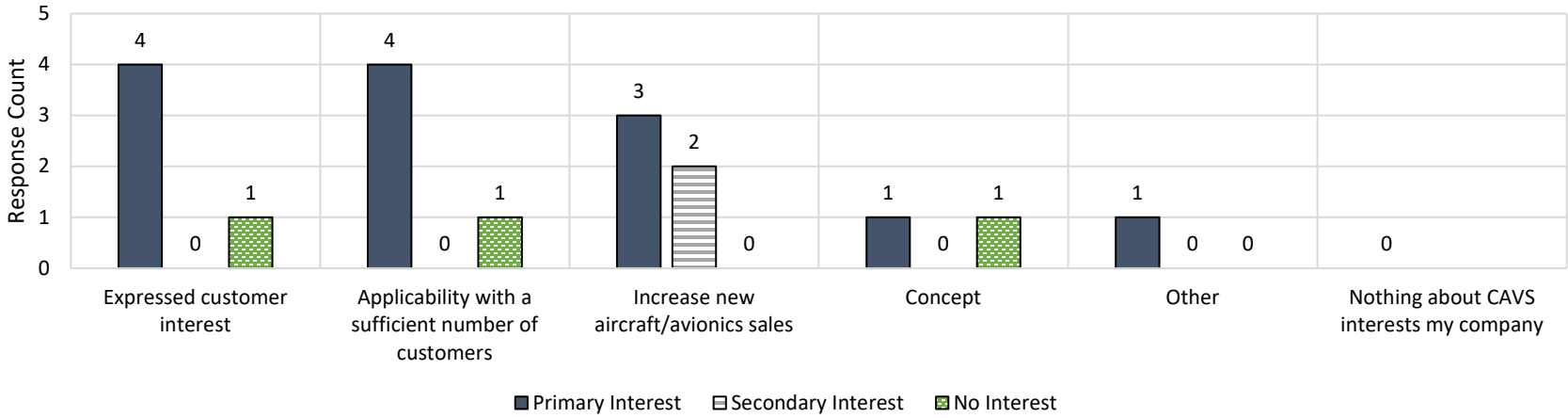


Figure A-5. Responses to "What is it about CAVS that interests your company?"

QA.7.OEM Comments

- None

QA.8. What is it about CAVS that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	0	0%	1	20%
Cost	2	40%	0	0%	1	20%
Insufficient customer interest	2	40%	1	20%	0	0%
Concept complexity	0	0%	1	20%	2	40%
Necessary procedural changes	0	0%	1	20%	2	40%
Necessary controller automation	0	0%	0	0%	3	60%
Other	1	20%	0	0%	0	0%
No concerns	2					
N	5					

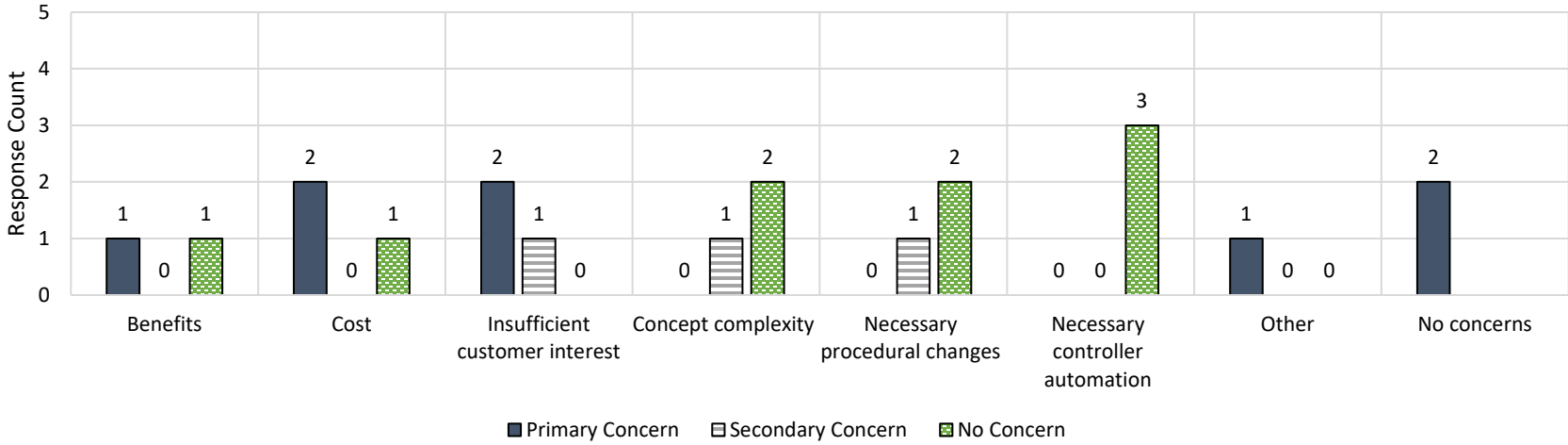


Figure A-6. Responses to "What is it about CAVS that concerns your company?"

QA.8.OEM Comments

- ROI for A/L is the main concern for the benefits and the costs. Procedural change: additional clarifications on pilot procedure.

QA.9. If your company is interested in CAVS, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	0	0%	0	0%	3	60%
FAA Investment decision to proceed with FIM Phase 2	0	0%	0	0%	3	60%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	3	60%
FAA Automation enhancements and corresponding procedures deployed	0	0%	0	0%	2	40%
Implementation of a two-rate Ground Delay Program (GDP)*	0	0%	1	20%	3	60%
Industry and FAA agreement on an application adoption timeline	1	20%	0	0%	2	40%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	0	0%	2	40%	2	40%
Sufficient customer commitment	3	60%	1	20%	0	0%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	1	20%				
N	5					

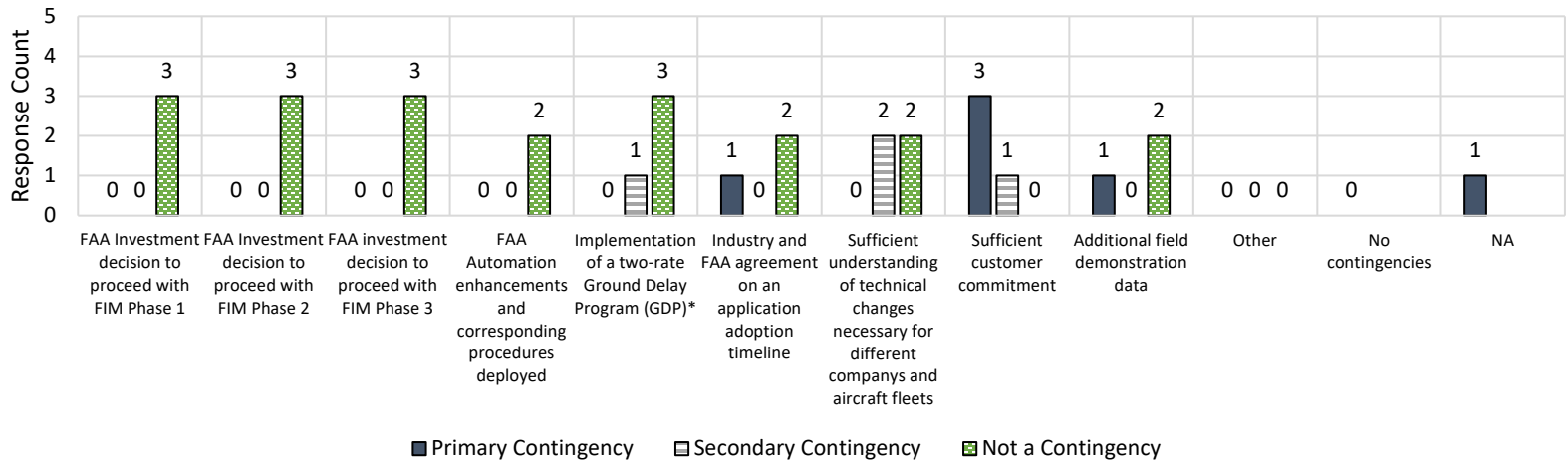


Figure A-7. Responses to "If your company is interested in CAVS, are there contingencies on an investment?"

QA.9.OEM Comments

- CAVS investment has already been made

QA.10. If your company is interested but not willing to commit to investment in CAVS, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	3	60%
Insufficient understanding of the ADS-B In application benefits	1	20%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	3	60%
Insufficient funds	1	20%	2	40%	1	20%
Lack of benefits data	1	20%	0	0%	2	40%
Lack of field demonstration data	1	20%	0	0%	2	40%
Unclear interest from customers	2	40%	1	20%	1	20%
Unclear FAA commitments on automation investments	0	0%	0	0%	3	60%
Unclear FAA commitments on necessary procedural changes	0	0%	1	20%	2	40%
Lack of information on avionics installation requirements	0	0%	0	0%	3	60%
Pilot acceptability issues	1	20%	0	0%	2	40%
Controller acceptability issues	0	0%	0	0%	3	60%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	1	20%				
N	5					

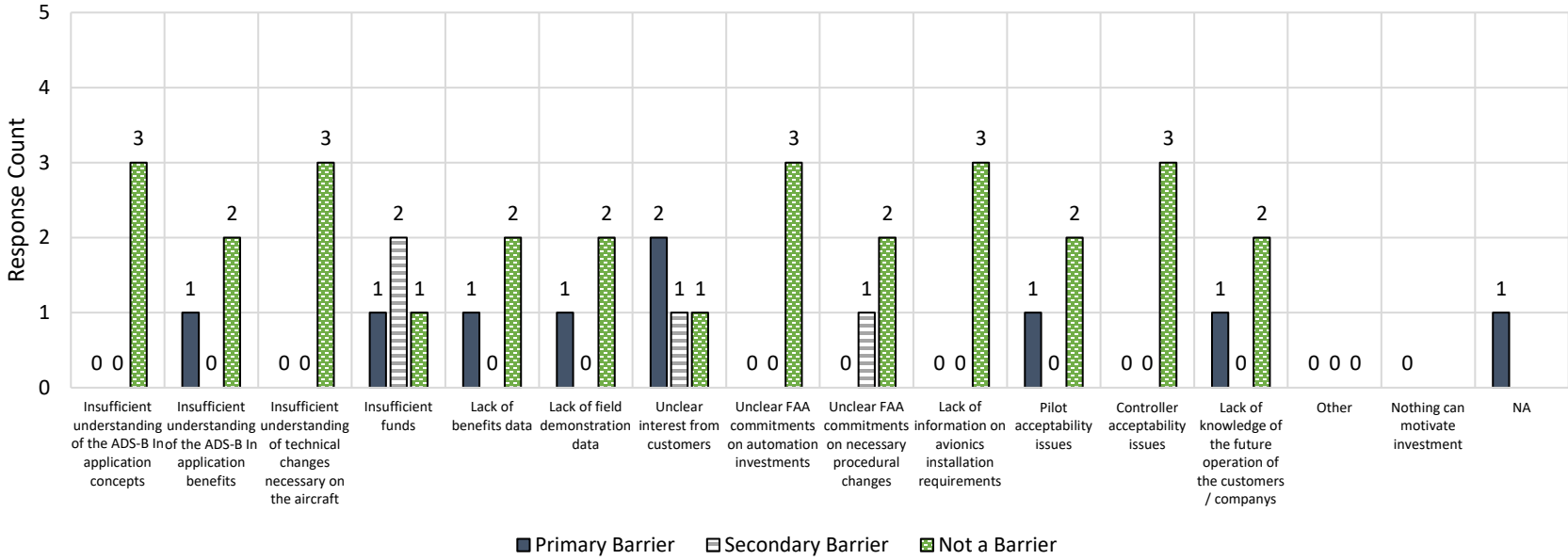


Figure A-8. Responses to "If your company is interested but not willing to commit to an investment in CAVS, what barriers could be removed to incentivize your company to invest?"

QA.10.OEM Comments

- CAVS investment has already been made, and available to the market
- Pilot acceptability issues : non US pilots.

QA.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in CAVS.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	0	0%
Strongly Agree	4	100%
NA	1	
N	5	
Total Agreement	4	100%
Total Disagreement	0	0%

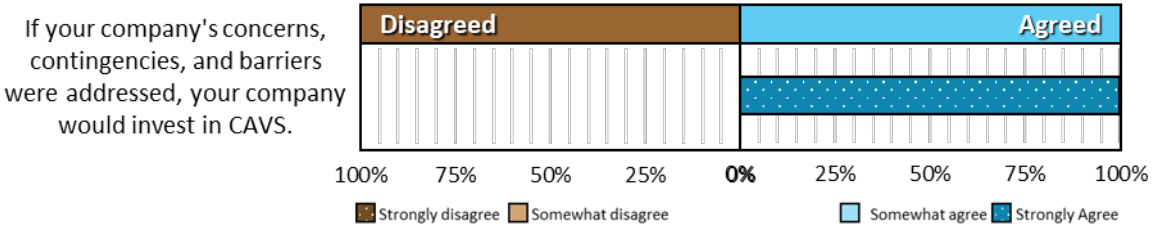


Figure A-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in CAVS."

QA.11.OEM Comments

- CAVS investment has already been made, and available to the market

QA.12. When would your company expect to offer CAVS?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	2	50%
In a later offering of avionics providing ADS-B In applications	1	25%
Other	1	25%
Never	0	0%
NA	1	
N	5	

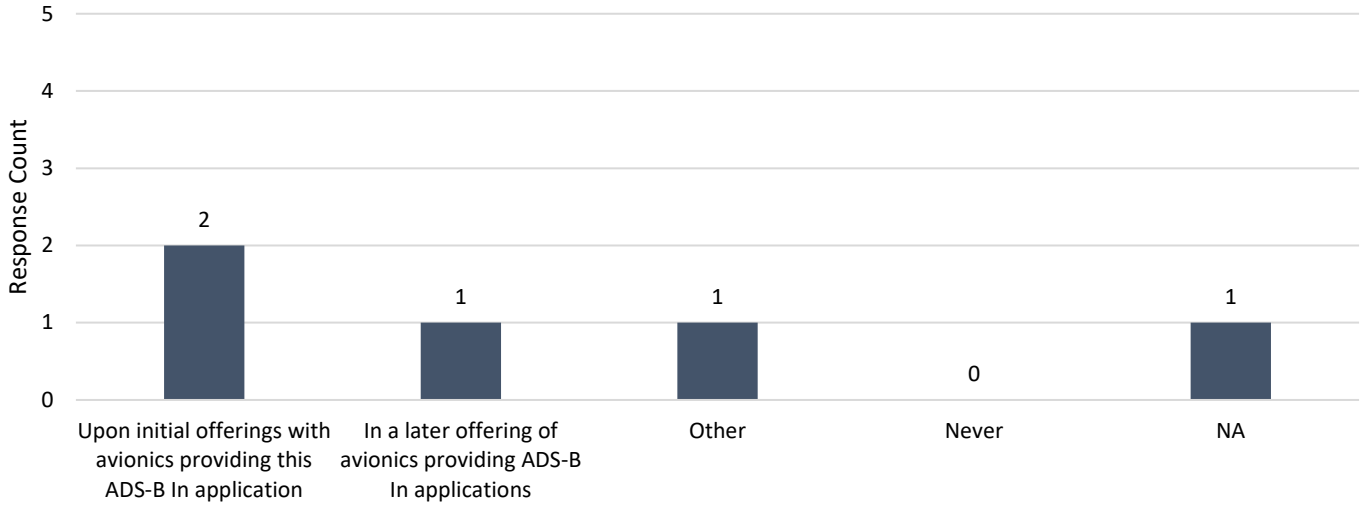


Figure A-10. Responses to "When would your company expect to offer CAVS?"

QA.12.OEM Comments

- CAVS investment has already been made, and available to the market
- CAVS is included on the roadmap for all traffic surveillance portfolios and will be offered started in 2023.
- Aircraft models that have basic ADS-B application could support earlier offering of CAVS.

QA.13. If your company decides to offer CAVS, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	1	0
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	1	2	0
Gen 0: Most recent TCAS / ADS-B In product offering	1	1	3	0
Gen +1: At least one ADS-B Application would require a new product offering	2	1	2	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	2	0	1	0

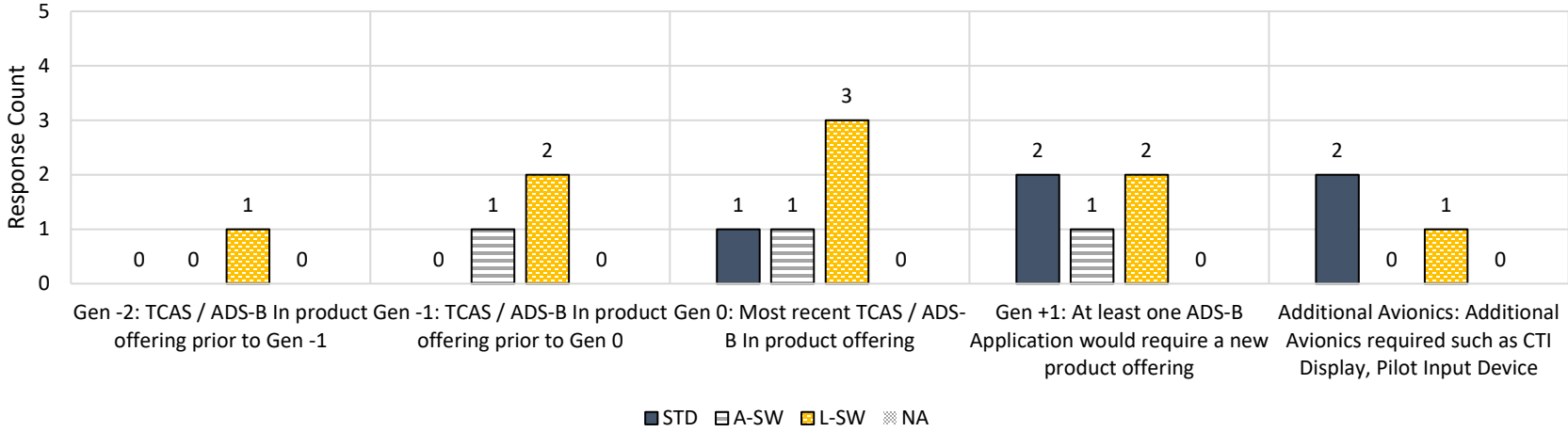


Figure A-11. Responses to "If your company decides to offer CAVS, how do you plan to offer the ADS-B In application avionics capabilities?"

QA14. Do you have any additional thoughts for the NAC to share with the FAA related to CAVS?

- FAA has shown sufficient support for the deployment of CAVS.
- Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

CDTI-Assisted Separation (CAS) - Approach

QB.3. Does your company currently offer CAS-A?

	Count	Percentage
Yes, as an offering compliant with a TSO	1	20%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	1	20%
No offering	3	60%
Missing	0	
N	5	

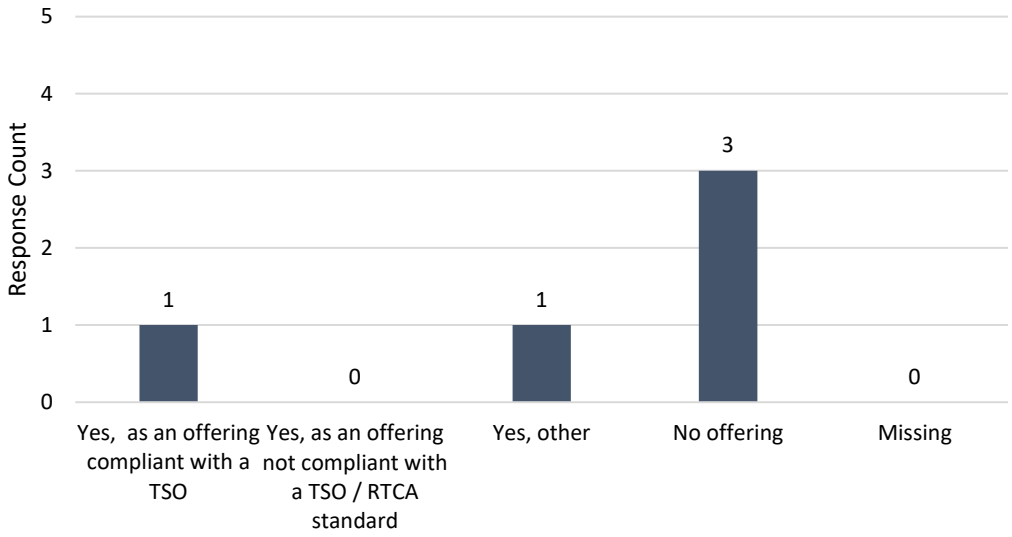


Figure B-1. Responses to "Does your company currently offer CAS-A?"

QB.3.OEM Comments

- My companies understanding of CAS is that it is a procedural extension of CAVS and that airborne equipment capable of CAVS would not have to change to support CAS-Approach.
- Assumption that CAS - Approach operations can be supported by existing DO-317B compliant CAVS implementation

QB.4. My company is interested in offering CAS-A.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	1	20%
Strongly Agree	4	80%
N	5	
Total Agreement	5	100%
Total Disagreement	0	0%

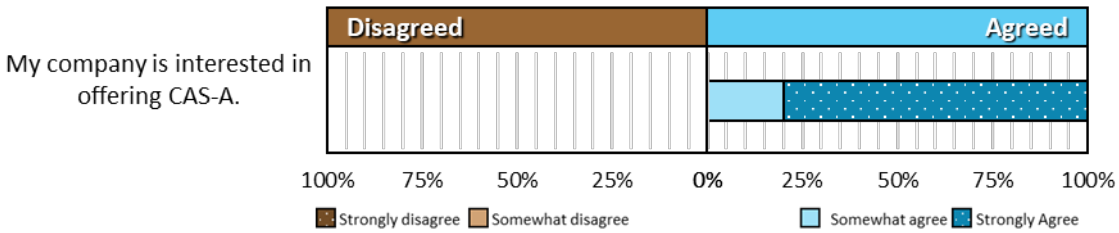


Figure B-2. Responses to "My company is interested in offering CAS-A."

QB.4.OEM Comments

- None

QB.5. Rate your company's priority for CAS-A amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	0	0%
High	5	100%
Missing	0	
N	5	

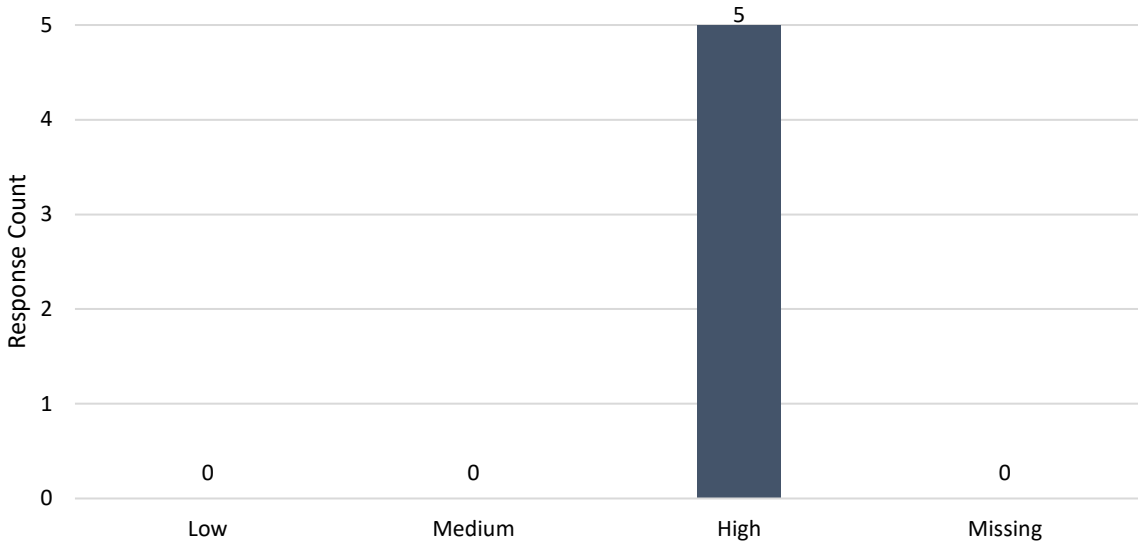


Figure B-3. Rate your company's priority for CAS-A amongst the set of ADS-B In applications

QB.5.OEM Comments

- My companies interest in CAS is based on the understanding that equipment capable of CAVS will not have to change to accommodate CAS. If this understanding is not correct, information regarding necessary changes needs to be made available in a timely manner.

QB.6. If your company decides to offer CAS-A, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	4	80%
5 - 10 years	1	20%
10 - 15 years	0	0%
> 15 years	0	0%
NA	0	0%
Missing	0	
N	5	

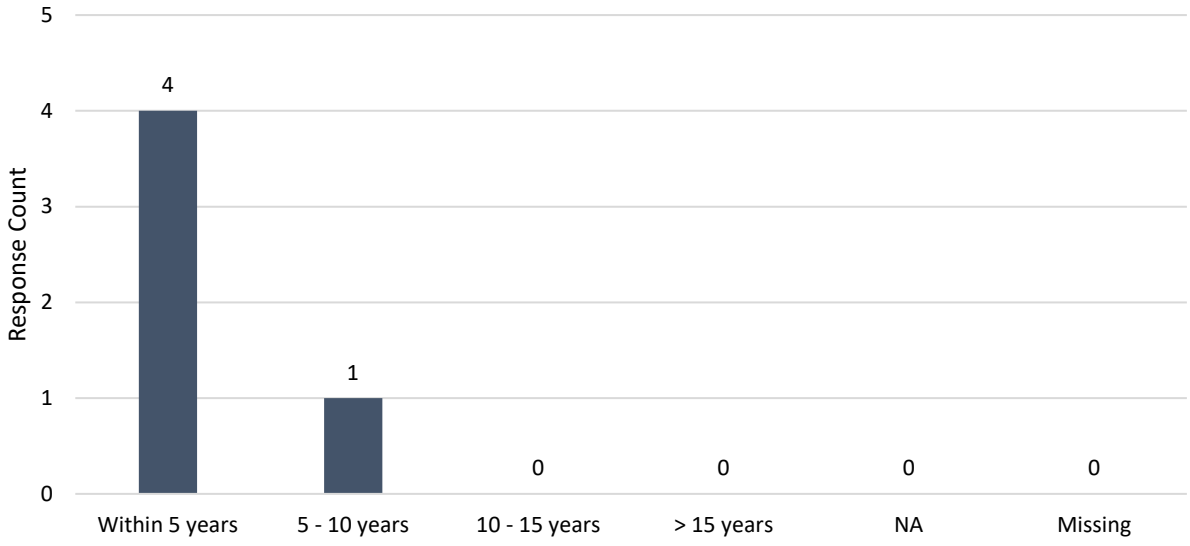


Figure B-4. Responses to " If your company decides to offer CAS-A, in what timeframe do you expect to offer it?"

QB.6.OEM Comments

- None

QB.7. What is it about CAS-A that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	4	80%	0	0%	1	20%
Applicability with a sufficient number of customers	4	80%	0	0%	1	20%
Increase new aircraft/avionics sales	3	60%	2	40%	0	0%
Concept	2	40%	0	0%	1	20%
Other	1	20%	0	0%	0	0%
Nothing about CAS-A interests my company	0	0%				
N	5					

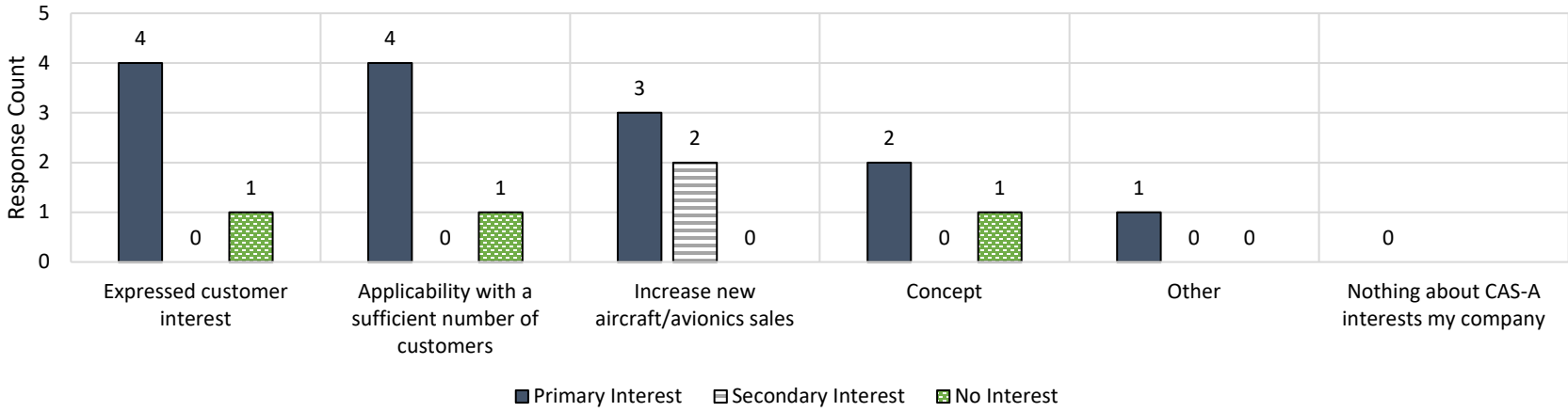


Figure B-5. Responses to "What is it about CAS-A that interests your company?"

QB.7.OEM Comments

- None

QB.8. What is it about CAS-A that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	0	0%	4	80%
Cost	2	40%	0	0%	3	60%
Insufficient customer interest	2	40%	1	20%	2	40%
Concept complexity	0	0%	1	20%	4	80%
Necessary procedural changes	0	0%	3	60%	2	40%
Necessary controller automation	1	20%	0	0%	4	80%
Other	0	0%	0	0%	0	0%
No concerns	0					
N	5					

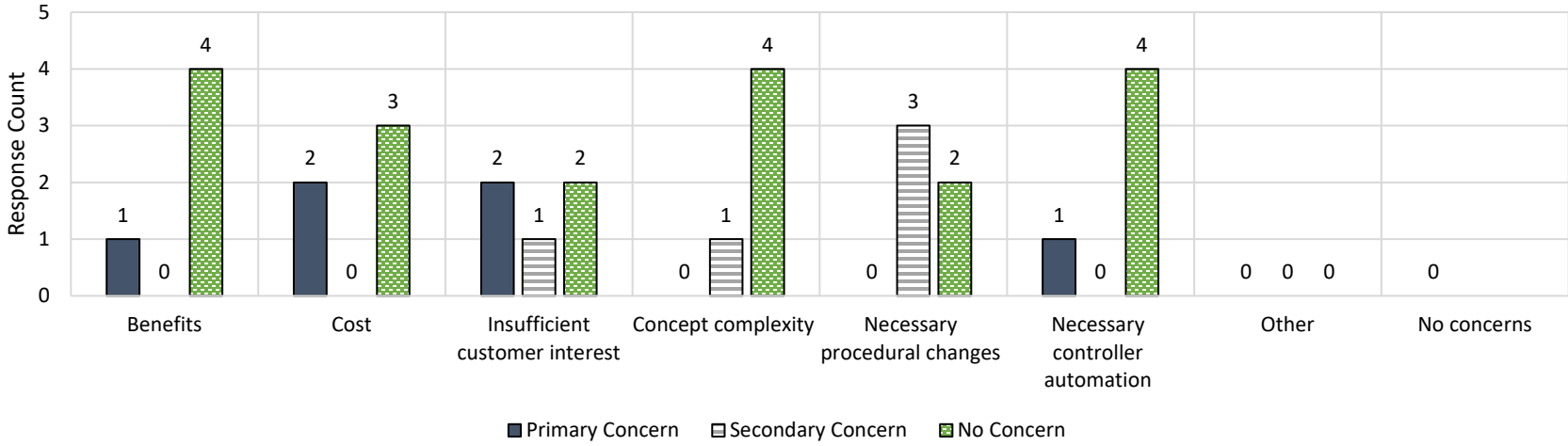


Figure B-6. Responses to "What is it about CAS-A that concerns your company?"

QB.8.OEM Comments

- Future investment justification is dependent on timely procedural and automation support

QB.9. If your company is interested in CAS-A, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	0	0%	1	20%	2	40%
FAA Investment decision to proceed with FIM Phase 2	0	0%	0	0%	3	60%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	3	60%
FAA Automation enhancements and corresponding procedures deployed	0	0%	0	0%	3	60%
Implementation of a two-rate Ground Delay Program (GDP)*	0	0%	1	20%	3	60%
Industry and FAA agreement on an application adoption timeline	1	20%	1	20%	1	20%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	0	0%	3	60%	1	20%
Sufficient customer commitment	3	60%	0	0%	1	20%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	1	20%				
N	5					

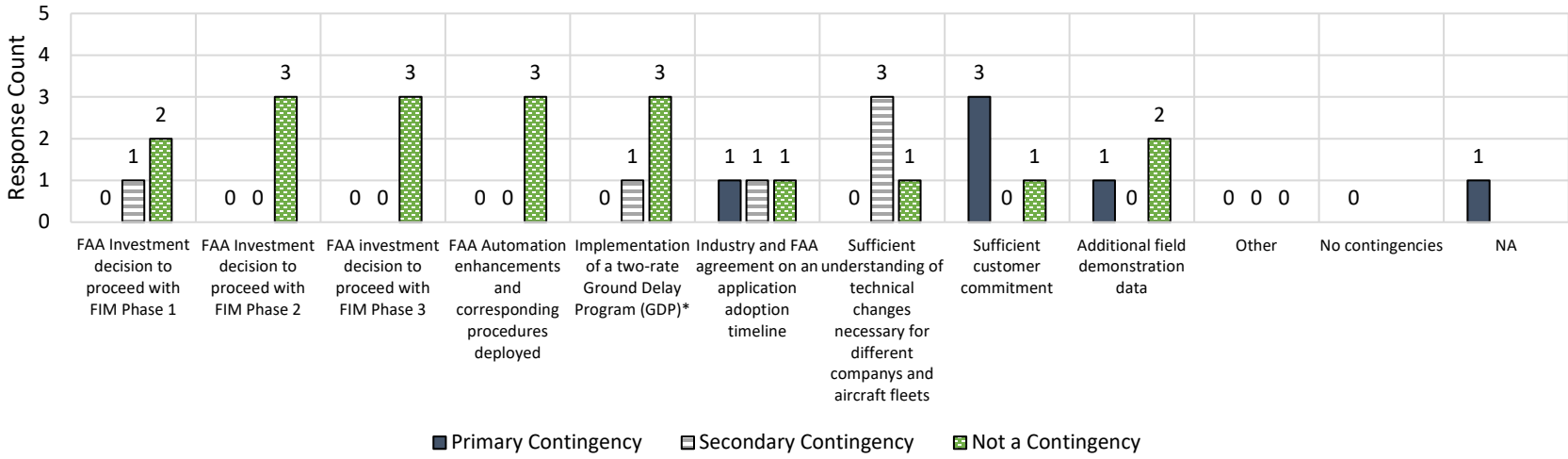


Figure B-7. Responses to "If your company is interested in CAS-A, are there contingencies on an investment?"

QB.9.OEM Comments

- CAVS investment has already been made in support of CAS - Approach, FAA investment in infrastructure support is critical for deployment

QB.10. If your company is interested but not willing to commit to an investment in CAS-A, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	3	60%
Insufficient understanding of the ADS-B In application benefits	1	20%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	3	60%
Insufficient funds	1	20%	1	20%	2	40%
Lack of benefits data	1	20%	0	0%	2	40%
Lack of field demonstration data	1	20%	0	0%	2	40%
Unclear interest from customers	2	40%	0	0%	2	40%
Unclear FAA commitments on automation investments	0	0%	0	0%	3	60%
Unclear FAA commitments on necessary procedural changes	0	0%	1	20%	2	40%
Lack of information on avionics installation requirements	0	0%	0	0%	3	60%
Pilot acceptability issues	1	20%	0	0%	2	40%
Controller acceptability issues	0	0%	0	0%	2	40%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	1	20%				
N	5					

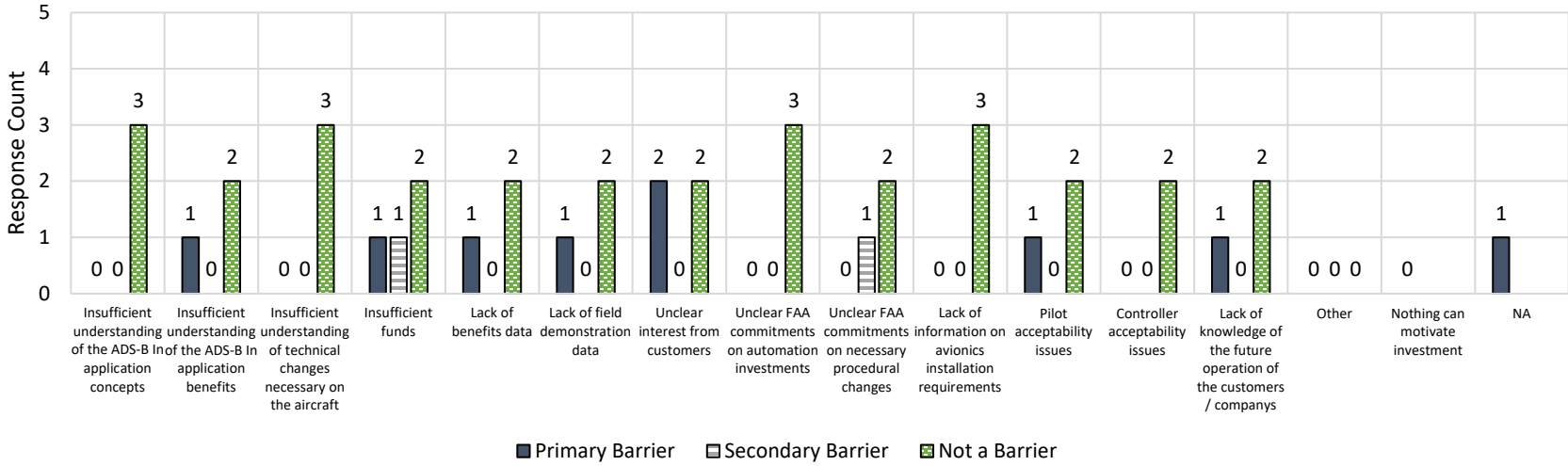


Figure B-8. Responses to "If your company is interested but not willing to commit to an investment in CAS-A, what barriers could be removed to incentivize your company to invest?"

QB.10.OEM Comments

- It needs to be clear what the expectation is beyond CAVS compliant airborne equipment from an equipment manufacturers [sic] perspective.
- CAVS investment has already been made in support of CAS - Approach, FAA investment in infrastructure support is critical for deployment

QB.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in CAS-A.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	0	0%
Strongly Agree	4	100%
NA	1	
N	5	
Total Agreement	4	100%
Total Disagreement	0	0%

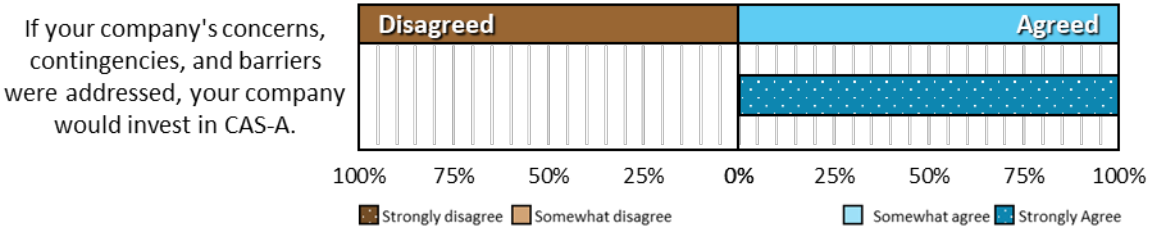


Figure B-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in CAS-A."

QB.11.OEM Comments

- CAVS investment has already been made in support of CAS - Approach, FAA investment in infrastructure support is critical for deployment

QB.12. When would your company expect to offer CAS-A?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	2	50%
In a later offering of avionics providing ADS-B In applications	2	50%
Other	0	0%
Never	0	0%
NA	1	
N	5	

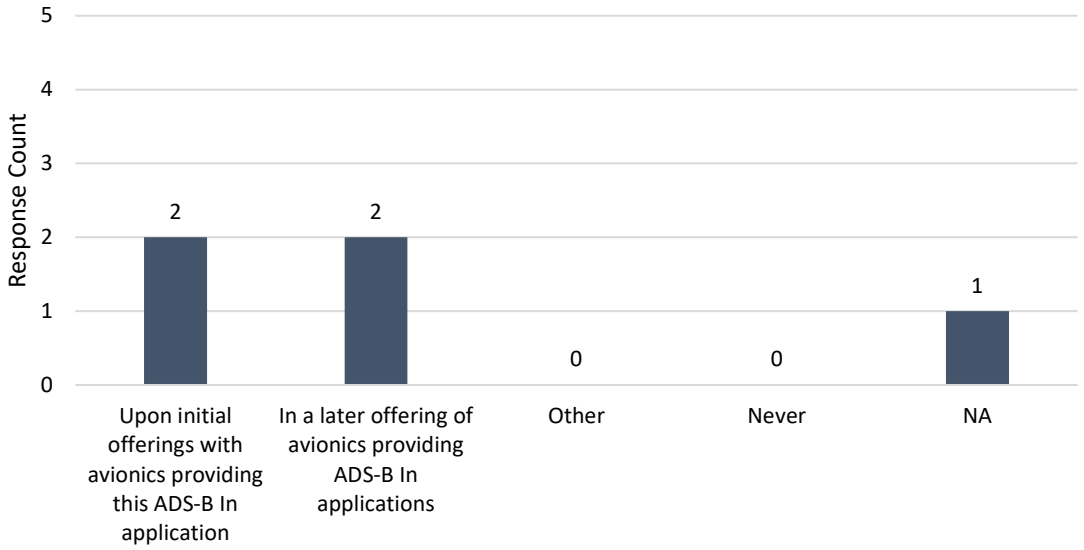


Figure B-10. Responses to "When would your company expect to offer CAS-A?"

QB.12.OEM Comments

- Aircraft models that have basic ADS-B application could support earlier offering of CAVS.

QB.13. If your company decides to offer CAS-A, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	0
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	1	2	0
Gen 0: Most recent TCAS / ADS-B In product offering	1	1	3	0
Gen +1: At least one ADS-B Application would require a new product offering	2	1	2	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	2	0	1	0

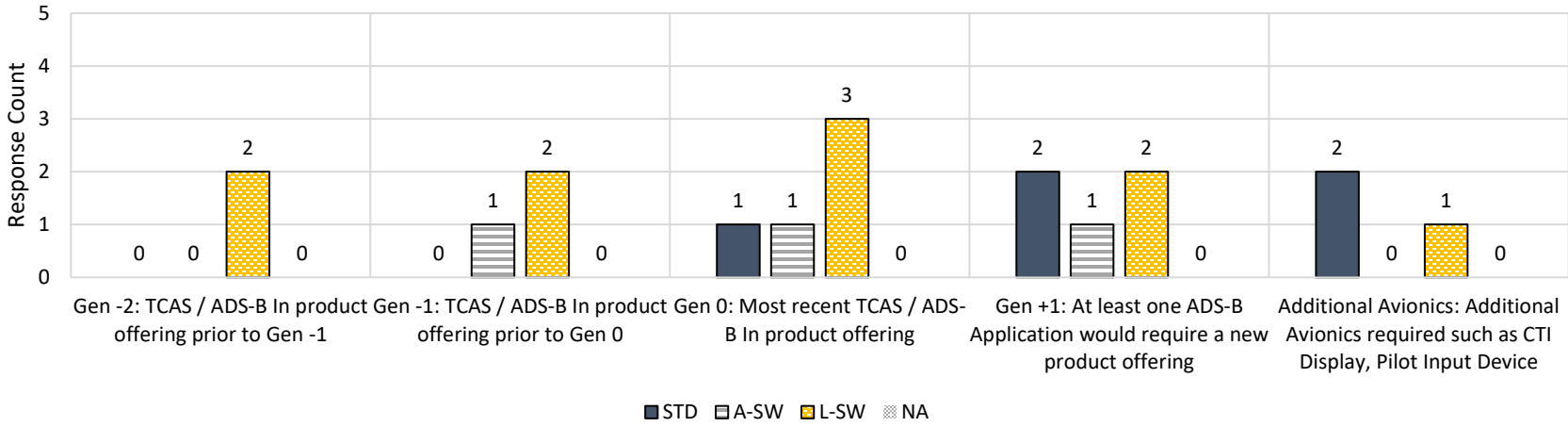


Figure B-11. Responses to "If your company decides to offer CAS-A, how do you plan to offer the ADS-B In application avionics capabilities?"

QB14. Do you have any additional thoughts for the NAC to share with the FAA related to CAS-A?

- The FAA needs to clarify the implications of CAS and whether or not there is additional requirements on compliant airborne CAVS equipment.
- Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

CDTI-Assisted Separation (CAS) - Departure

QC.3. Does your company currently offer CAS-D?

	Count	Percentage
Yes, as an offering compliant with a TSO	1	20%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	4	80%
Missing	0	
N	5	

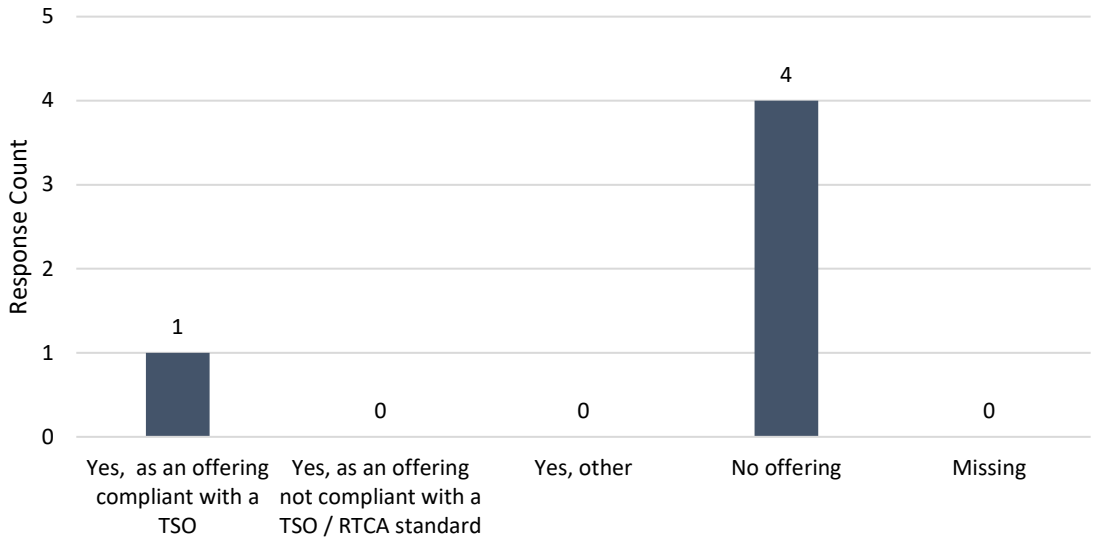


Figure C-1. Responses to "Does your company currently offer CAS-D?"

QC.3.OEM Comments

- Assumption that CAS - Departure operations can be supported by existing DO-317B compliant CAVS implementation

QC.4. My company is interested in offering CAS-D.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	20%
Somewhat Agree	1	20%
Strongly Agree	3	60%
N	5	
Total Agreement	4	80%
Total Disagreement	0	0%

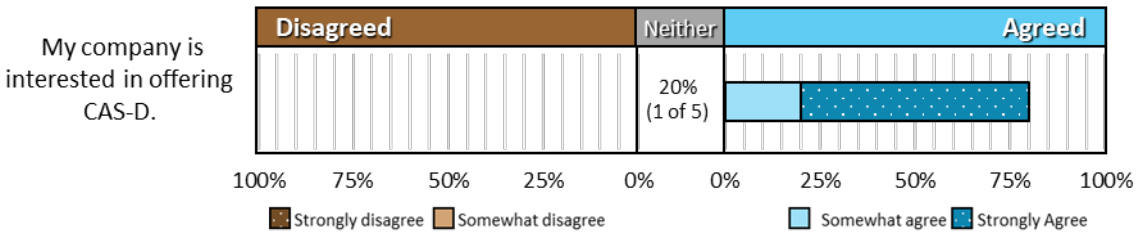


Figure C-2. Responses to "My company is interested in offering CAS-D."

QC.4.OEM Comments

- My company is interested, however, CAS-Departure is a fairly new concept and it is not clear what the expectations are from an avionics manufacturers perspective. For the purposes of this survey, my company will assume that CAS-Departure is a procedural extension to CAVS and that compliant CAVS solutions will not have to change to support CAS-Departure.

QC.5. Rate your company's priority for CAS-D amongst the set of ADS-B In applications

	Count	Percentage
Low	1	20%
Medium	0	0%
High	4	80%
Missing	0	
N	5	

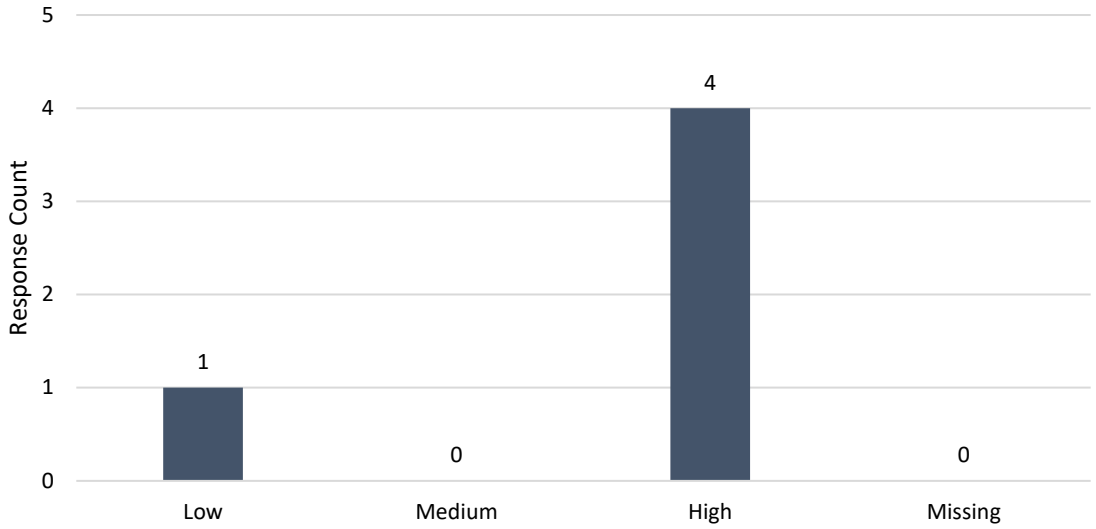


Figure C-3. Rate your company's priority for CAS-D amongst the set of ADS-B In applications

QC.5.OEM Comments

- Assumption that CAS - Departure operations can be supported by existing DO-317B compliant CAVS implementation

QC.6. If your company decides to offer CAS-D, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	3	60%
5 - 10 years	2	40%
10 - 15 years	0	0%
> 15 years	0	0%
NA	0	0%
Missing	0	
N	5	

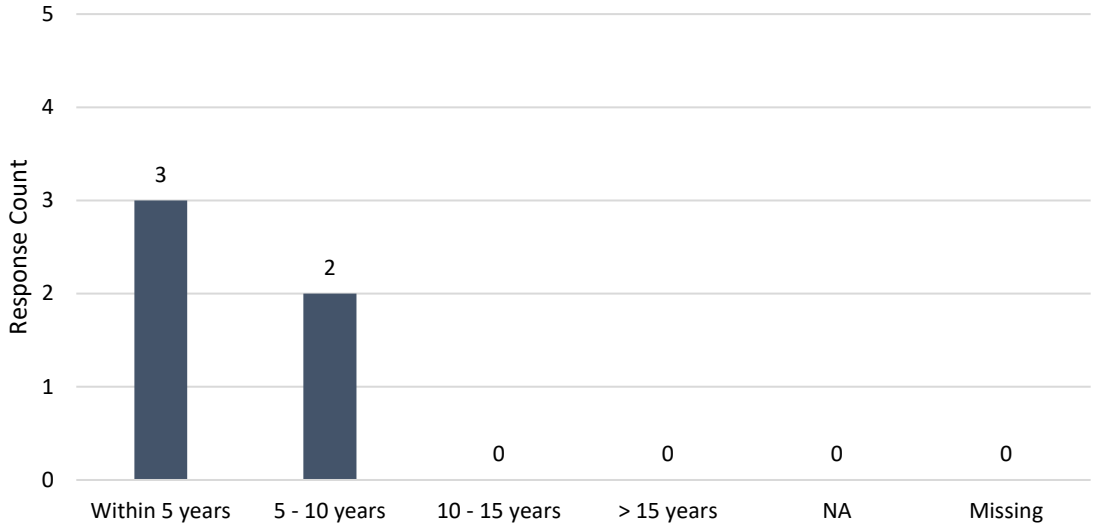


Figure C-4. Responses to " If your company decides to offer CAS-D, in what timeframe do you expect to offer it?"

QC.6.OEM Comments

- Assumption that CAS - Departure operations can be supported by existing DO-317B compliant CAVS implementation

QC.7. What is it about CAS-D that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	3	60%	1	20%	1	20%
Applicability with a sufficient number of customers	3	60%	1	20%	1	20%
Increase new aircraft/avionics sales	3	60%	2	40%	0	0%
Concept	1	20%	1	20%	1	20%
Other	0	0%	0	0%	0	0%
Nothing about CAS-D interests my company	0	0%				
N	5					

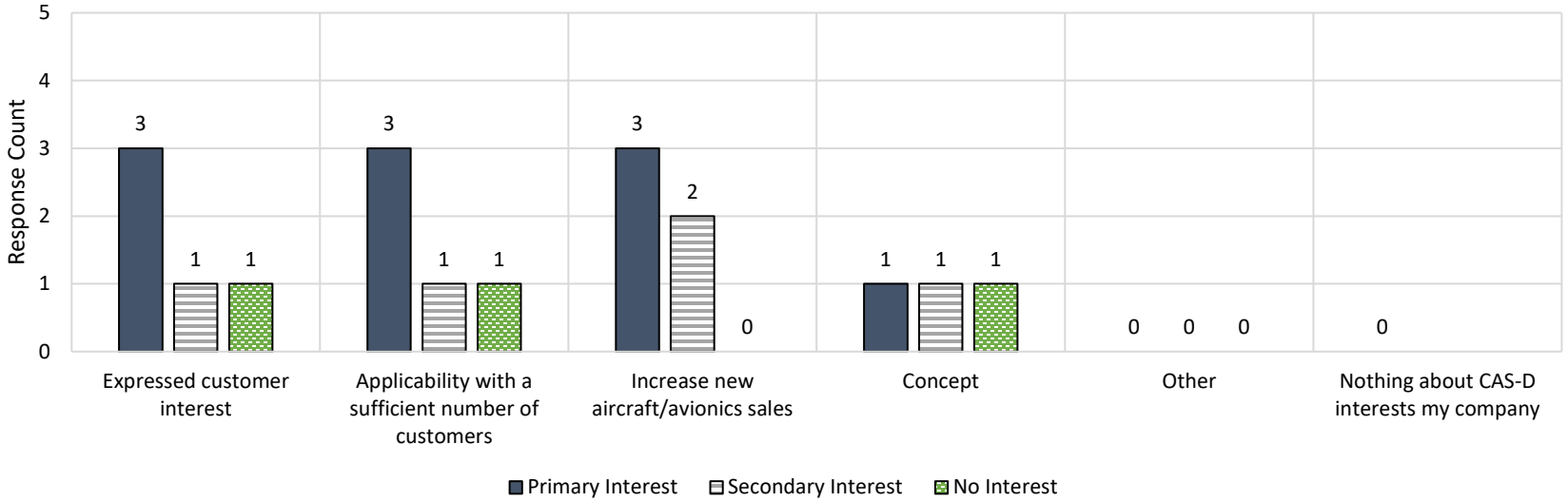


Figure C-5. Responses to "What is it about CAS-D that interests your company?"

QC.7.OEM Comments

- None

QC.8. What is it about CAS-D that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	1	20%	2	40%
Cost	1	20%	0	0%	3	60%
Insufficient customer interest	2	40%	1	20%	2	40%
Concept complexity	1	20%	1	20%	3	60%
Necessary procedural changes	2	40%	1	20%	2	40%
Necessary controller automation	2	40%	1	20%	1	20%
Other	0	0%	0	0%	0	0%
No concerns	0					
N	5					

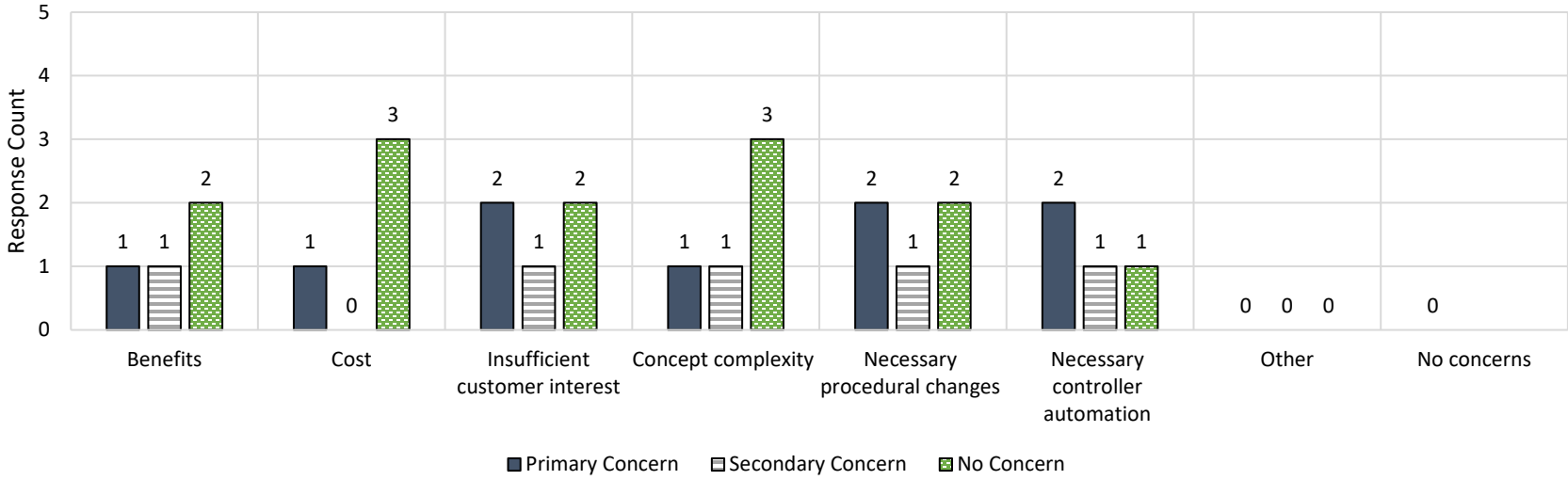


Figure C-6. Responses to "What is it about CAS-D that concerns your company?"

QC.8.OEM Comments

- Future investment justification is dependent on timely procedural and automation supportQC.9. If your company is interested in CAS-D, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	0	0%	1	20%	2	40%
FAA Investment decision to proceed with FIM Phase 2	0	0%	0	0%	3	60%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	3	60%
FAA Automation enhancements and corresponding procedures deployed	0	0%	1	20%	2	40%
Implementation of a two-rate Ground Delay Program (GDP)*	0	0%	0	0%	3	60%
Industry and FAA agreement on an application adoption timeline	1	20%	1	20%	1	20%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	0	0%	3	60%	1	20%
Sufficient customer commitment	3	60%	0	0%	1	20%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	1	20%				
N	5					

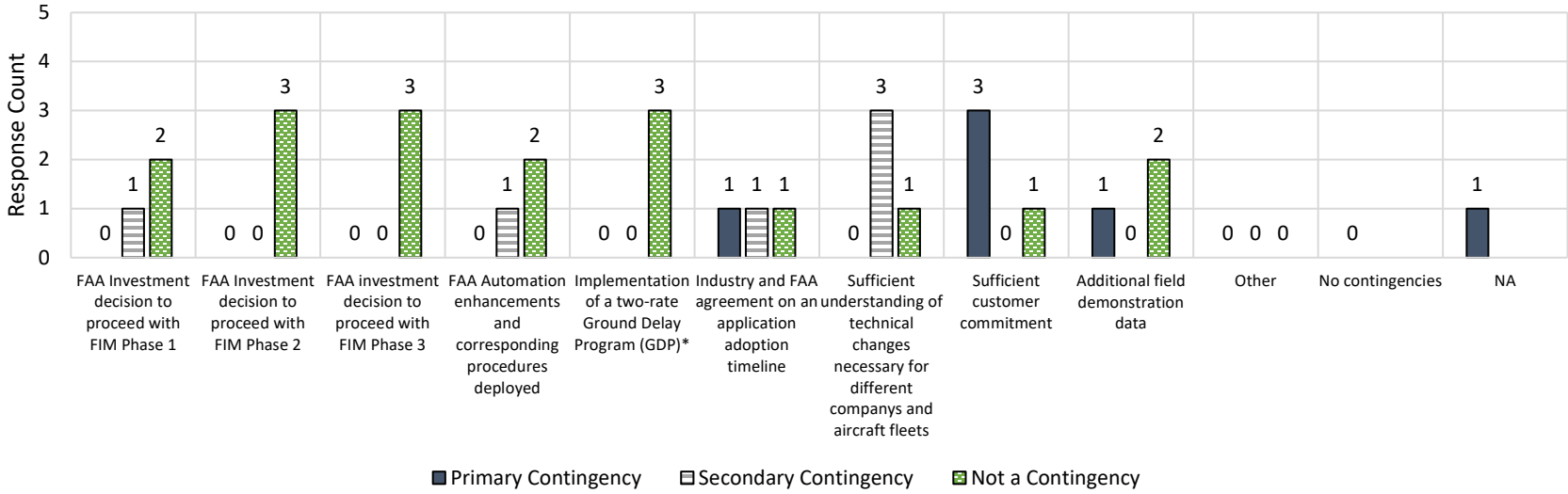


Figure C-7. Responses to "If your company is interested in CAS-D, are there contingencies on an investment?"

QC.9.OEM Comments

- CAVS investment has already been made in support of CAS - Departure, FAA investment in infrastructure support is critical for deployment

QC.10. If your company is interested but not willing to commit to an investment in CAS-D, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	3	60%
Insufficient understanding of the ADS-B In application benefits	1	20%	0	0%	1	20%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	1	20%	2	40%
Insufficient funds	1	20%	2	40%	1	20%
Lack of benefits data	1	20%	0	0%	2	40%
Lack of field demonstration data	1	20%	0	0%	2	40%
Unclear interest from customers	2	40%	1	20%	1	20%
Unclear FAA commitments on automation investments	0	0%	0	0%	3	60%
Unclear FAA commitments on necessary procedural changes	0	0%	3	60%	1	20%
Lack of information on avionics installation requirements	0	0%	1	20%	2	40%
Pilot acceptability issues	1	20%	0	0%	2	40%
Controller acceptability issues	0	0%	1	20%	2	40%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	1	20%				
N	5					

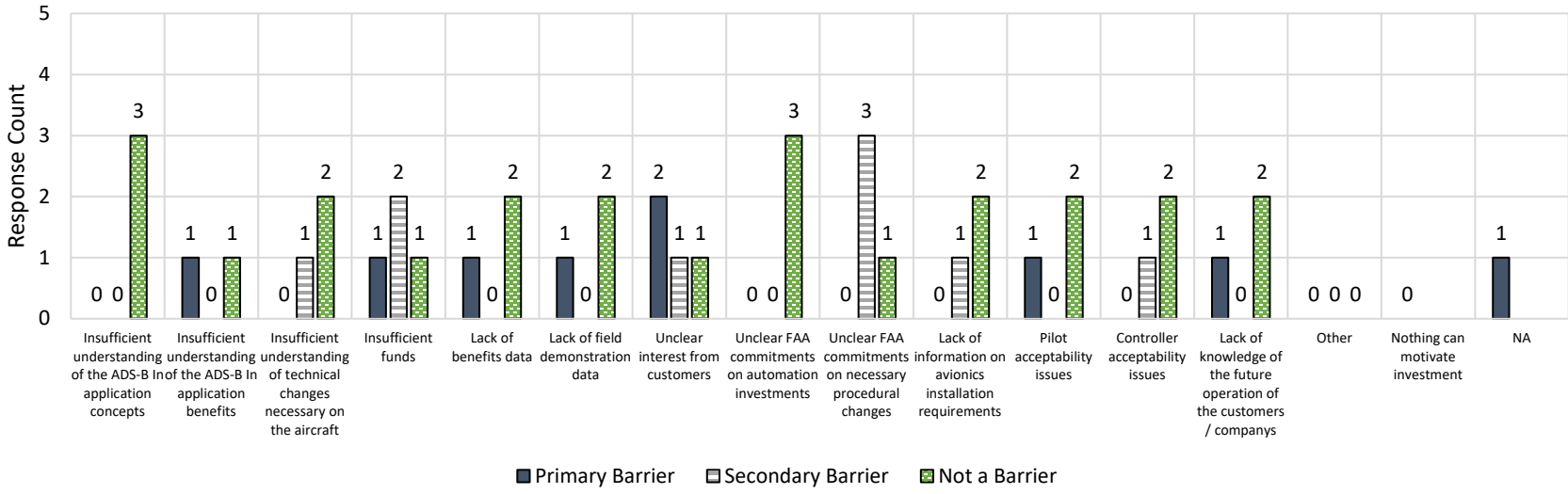


Figure C-8. Responses to "If your company is interested but not willing to commit to an investment in CAS-D, what barriers could be removed to incentivize your company to invest?"

QC.10.OEM Comments

- Lack of information on avionics installation requirements.
- CAVS investment has already been made in support of CAS - Departure, FAA investment in infrastructure support is critical for deployment

QC.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in CAS-D.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	25%

Somewhat Agree	0	0%
Strongly Agree	3	75%
NA	1	
N	5	
Total Agreement	3	75%
Total Disagreement	0	0%

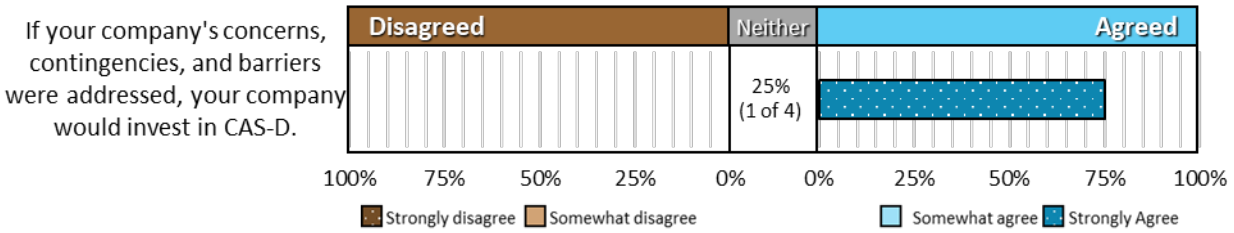


Figure C-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in CAS-D."

QC.11.OEM Comments

- CAVS investment has already been made in support of CAS - Departure, FAA investment in infrastructure support is critical for deployment

QC.12. When would your company expect to offer CAS-D?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	1	25%
In a later offering of avionics providing ADS-B In applications	3	75%
Other	0	0%
Never	0	0%
NA	1	
N	5	

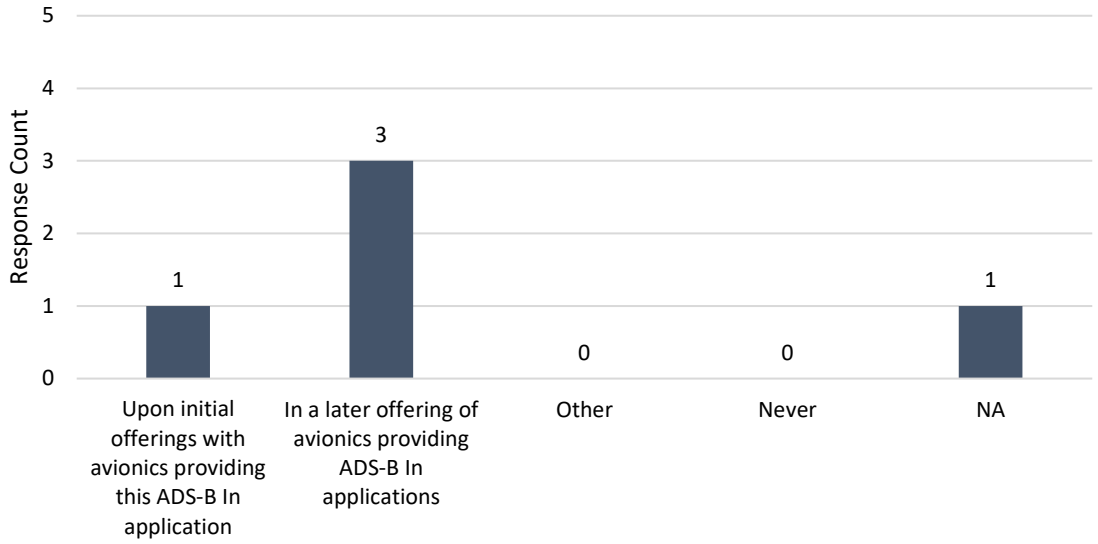


Figure C-10. Responses to "When would your company expect to offer CAS-D?"

QC.12.OEM Comments

- Aircraft models that have basic ADS-B application could support earlier offering of CAVS.

QC.13. If your company decides to offer CAS-D, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	0
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	1	2	0
Gen 0: Most recent TCAS / ADS-B In product offering	1	1	2	0
Gen +1: At least one ADS-B Application would require a new product offering	2	0	2	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	2	0	1	0

Figure C-11. Responses to "If your company decides to offer CAS-D, how do you plan to offer the ADS-B In application avionics capabilities?"

QC14. Do you have any additional thoughts for the NAC to share with the FAA related to CAS-D?

- Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.
- FAA needs to define clear expectations associated with CAS-Departure from all perspectives.

Oceanic In-Trail Procedure (ITP)

QD.3. Does your company currently offer ITP?

	Count	Percentage
Yes, as an offering compliant with a TSO	4	80%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	1	20%
No offering	0	0%
Missing	0	
N	5	

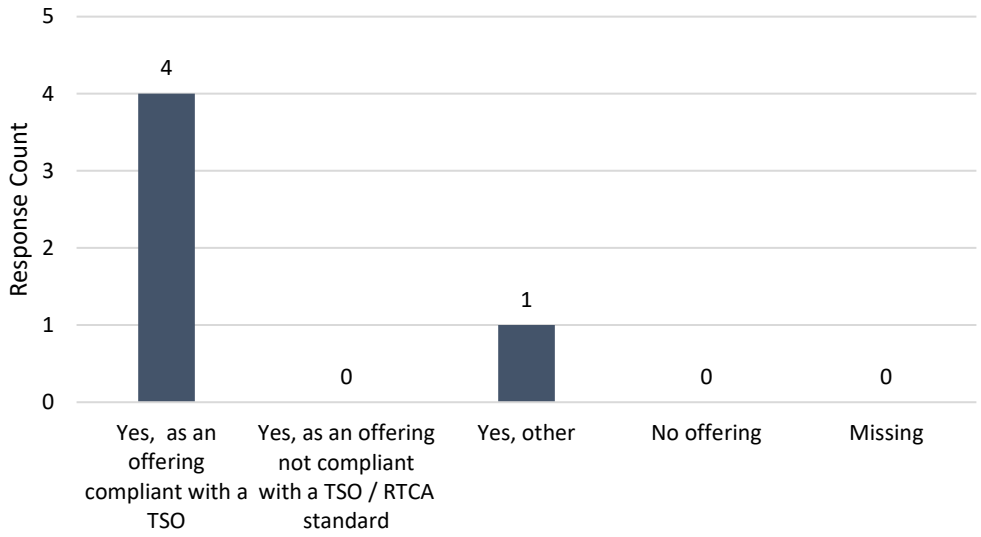


Figure D-1. Responses to "Does your company currently offer ITP?"

QD.3.OEM Comments

- As an offering compliant with RTCA SPR.

QD.4. My company is interested in offering ITP.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	20%
Somewhat Agree	0	0%
Strongly Agree	4	80%
N	5	
Total Agreement	4	80%
Total Disagreement	0	0%

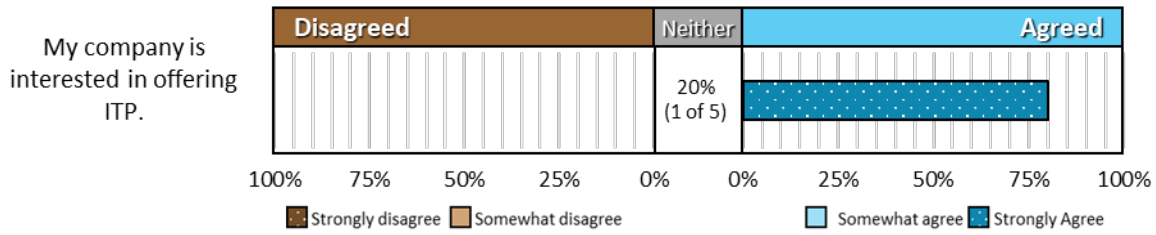


Figure D-2. Responses to "My company is interested in offering ITP."

QD.4.OEM Comments

- TSO-Compliant ITP Application is currently available

QD.5. Rate your company's priority for ITP amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	1	25%
High	3	75%
Missing	1	
N	4	

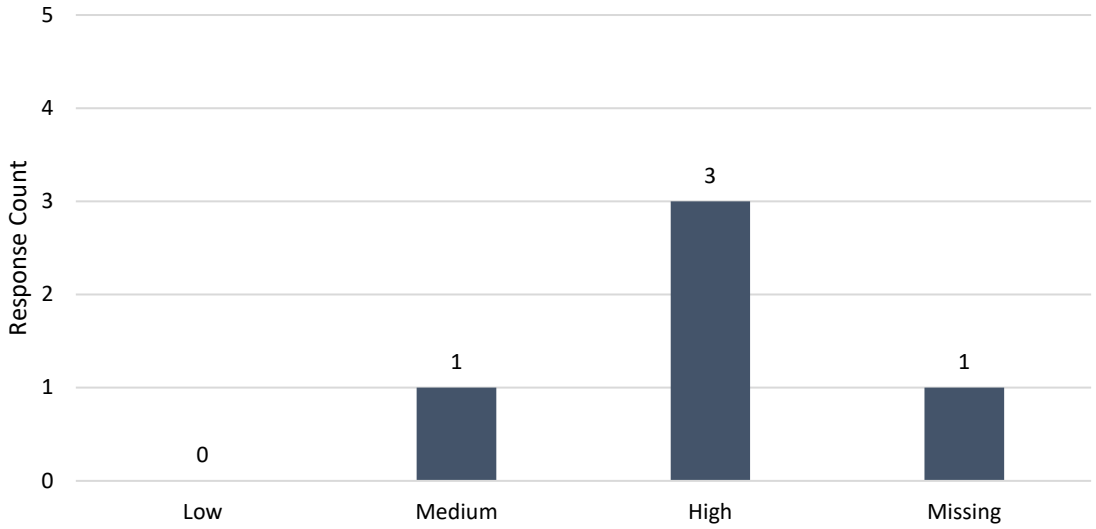


Figure D-3. Rate your company's priority for ITP amongst the set of ADS-B In applications

QD.5.OEM Comments

- TSO-Compliant ITP Application is currently available
- Existing offer.

QD.6. If your company decides to offer ITP, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	3	100%
5 - 10 years	0	0%
10 - 15 years	0	0%
> 15 years	0	0%
NA	0	0%
Missing	2	
N	3	

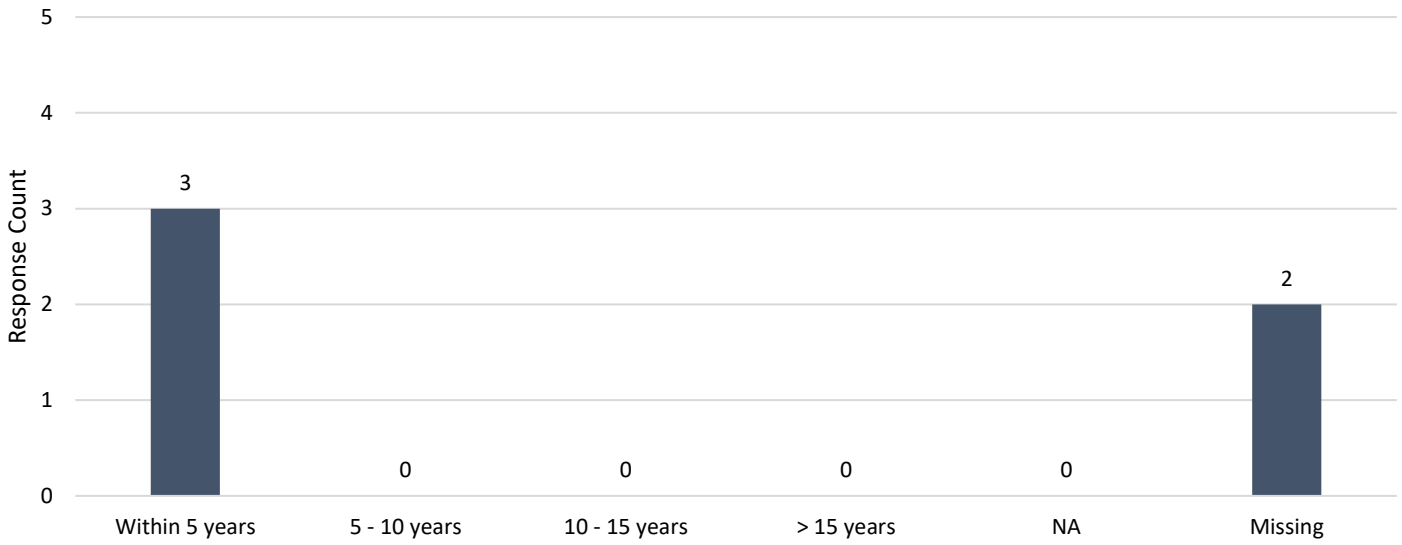


Figure D-4. Responses to " If your company decides to offer ITP, in what timeframe do you expect to offer it?"

QD.6.OEM Comments

- ITP is currently offered on some traffic surveillance architectures. It is not clear that the value of ITP will continue based on the availability of space-based ADS-B and subsequent services that may be enabled.
- TSO-Compliant ITP Application is currently available
- Currently available on new long range airplanes
- Existing offer.

QD.7. What is it about ITP that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	3	60%	0	0%	1	20%
Applicability with a sufficient number of customers	3	60%	0	0%	1	20%
Increase new aircraft/avionics sales	3	60%	1	20%	0	0%
Concept	0	0%	1	20%	1	20%
Other	0	0%	0	0%	0	0%
Nothing about ITP interests my company	0	0%				
N	5					

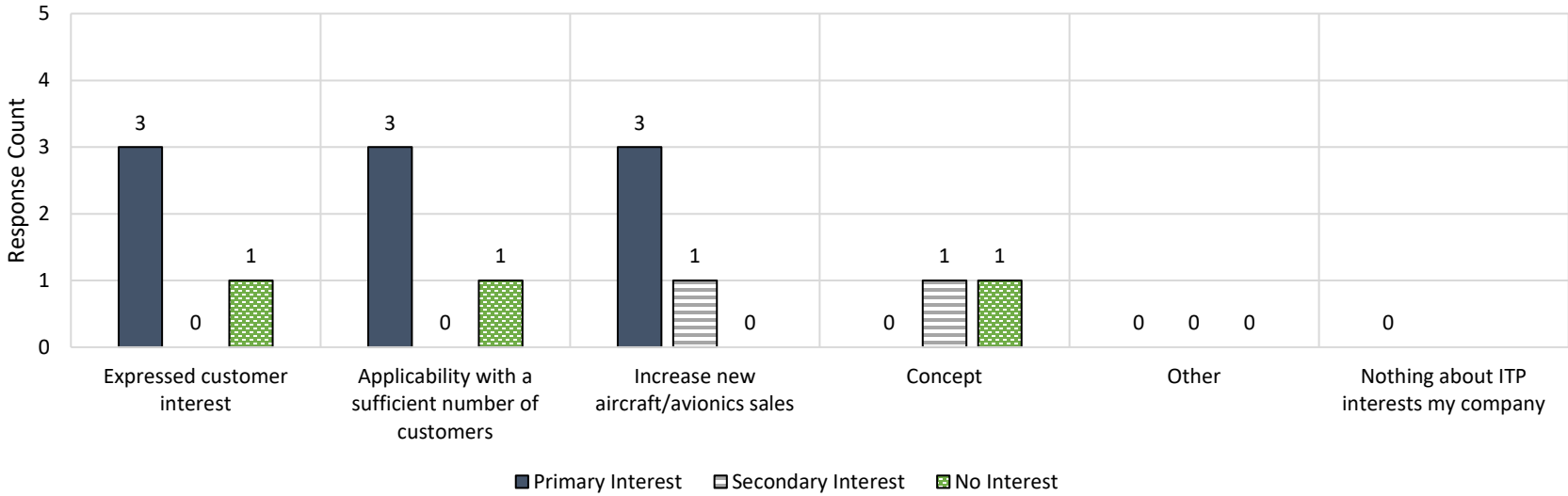


Figure D-5. Responses to "What is it about ITP that interests your company?"

QD.7.OEM Comments

- TSO-Compliant ITP Application is currently available
- Existing offer.

QD.8. What is it about ITP that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	0	0%	2	40%	1	20%
Cost	0	0%	0	0%	3	60%
Insufficient customer interest	1	20%	1	20%	0	0%
Concept complexity	0	0%	0	0%	2	40%
Necessary procedural changes	0	0%	1	20%	1	20%
Necessary controller automation	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No concerns	1					
N	5					

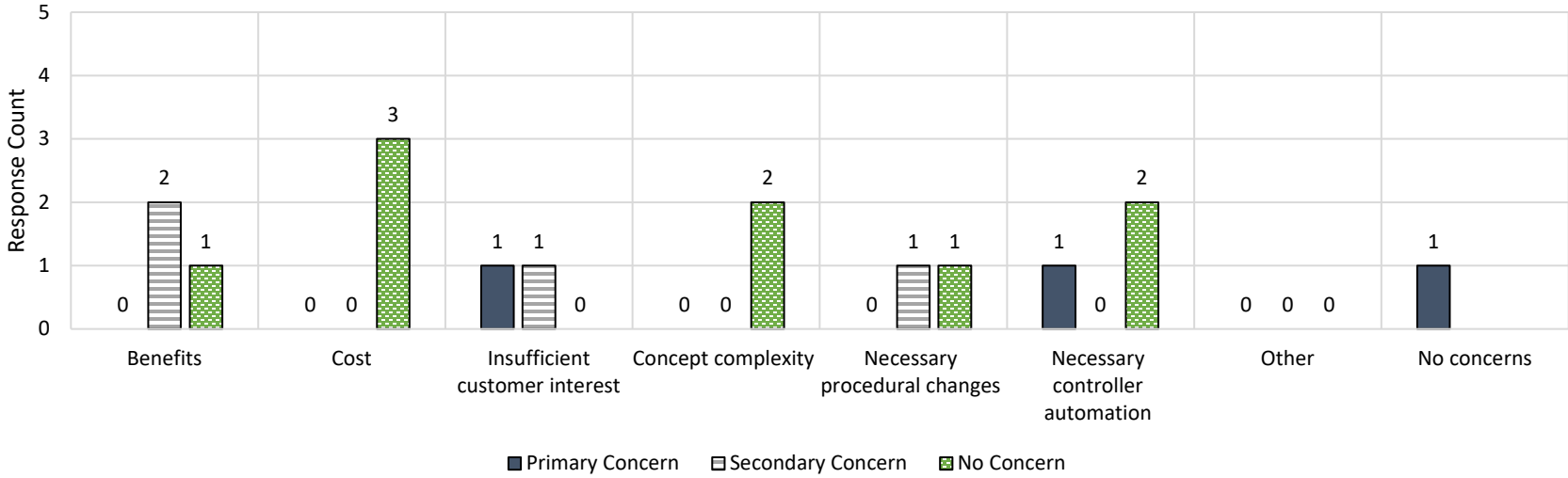


Figure D-6. Responses to "What is it about ITP that concerns your company?"

QD.8.OEM Comments

- Not yet widely supported by Oceanic ATC Centers
- Existing offer.

QD.9. If your company is interested in ITP, are there contingencies on an investment?

*Note that this question is not applicable to any of the respondents because all respondents indicated that they offer ITP

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	0	0%	0	0%	0	0%
FAA Investment decision to proceed with FIM Phase 2	0	0%	0	0%	0	0%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	0	0%
FAA Automation enhancements and corresponding procedures deployed	0	0%	0	0%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)*	0	0%	0	0%	0	0%
Industry and FAA agreement on an application adoption timeline	0	0%	0	0%	0	0%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	0	0%	0	0%	0	0%
Sufficient customer commitment	0	0%	0	0%	0	0%
Additional field demonstration data	0	0%	0	0%	0	0%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	5	100%				
N	5					

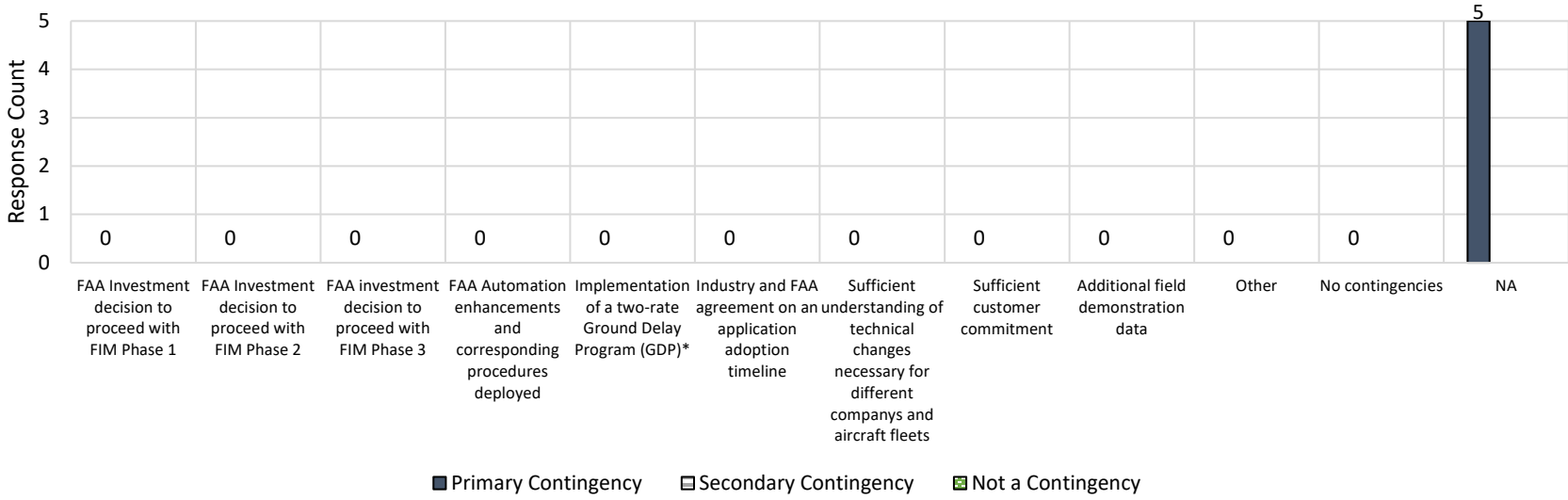


Figure D-7. Responses to "If your company is interested in ITP, are there contingencies on an investment?"

QD.9.OEM Comments

- TSO-Compliant ITP Application is currently available via Retrofit STC
- This is for short range aircraft.
- Existing offer.

QD.10. If your company is interested but not willing to commit to an investment in ITP, what barriers could be removed to incentivize your company to invest?

*Note that this question is not applicable to any of the respondents because all respondents indicated that they offer ITP

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	0	0%
Insufficient understanding of the ADS-B In application benefits	0	0%	0	0%	0	0%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	0	0%
Insufficient funds	0	0%	0	0%	0	0%
Lack of benefits data	0	0%	0	0%	0	0%
Lack of field demonstration data	0	0%	0	0%	0	0%
Unclear interest from customers	0	0%	0	0%	0	0%
Unclear FAA commitments on automation investments	0	0%	0	0%	0	0%
Unclear FAA commitments on necessary procedural changes	0	0%	0	0%	0	0%
Lack of information on avionics installation requirements	0	0%	0	0%	0	0%
Pilot acceptability issues	0	0%	0	0%	0	0%
Controller acceptability issues	0	0%	0	0%	0	0%
Lack of knowledge of the future operation of the customers / companies	0	0%	0	0%	0	0%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	5	100%				
N	5					

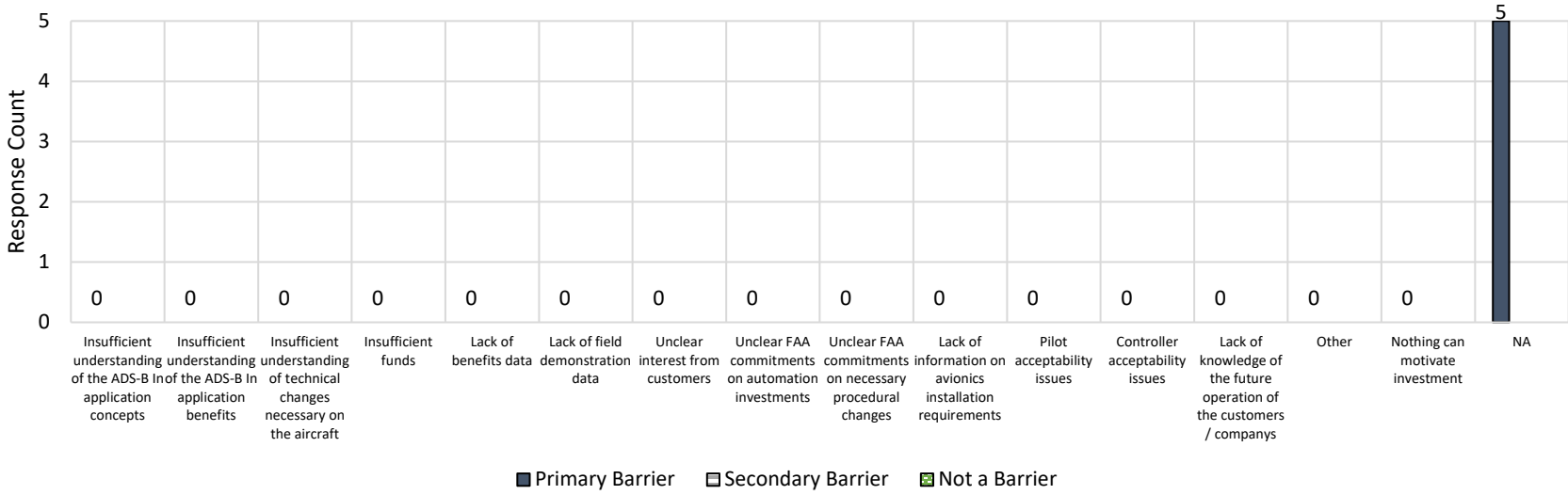


Figure D-8. Responses to "If your company is interested but not willing to commit to an investment in ITP, what barriers could be removed to incentivize your company to invest?"

QD.10.OEM Comments

- TSO-Compliant ITP Application is currently available via Retrofit STC
- This is for short range aircraft.
- Existing offer.

QD.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in ITP.

*Note that this question is not applicable to any of the respondents because all respondents indicated that they offer ITP

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	0	0%
Strongly Agree	0	0%
NA	5	0%
N	5	0%
Total Agreement	0	0%
Total Disagreement	0	0%

Figure NA

QD.11.OEM Comments

- TSO-Compliant ITP Application is currently available via Retrofit STC
- This is for short range aircraft.
- Already certified.

QD.12. When would your company expect to offer ITP?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	0	0%
Other	0	0%
Never	0	0%
NA	5	0%
N	5	

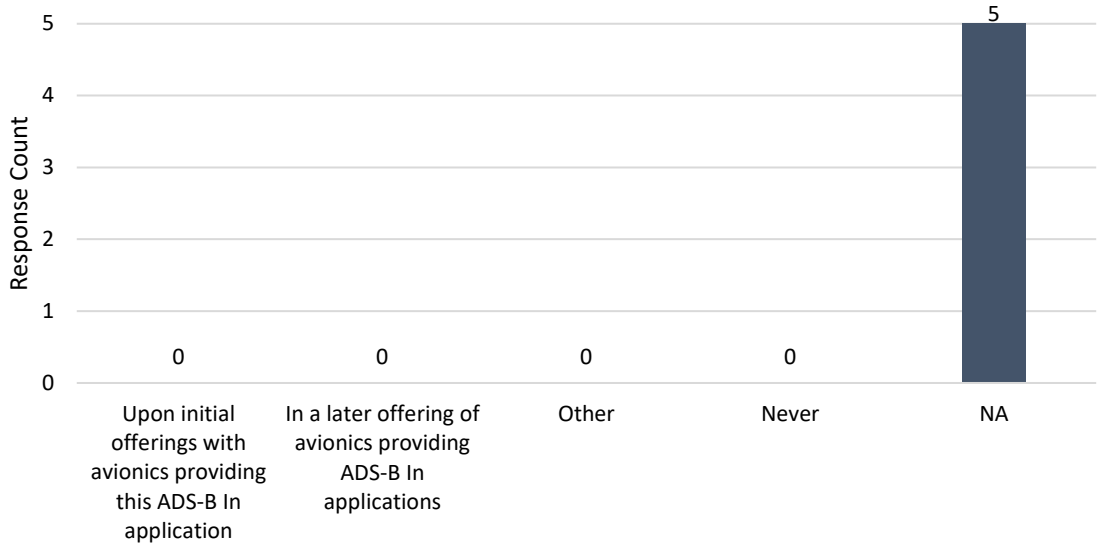


Figure D-9. Responses to "When would your company expect to offer ITP?"

QD.12.OEM Comments

- ITP is currently offered on one traffic surveillance architecture. Upgrades to other architectures will be based on market interest.
- TSO-Compliant ITP Application is currently available via Retrofit STC
- Already available as optional offer.
- This is for short range aircraft.

QD.13. If your company decides to offer ITP, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	1	1	0
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	3	0	0
Gen 0: Most recent TCAS / ADS-B In product offering	2	2	1	0
Gen +1: At least one ADS-B Application would require a new product offering	3	1	1	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	2	0	1	0

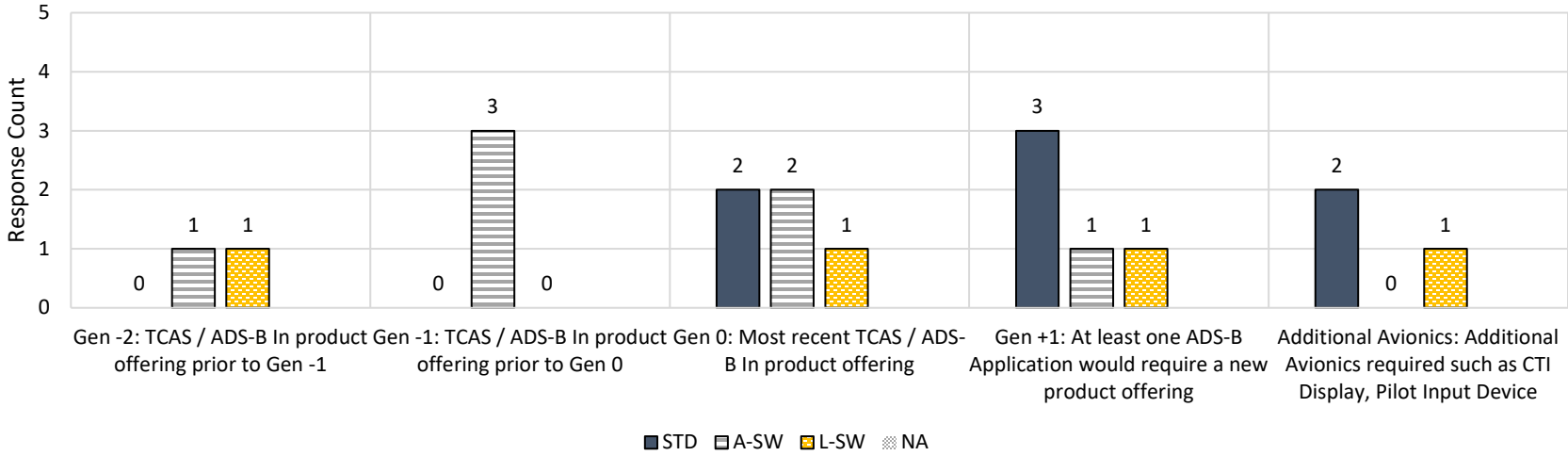


Figure D-10. Responses to "If your company decides to offer ITP, how do you plan to offer the ADS-B In application avionics capabilities?"

QD14. Do you have any additional thoughts for the NAC to share with the FAA related to ITP?

- It would be good if the FAA would clearly state their interest and intentions associated with ITP. Perhaps that [sic] have, but it remains unclear to my company.
- Gen -1 and Gen -2 would require a small hardware upgrade in addition to the A-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.
- 1) It is unclear the benefit of ITP for short range aircraft.
- 2) With the implementation of Space Based ADS-B, how does Space Based ADS-B affect the ITP.

Surface (SURF)

QE.3. Does your company currently offer SURF?

	Count	Percentage
Yes, as an offering compliant with a TSO	1	20%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	4	80%
Missing	0	
N	5	

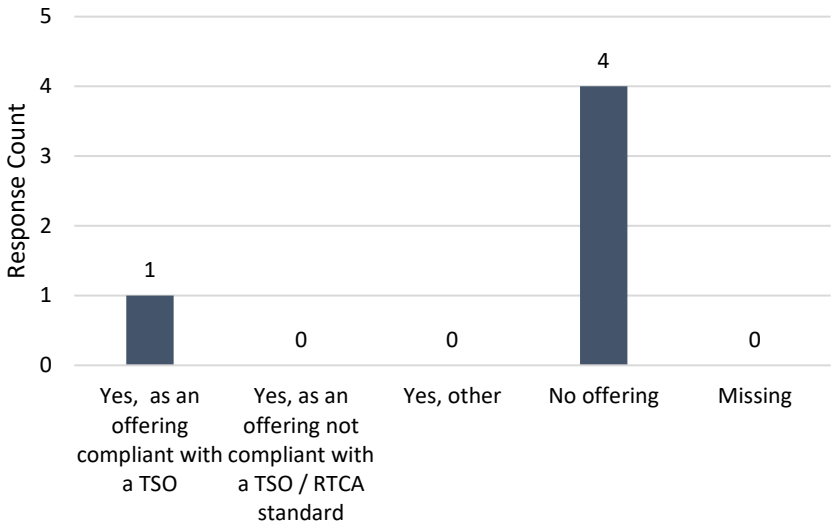


Figure E-1. Responses to "Does your company currently offer SURF?"

QE.3.OEM Comments

- None

QE.4. My company is interested in offering SURF.

	Count	Percentage
Strongly Disagree	1	20%
Somewhat Disagree	0	0%
Neither	1	20%
Somewhat Agree	2	40%
Strongly Agree	1	20%
N	5	
Total Agreement	3	60%
Total Disagreement	1	20%

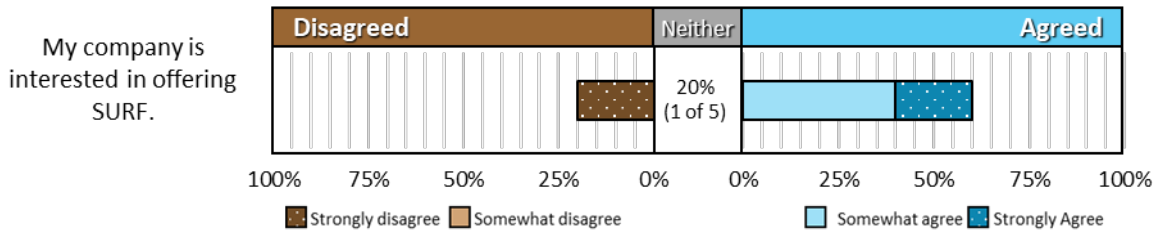


Figure E-2. Responses to "My company is interested in offering SURF."

QE.4.OEM Comments

- Dependent on business case and certifiable display interface

QE.5. Rate your company's priority for SURF amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	3	60%
High	2	40%
Missing	0	
N	5	

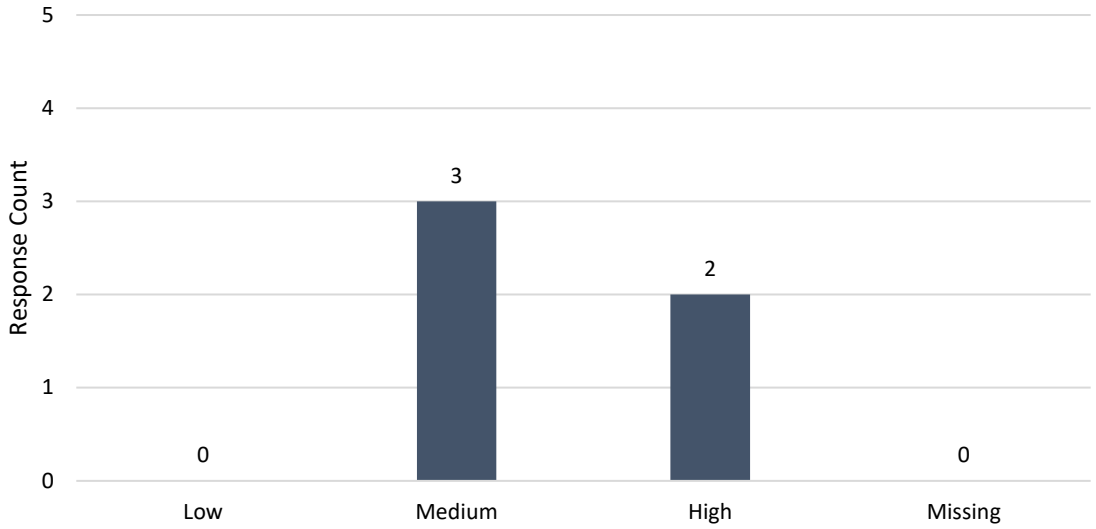


Figure E-3. Rate your company's priority for SURF amongst the set of ADS-B In applications

QE.5.OEM Comments

- None

QE.6. If your company decides to offer SURF, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	2	67%
5 - 10 years	1	33%
10 - 15 years	0	0%
> 15 years	0	0%
NA	0	0%
Missing	2	
N	3	

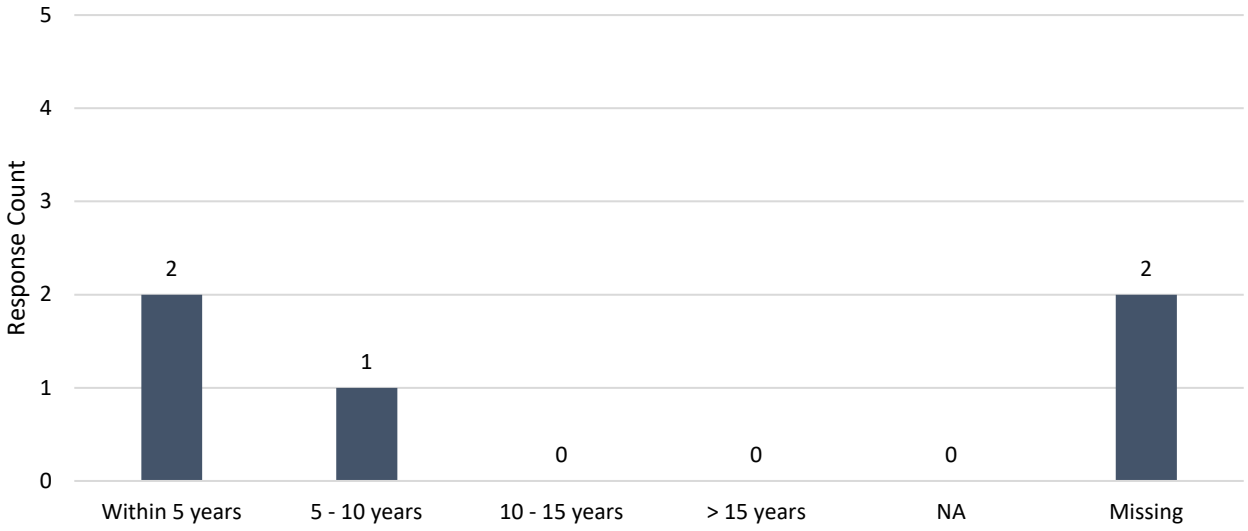


Figure E-4. Responses to " If your company decides to offer SURF, in what timeframe do you expect to offer it?"

QE.6.OEM Comments

- Dependent on business case and certifiable display interface

QE.7. What is it about SURF that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	3	60%	1	20%	1	20%
Applicability with a sufficient number of customers	1	20%	2	40%	2	40%
Increase new aircraft/avionics sales	4	80%	1	20%	0	0%
Concept	0	0%	1	20%	2	40%
Other	1	20%	0	0%	0	0%
Nothing about SURF interests my company	0	0%				
N	5					

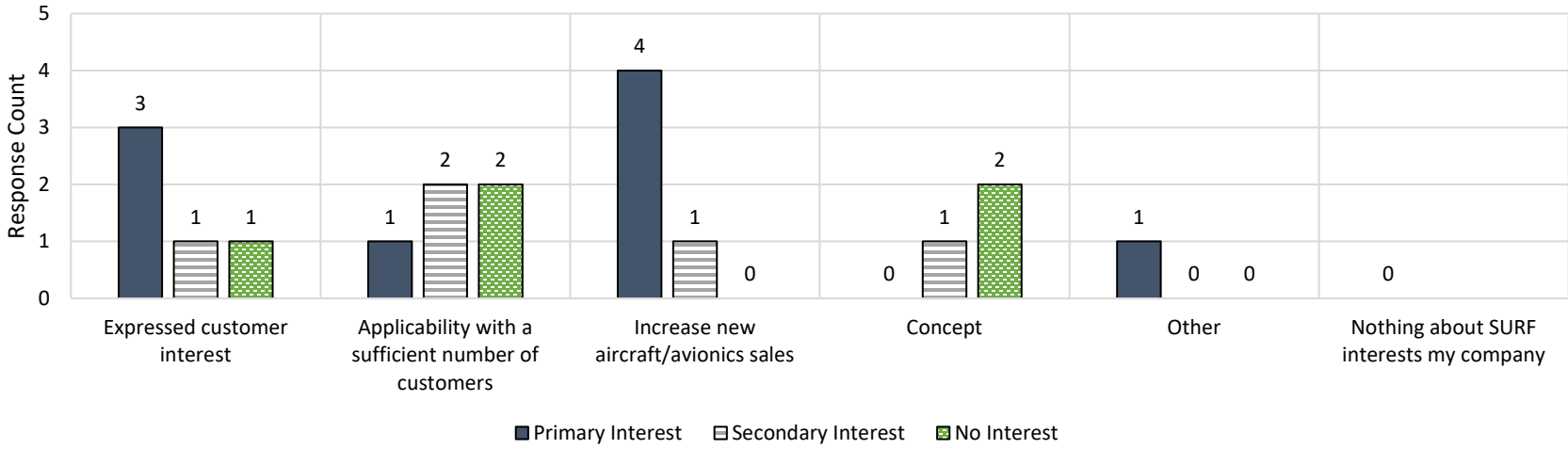


Figure E-5. Responses to "What is it about SURF that interests your company?"

QE.7.OEM Comments

- Improved situational awareness on ground.

QE.8. What is it about SURF that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	0	0%	0	0%	4	80%
Cost	2	40%	1	20%	2	40%
Insufficient customer interest	2	40%	1	20%	2	40%
Concept complexity	0	0%	1	20%	3	60%
Necessary procedural changes	0	0%	0	0%	4	80%
Necessary controller automation	0	0%	0	0%	3	60%
Other	1	20%	0	0%	0	0%
No concerns	0					
N	5					

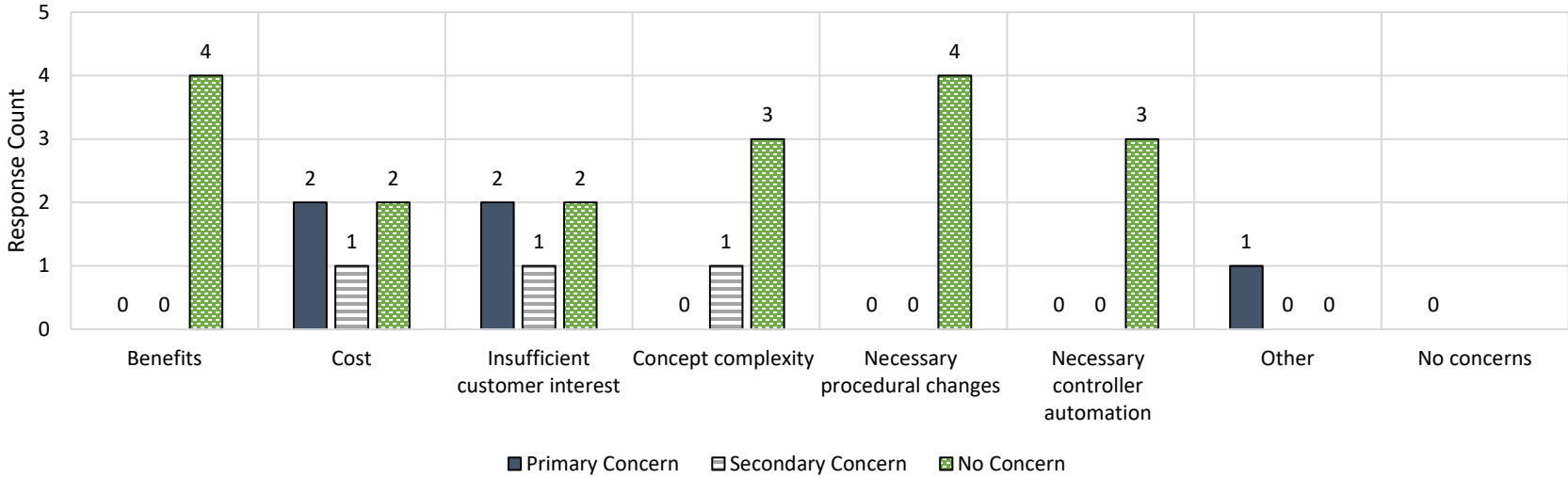


Figure E-6. Responses to "What is it about SURF that concerns your company?"

QE.8.OEM Comments

- Display/EFB integration challenges

QE.9. If your company is interested in SURF, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	0	0%	1	20%	1	20%
FAA Investment decision to proceed with FIM Phase 2	0	0%	0	0%	2	40%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	2	40%
FAA Automation enhancements and corresponding procedures deployed	0	0%	1	20%	1	20%
Implementation of a two-rate Ground Delay Program (GDP)*	0	0%	0	0%	2	40%
Industry and FAA agreement on an application adoption timeline	0	0%	1	20%	1	20%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	0	0%	0	0%	1	20%
Sufficient customer commitment	3	60%	1	20%	0	0%
Additional field demonstration data	0	0%	0	0%	2	40%
Other	1	20%	0	0%	0	0%
No contingencies	0	0%				
NA	1	20%				
N	5					

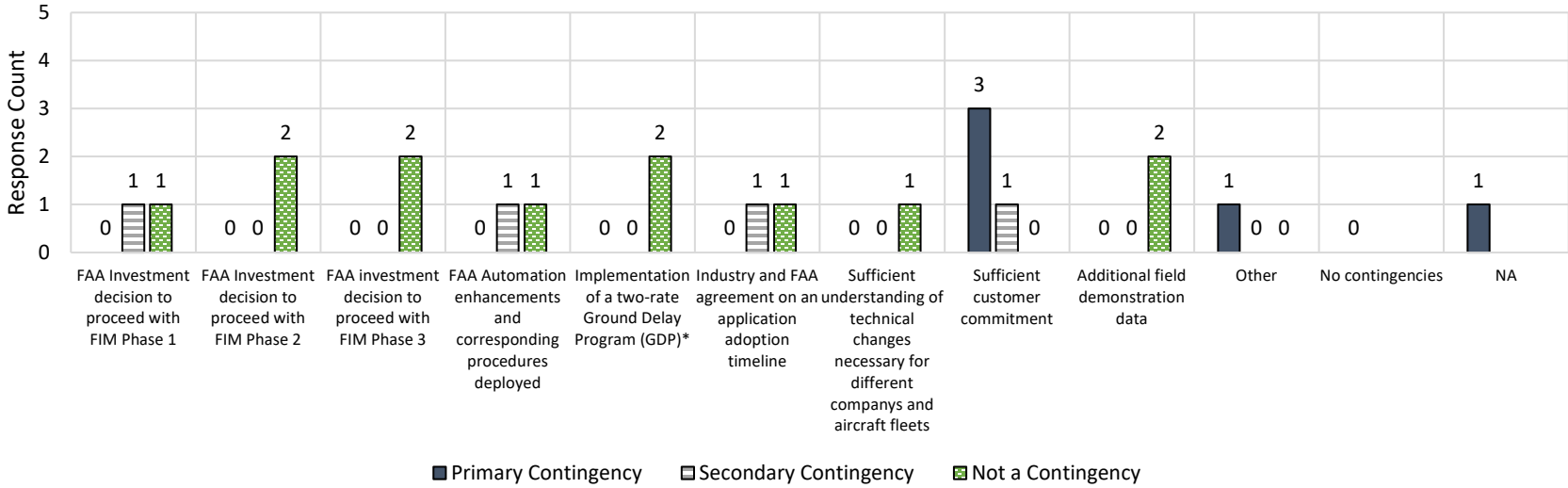


Figure E-7. Responses to "If your company is interested in SURF, are there contingencies on an investment?"

QE.9.OEM Comments

- Business case with interested customer
- Would require integration with certified display/EFB.

QE.10. If your company is interested but not willing to commit to an investment in SURF, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	1	20%
Insufficient understanding of the ADS-B In application benefits	0	0%	0	0%	1	20%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	1	20%
Insufficient funds	0	0%	2	40%	0	0%
Lack of benefits data	0	0%	0	0%	1	20%
Lack of field demonstration data	0	0%	0	0%	1	20%
Unclear interest from customers	1	20%	1	20%	0	0%
Unclear FAA commitments on automation investments	0	0%	1	20%	0	0%
Unclear FAA commitments on necessary procedural changes	0	0%	1	20%	0	0%
Lack of information on avionics installation requirements	0	0%	0	0%	1	20%
Pilot acceptability issues	0	0%	0	0%	1	20%
Controller acceptability issues	0	0%	0	0%	1	20%
Lack of knowledge of the future operation of the customers / companies	0	0%	0	0%	1	20%
Other	1	20%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	1	20%				
N	5					

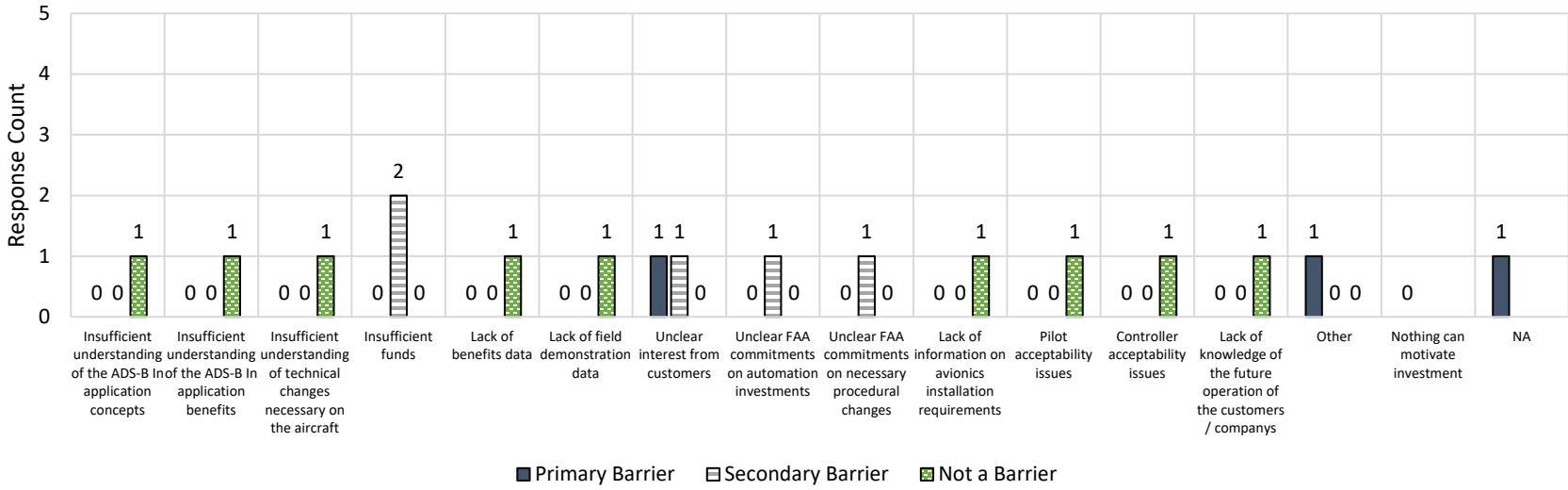


Figure E-8. Responses to "If your company is interested but not willing to commit to an investment in SURF, what barriers could be removed to incentivize your company to invest?"

QE.10.OEM Comments

- Business case with interested customer

QE.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in SURF.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	25%
Somewhat Agree	1	25%
Strongly Agree	2	50%
NA	1	
N	5	
Total Agreement	3	75%
Total Disagreement	0	0%

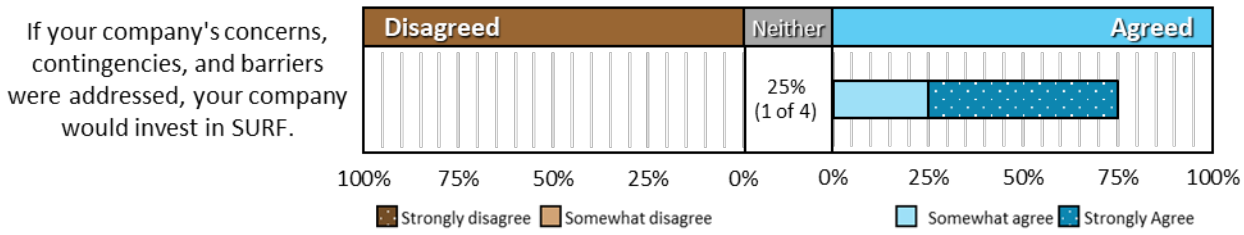


Figure E-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in SURF."

QE.11.OEM Comments

- Basic SURF provides situational awareness only which is hard to quantify the benefit.

QE.12. When would your company expect to offer SURF?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	3	75%
Other	1	25%
Never	0	0%
NA	1	
N	5	

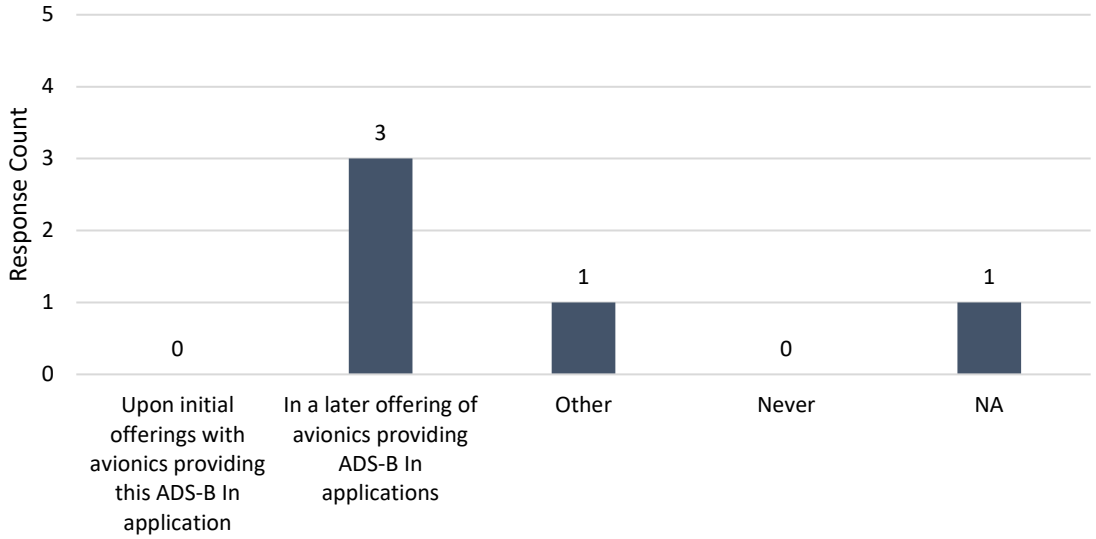


Figure E-10. Responses to "When would your company expect to offer SURF?"

QE.12.OEM Comments

- SURF would be offered where market demand dictates.
- Depend [sic] on customer interest

QE.13. If your company decides to offer SURF, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	1	1	0
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	1	2	0
Gen 0: Most recent TCAS / ADS-B In product offering	1	0	3	0
Gen +1: At least one ADS-B Application would require a new product offering	2	0	2	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	1	0	2	0

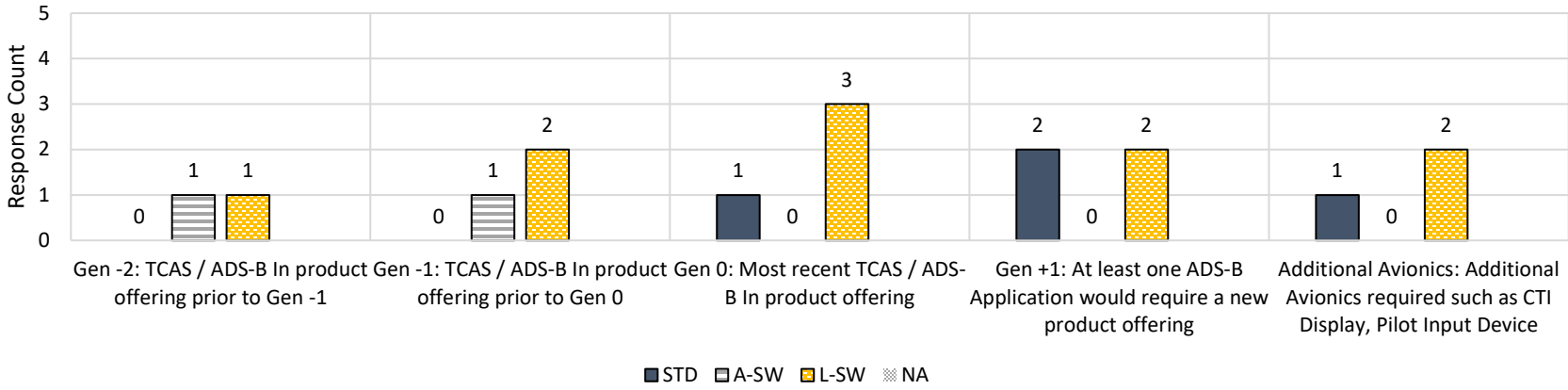


Figure E-11. Responses to "If your company decides to offer SURF, how do you plan to offer the ADS-B In application avionics capabilities?"

QE14. Do you have any additional thoughts for the NAC to share with the FAA related to SURF?

- Gen -1 and Gen -2 would require a small hardware upgrade in addition to the A-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

Surface Alerting (SURF-A)

QF.3. Does your company currently offer SURF-A?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	5	100%
Missing	0	
N	5	

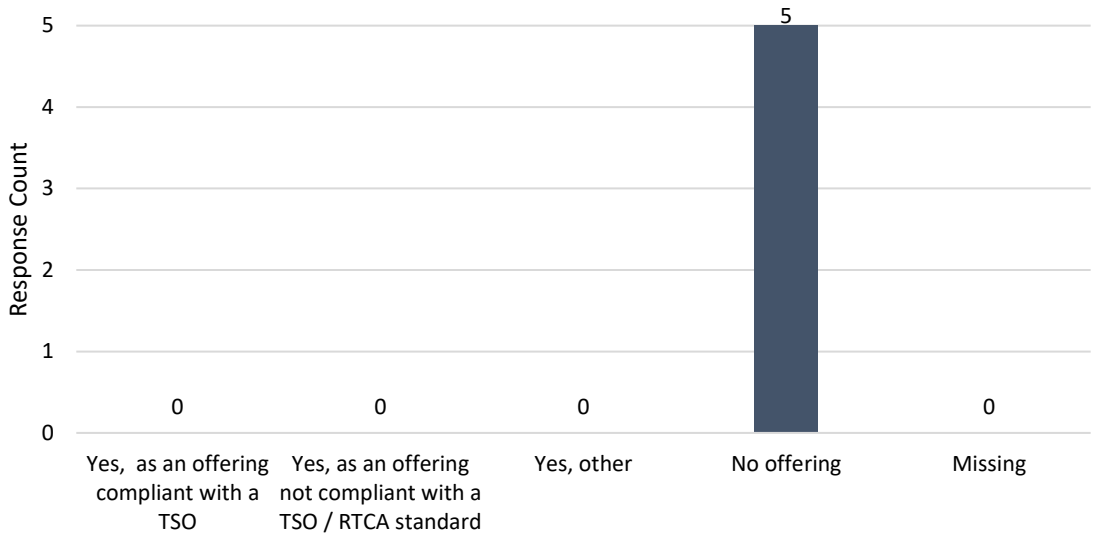


Figure F-1. Responses to "Does your company currently offer SURF-A?"

QF.3.OEM Comments

- None

QF.4. My company is interested in offering SURF-A.

	Count	Percentage
Strongly Disagree	1	20%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	2	40%
N	5	
Total Agreement	4	80%
Total Disagreement	1	20%

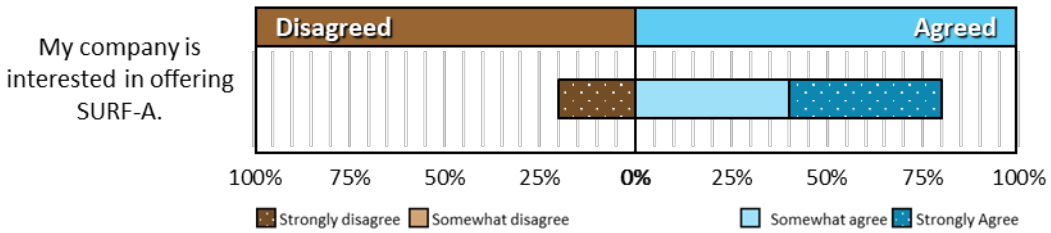


Figure F-2. Responses to "My company is interested in offering SURF-A."

QF.4.OEM Comments

- SURF-A seems like a viable retrofit option but would not make sense for forward fit.

QF.5. Rate your company's priority for SURF-A amongst the set of ADS-B In applications

	Count	Percentage
Low	1	20%
Medium	3	60%
High	1	20%
Missing	0	
N	5	

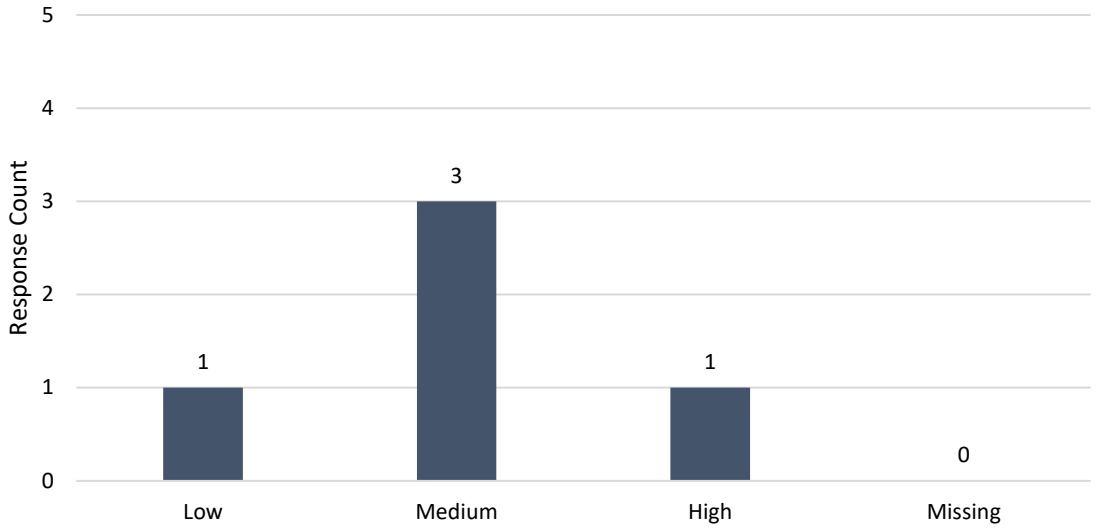


Figure F-3. Rate your company's priority for SURF-A amongst the set of ADS-B In applications

QF.5.OEM Comments

- None

QF.6. If your company decides to offer SURF-A, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	3	75%
5 - 10 years	1	25%
10 - 15 years	0	0%
> 15 years	0	0%
NA	0	0%
Missing	1	
N	4	

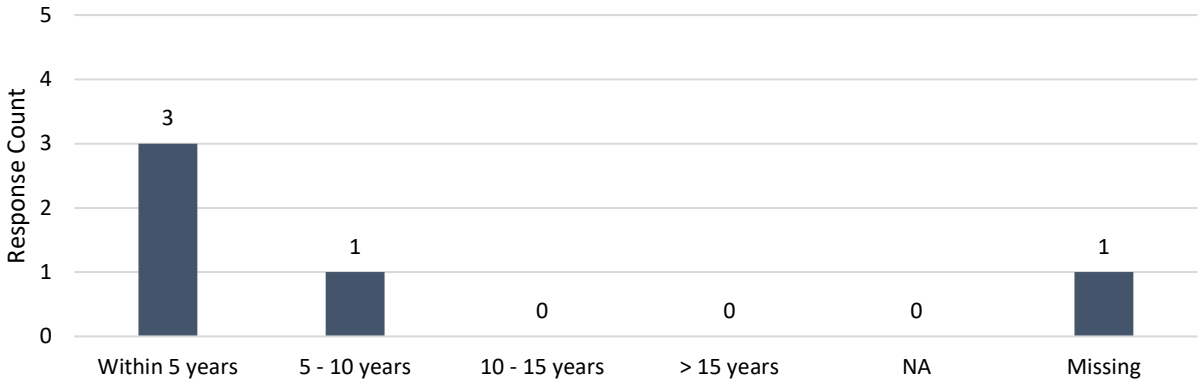


Figure F-4. Responses to " If your company decides to offer SURF-A, in what timeframe do you expect to offer it?"

QF.6.OEM Comments

- None

QF.7. What is it about SURF-A that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	1	20%	2	40%	0	0%
Applicability with a sufficient number of customers	1	20%	2	40%	1	20%
Increase new aircraft/avionics sales	2	40%	2	40%	0	0%
Concept	1	20%	1	20%	1	20%
Other	1	20%	0	0%	0	0%
Nothing about SURF-A interests my company	0	0%				
N	5					

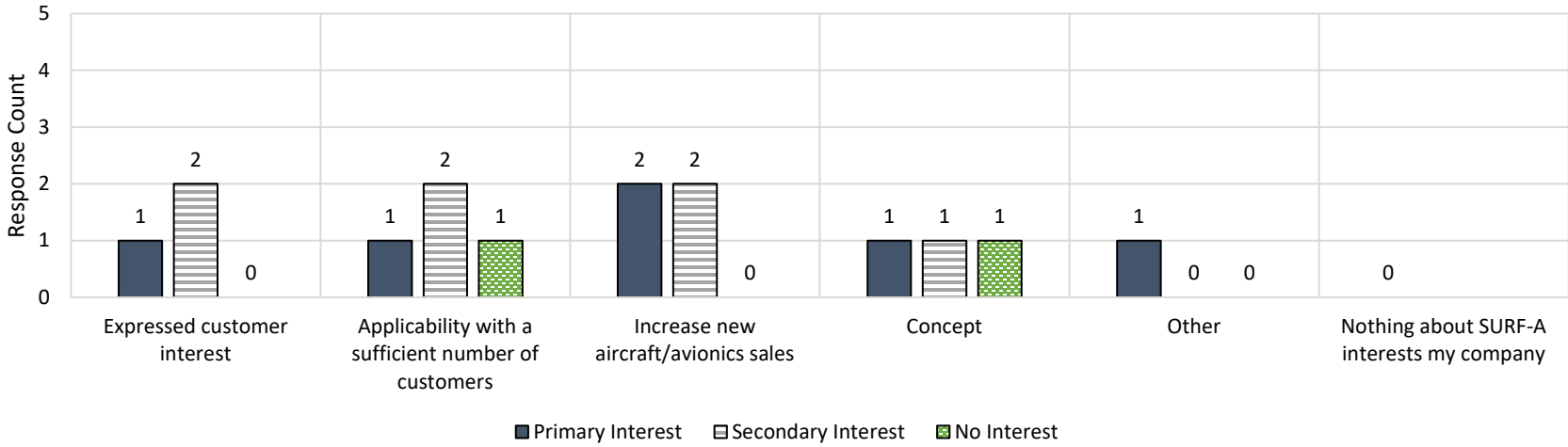


Figure F-5. Responses to "What is it about SURF-A that interests your company?"

QF.7.OEM Comments

- Customer interest in safety benefits

QF.8. What is it about SURF-A that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	0	0%	1	20%	1	20%
Cost	0	0%	1	20%	1	20%
Insufficient customer interest	1	20%	1	20%	0	0%
Concept complexity	0	0%	0	0%	2	40%
Necessary procedural changes	0	0%	0	0%	2	40%
Necessary controller automation	0	0%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No concerns	3					
N	5					

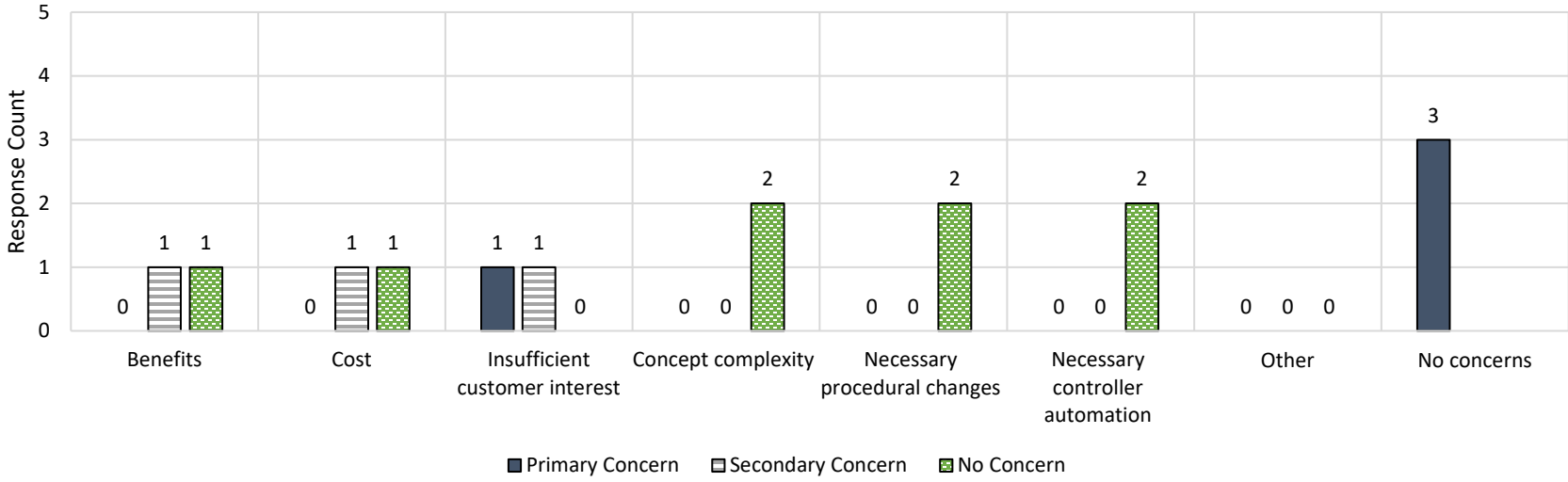


Figure F-6. Responses to "What is it about SURF-A that concerns your company?"

QA.8.OEM Comments

- None

QF.9. If your company is interested in SURF-A, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	0	0%	1	20%	2	40%
FAA Investment decision to proceed with FIM Phase 2	0	0%	0	0%	3	60%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	3	60%
FAA Automation enhancements and corresponding procedures deployed	0	0%	0	0%	3	60%
Implementation of a two-rate Ground Delay Program (GDP)*	0	0%	0	0%	3	60%
Industry and FAA agreement on an application adoption timeline	0	0%	1	20%	2	40%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	0	0%	0	0%	3	60%
Sufficient customer commitment	1	20%	1	20%	1	20%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	2	40%				
NA	0	0%				
N	5					

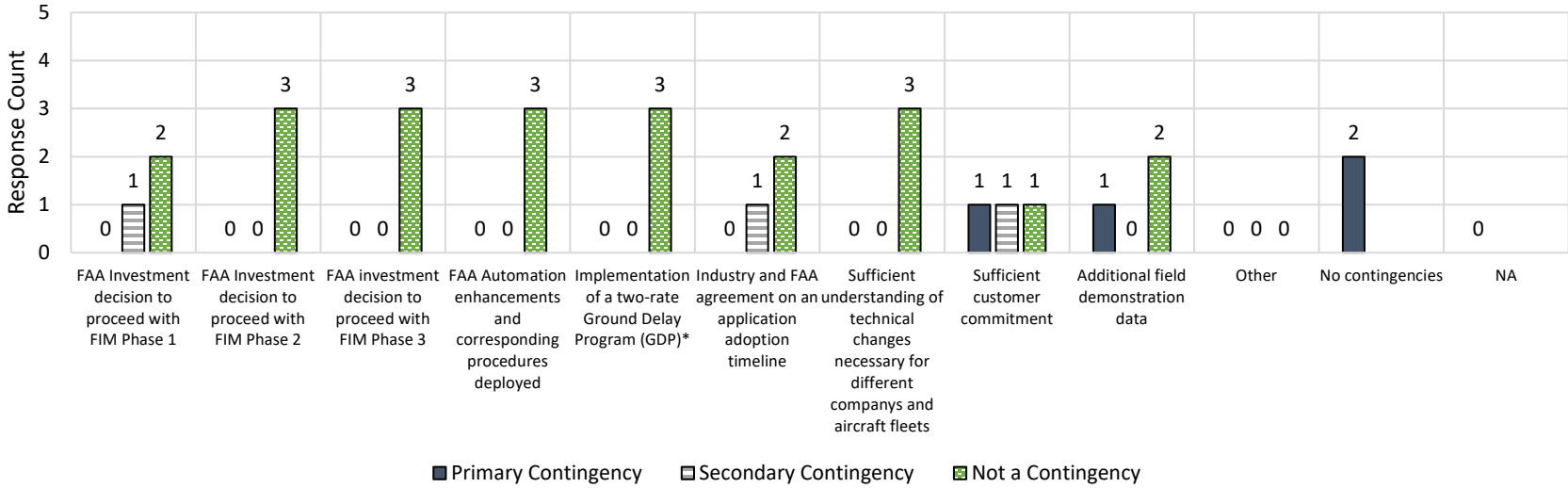


Figure F-7. Responses to "If your company is interested in SURF-A, are there contingencies on an investment?"

QF.9.OEM Comments

- None

QF.10. If your company is interested but not willing to commit to an investment in SURF-A, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	2	40%
Insufficient understanding of the ADS-B In application benefits	0	0%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	0	0%	0	0%	2	40%
Insufficient funds	1	20%	1	20%	0	0%
Lack of benefits data	0	0%	0	0%	2	40%
Lack of field demonstration data	0	0%	0	0%	2	40%
Unclear interest from customers	1	20%	1	20%	0	0%
Unclear FAA commitments on automation investments	0	0%	0	0%	2	40%
Unclear FAA commitments on necessary procedural changes	0	0%	0	0%	2	40%
Lack of information on avionics installation requirements	0	0%	0	0%	2	40%
Pilot acceptability issues	0	0%	1	20%	1	20%
Controller acceptability issues	0	0%	0	0%	2	40%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	1	20%
Other	1	20%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	0	0%				
N	5					

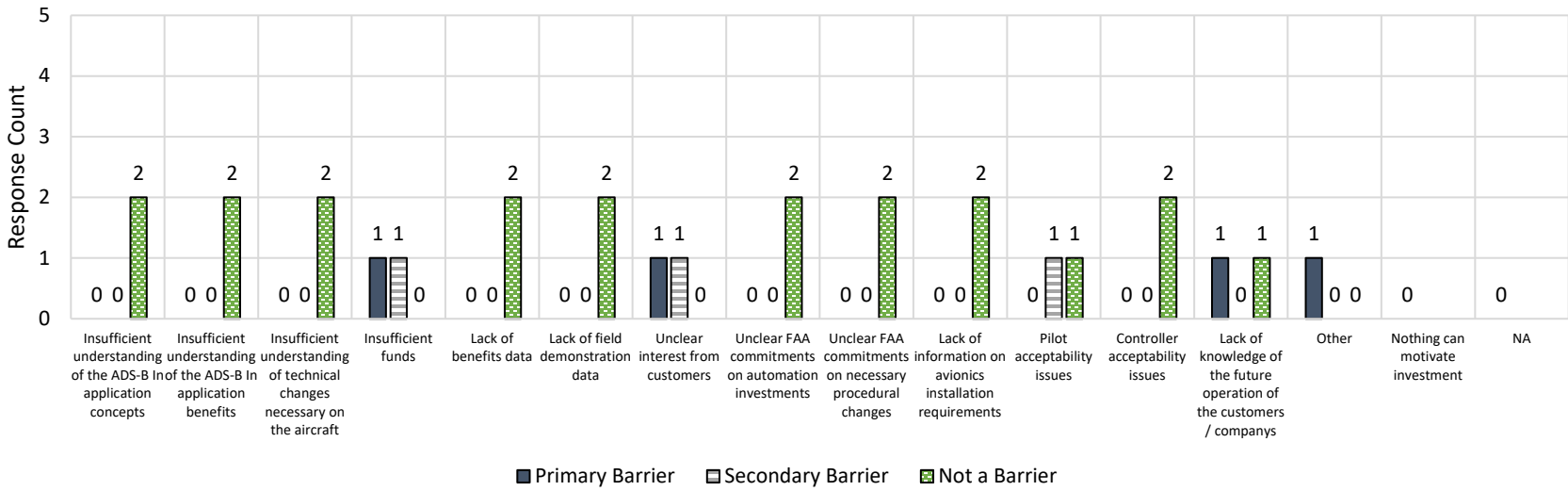


Figure 0-8. Responses to "If your company is interested but not willing to commit to an investment in SURF-A, what barriers could be removed to incentivize your company to invest?"

QF.10.OEM Comments

- Business case with interested customer

QF.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in SURF-A.

	Count	Percentage
Strongly Disagree	1	25%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	1	25%
Strongly Agree	2	50%
NA	0	
Missing	1	
N	4	
Total Agreement	3	75%
Total Disagreement	1	25%

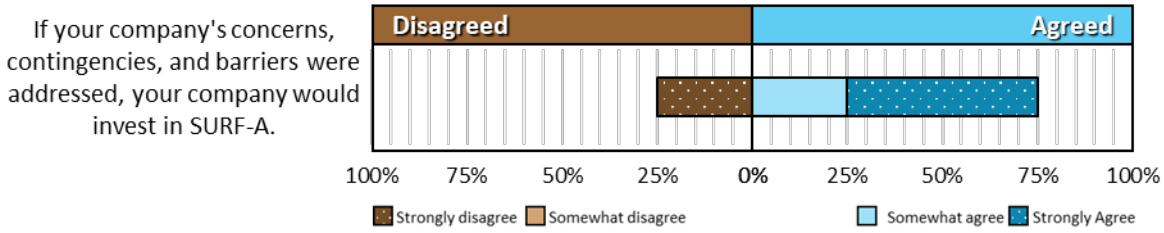


Figure F-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in SURF-A."

QF.11.OEM Comments

- Not applicable
- Market demand would dictate implementation.

QF.12. When would your company expect to offer SURF-A?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	1	20%
In a later offering of avionics providing ADS-B In applications	2	40%
Other	1	20%
Never	1	20%
NA	0	
N	5	

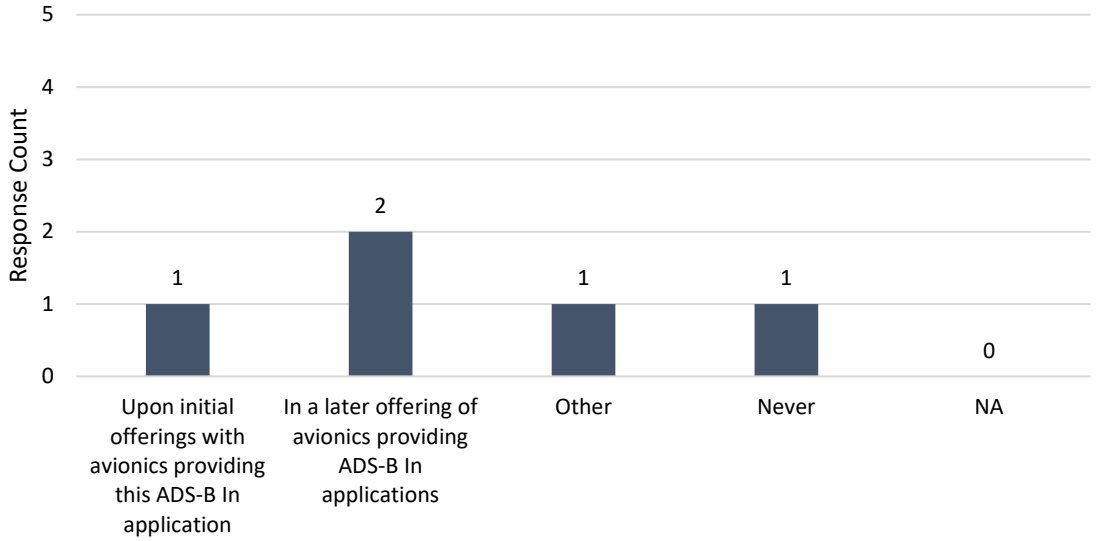


Figure F-10. Responses to "When would your company expect to offer SURF-A?"

QF.12.OEM Comments

- Market demand would dictate offerability.

QF.13. If your company decides to offer SURF-A, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	0
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	0	2	0
Gen 0: Most recent TCAS / ADS-B In product offering	0	2	2	0
Gen +1: At least one ADS-B Application would require a new product offering	2	1	1	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	1	1	0	0

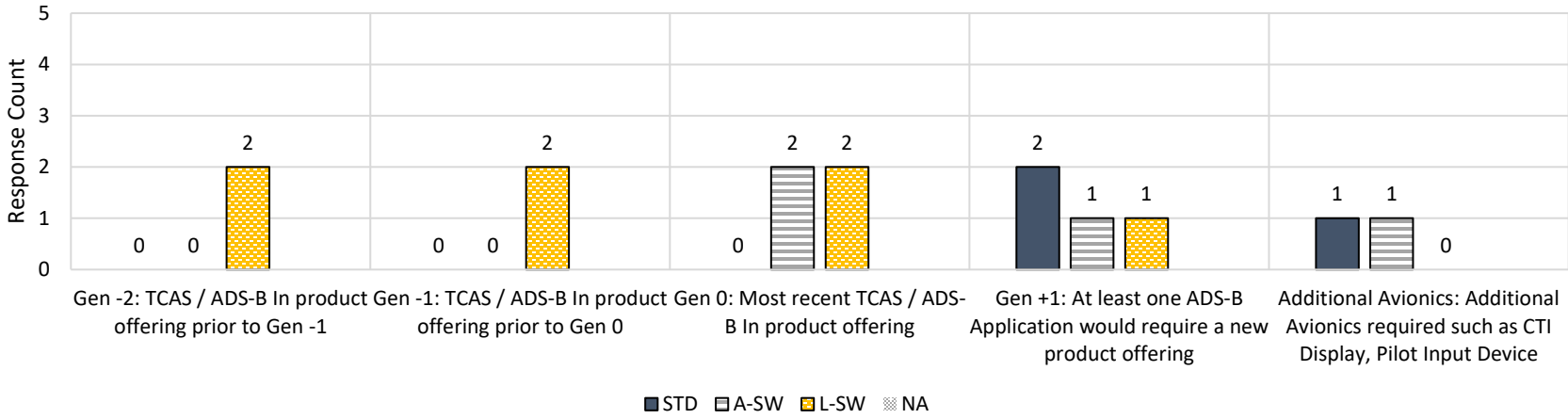


Figure F-11. Responses to "If your company decides to offer SURF-A, how do you plan to offer the ADS-B In application avionics capabilities?"

QF14. Do you have any additional thoughts for the NAC to share with the FAA related to SURF-A?

- Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW.
- What is the FAA's position on SURF-A?

Surface Indicating and Alerting (SURF-IA)

QG.3. Does your company currently offer SURF-A?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	5	100%
Missing	0	
N	5	

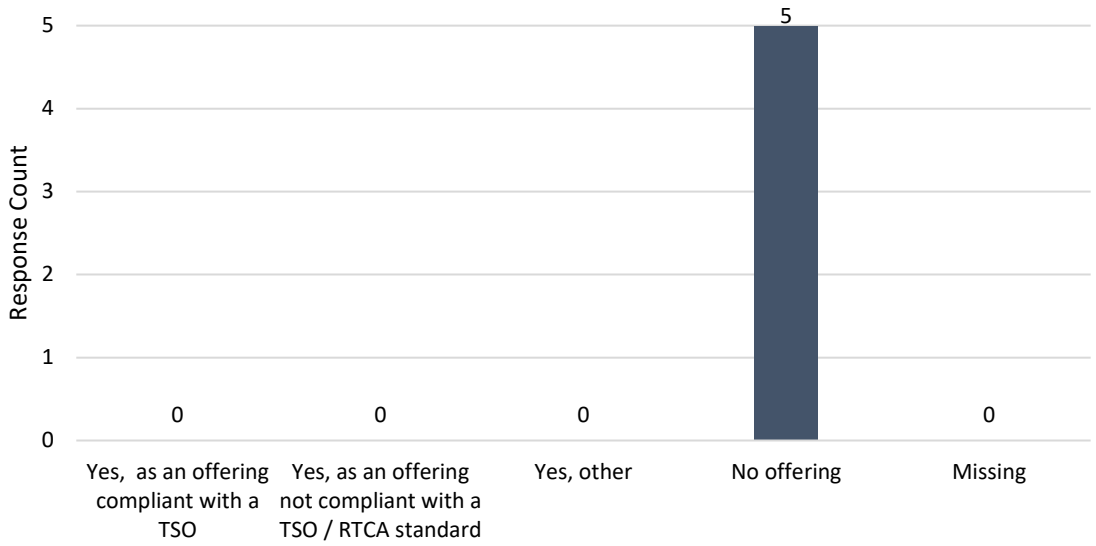


Figure G-1. Responses to "Does your company currently offer SURF-IA?"

QG.3.OEM Comments

- None

QG.4. My company is interested in offering SURF-IA.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	3	60%
Strongly Agree	2	40%
N	5	
Total Agreement	5	100%
Total Disagreement	0	0%

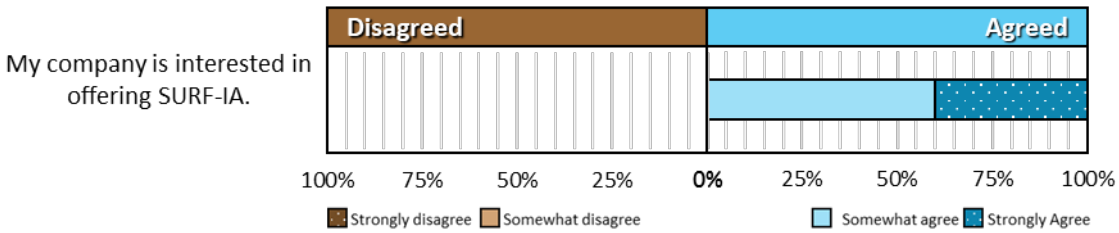


Figure G-2. Responses to "My company is interested in offering SURF-IA."

QG.4.OEM Comments

- None

QG.5. Rate your company's priority for SURF-IA amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	4	80%
High	1	20%
Missing	0	
N	5	

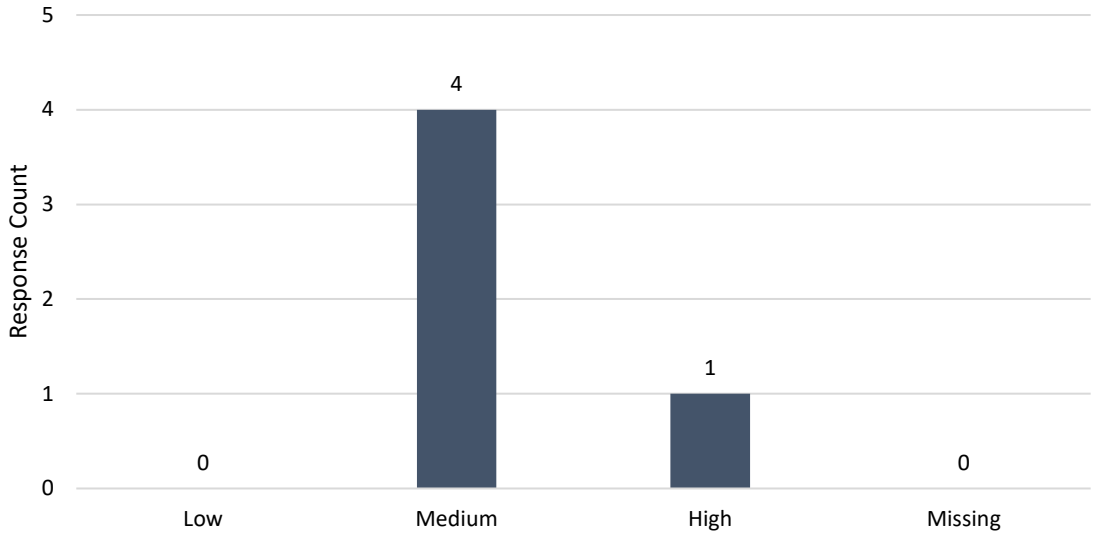


Figure G-3. Rate your company's priority for SURF-IA amongst the set of ADS-B In applications

QG.5.OEM Comments

- None

QG.6. If your company decides to offer SURF-IA, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	1	25%
5 - 10 years	2	50%
10 - 15 years	1	25%
> 15 years	0	0%
NA	0	0%
Missing	1	
N	4	

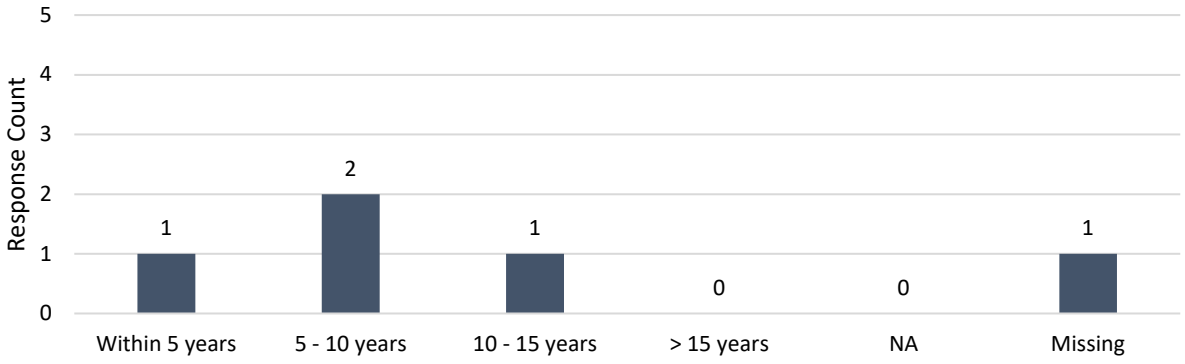


Figure G-4. Responses to " If your company decides to offer SURF-IA, in what timeframe do you expect to offer it?"

QG.6.OEM Comments

- Market interest will dictate offerability.
- Offering would be dependent on available MOPS and business case with operator
- Currently there are no Industry Standards (MOPS) or regulatory requirements/guidance to develop this application.

QG.7. What is it about SURF-IA that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	4	80%	1	20%	0	0%
Applicability with a sufficient number of customers	2	40%	1	20%	1	20%
Increase new aircraft/avionics sales	4	80%	1	20%	0	0%
Concept	1	20%	1	20%	1	20%
Other	1	20%	0	0%	0	0%
Nothing about SURF-IA interests my company	0	0%				
N	5					

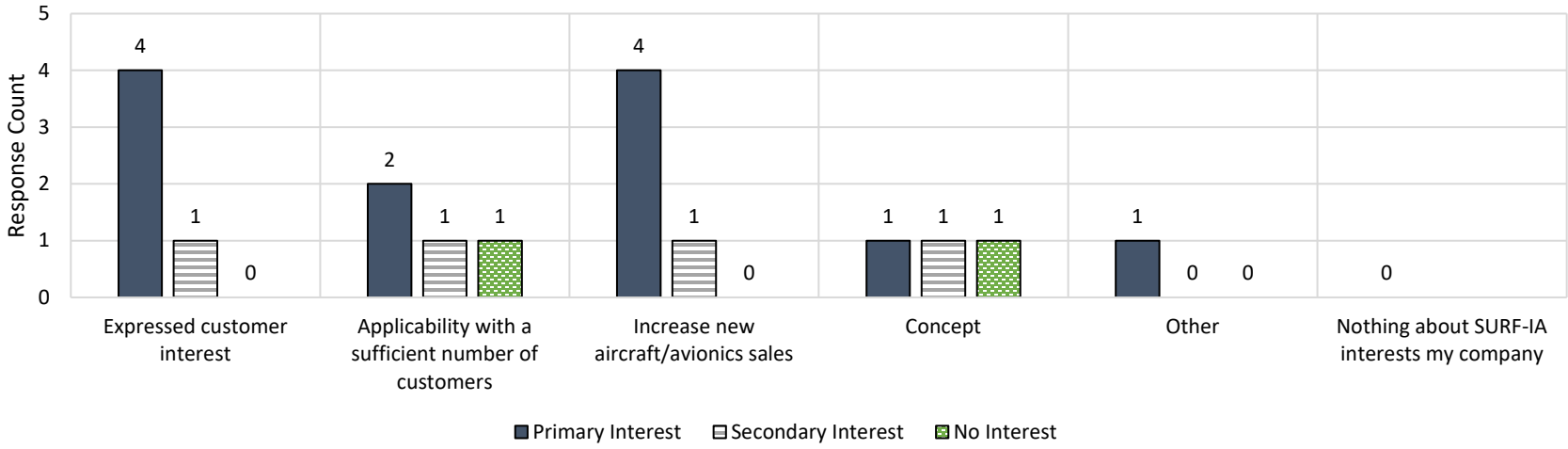


Figure G-5. Responses to "What is it about SURF-IA that interests your company?"

QG.7.OEM Comments

- Improved situational awareness with alerting on ground

QG.8. What is it about SURF-IA that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	0	0%	2	40%
Cost	2	40%	1	20%	0	0%
Insufficient customer interest	3	60%	1	20%	0	0%
Concept complexity	1	20%	2	40%	1	20%
Necessary procedural changes	0	0%	0	0%	3	60%
Necessary controller automation	0	0%	0	0%	3	60%
Other	1	20%	0	0%	0	0%
No concerns	0					
N	5					

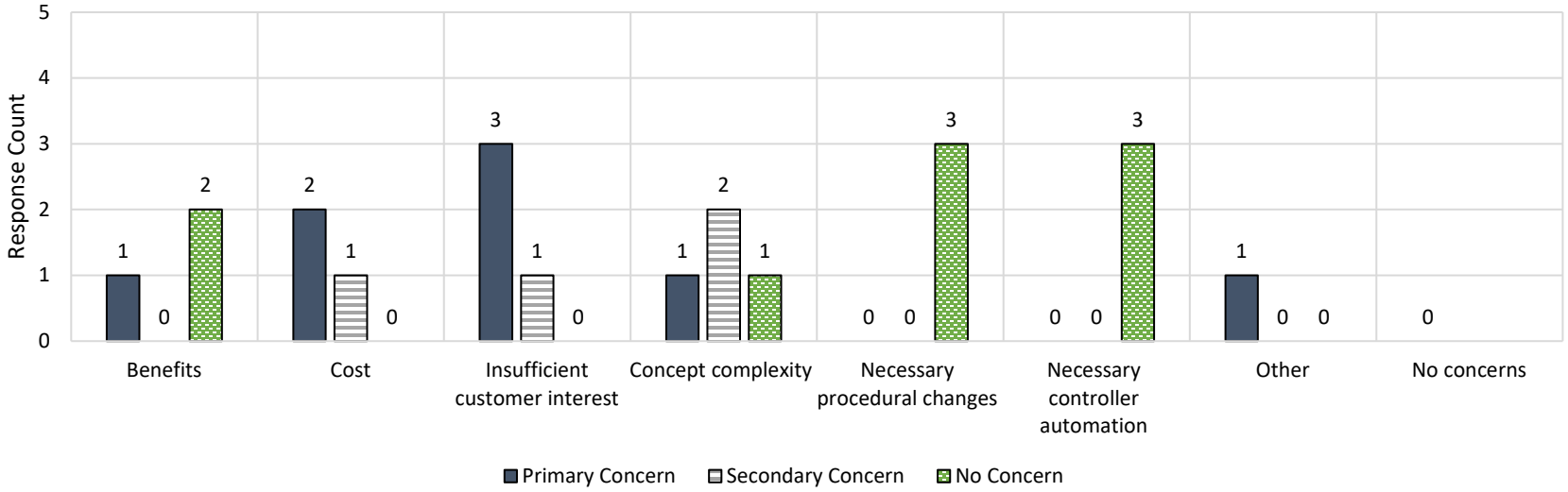


Figure G-6. Responses to "What is it about SURF-IA that concerns your company?"

QG.8.OEM Comments

- Integration with displays/EFB

QG.9. If your company is interested in SURF-IA, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	0	0%	1	20%	2	40%
FAA Investment decision to proceed with FIM Phase 2	0	0%	1	20%	2	40%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	3	60%
FAA Automation enhancements and corresponding procedures deployed	0	0%	0	0%	3	60%
Implementation of a two-rate Ground Delay Program (GDP)*	0	0%	0	0%	3	60%
Industry and FAA agreement on an application adoption timeline	0	0%	1	20%	2	40%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	1	20%	1	20%	2	40%
Sufficient customer commitment	4	80%	1	20%	0	0%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	0	0%				
N	5					

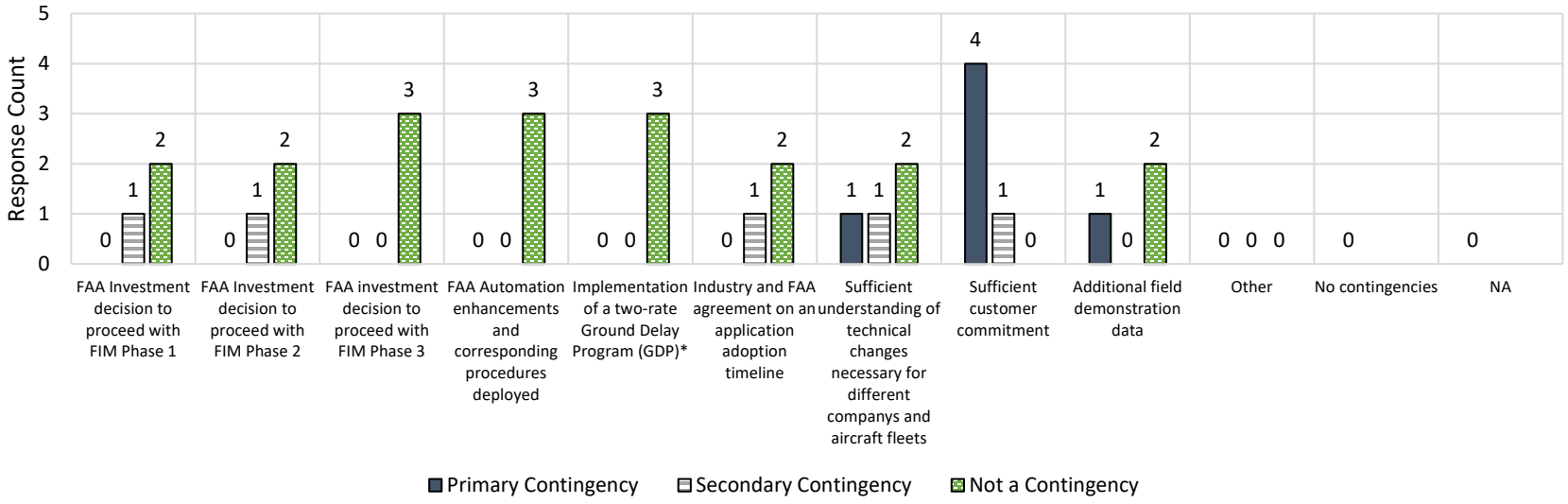


Figure G-7. Responses to "If your company is interested in SURF-IA, are there contingencies on an investment?"

QG.9.OEM Comments

- None

QG.10. If your company is interested but not willing to commit to an investment in SURF-IA, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	0	0%	3	60%
Insufficient understanding of the ADS-B In application benefits	0	0%	0	0%	3	60%
Insufficient understanding of technical changes necessary on the aircraft	1	20%	0	0%	3	60%
Insufficient funds	2	40%	2	40%	0	0%
Lack of benefits data	0	0%	1	20%	2	40%
Lack of field demonstration data	0	0%	1	20%	2	40%
Unclear interest from customers	3	60%	1	20%	0	0%
Unclear FAA commitments on automation investments	0	0%	1	20%	2	40%
Unclear FAA commitments on necessary procedural changes	0	0%	1	20%	2	40%
Lack of information on avionics installation requirements	1	20%	0	0%	3	60%
Pilot acceptability issues	0	0%	1	20%	2	40%
Controller acceptability issues	0	0%	0	0%	3	60%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	2	40%
Other	1	20%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	0	0%				
N	5					

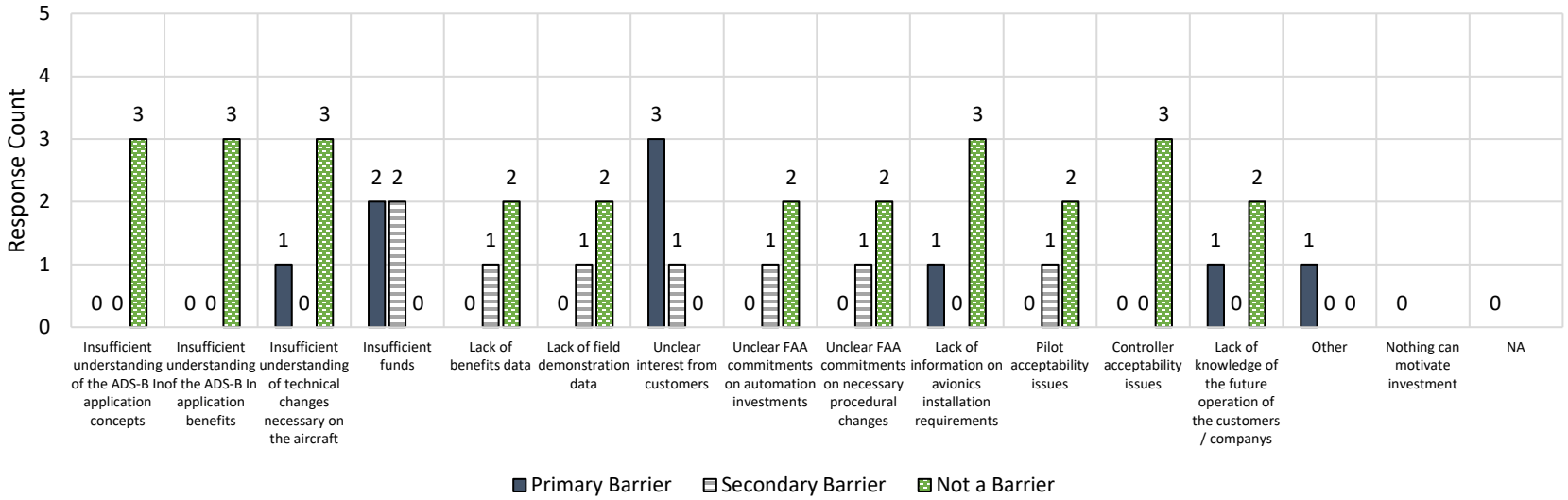


Figure G-8. Responses to "If your company is interested but not willing to commit to an investment in SURF-IA, what barriers could be removed to incentivize your company to invest?"

QG.10.OEM Comments

- Business case with interested customer

QG.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in SURF-IA.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	3	60%
NA	0	
N	5	
Total Agreement	5	100%
Total Disagreement	0	0%

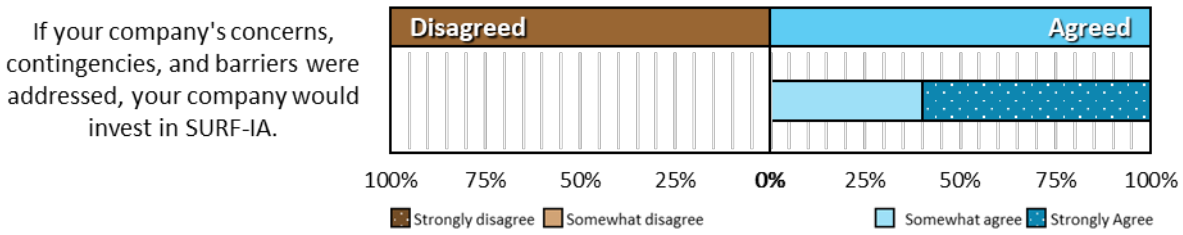


Figure G-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in SURF-IA."

QG.11.OEM Comments

- Market demand would drive offerability.

QG.12. When would your company expect to offer SURF-IA?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	4	80%
Other	1	20%
Never	0	0%
NA	0	
N	5	

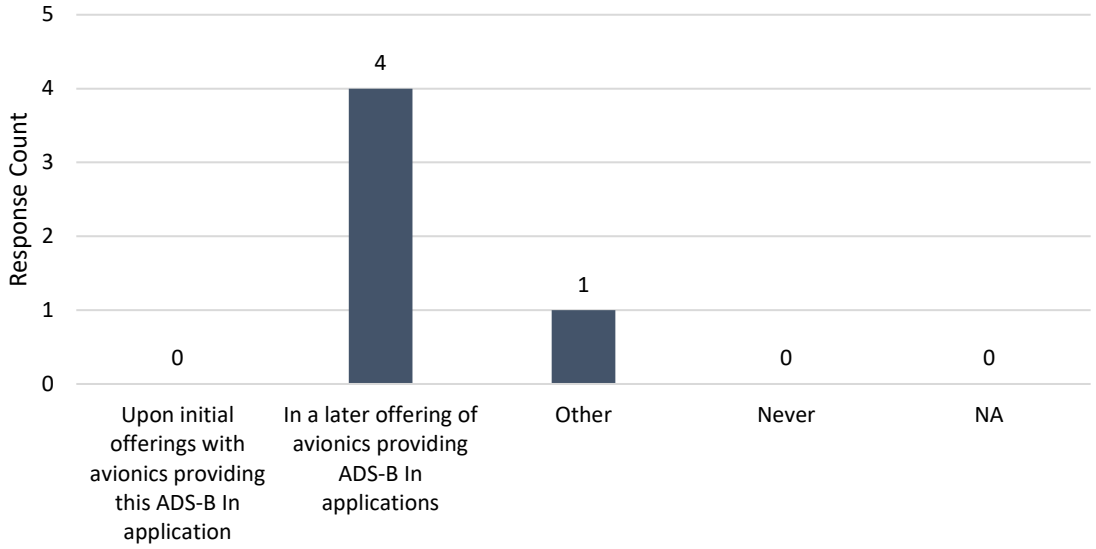


Figure G-10. Responses to "When would your company expect to offer SURF-IA?"

QG.12.OEM Comments

- Market demand would drive offerability.

QG.13. If your company decides to offer SURF-IA, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	0
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	0	3	0
Gen 0: Most recent TCAS / ADS-B In product offering	0	0	4	0
Gen +1: At least one ADS-B Application would require a new product offering	0	2	3	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	0	1	2	0

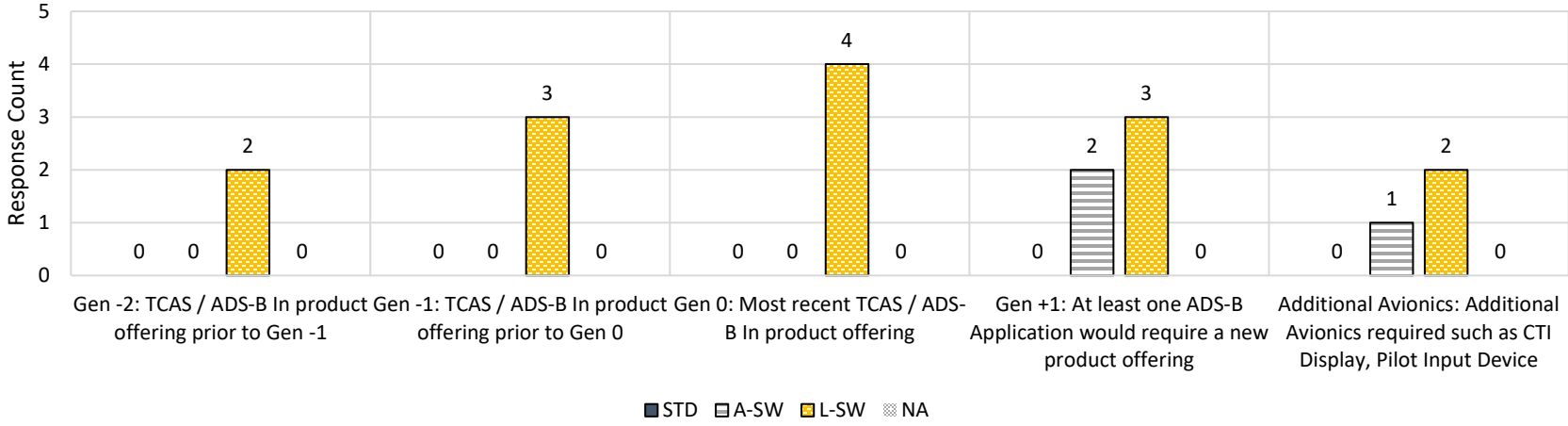


Figure G-11. Responses to "If your company decides to offer SURF-IA, how do you plan to offer the ADS-B In application avionics capabilities?"

QG14. Do you have any additional thoughts for the NAC to share with the FAA related to SURF-IA?

- Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need an airport surface display in addition to the TCAS/ADS-B In avionics.

Flight-deck Based Interval Management (FIM) – Same Corner Post Arrivals

QH.3. Does your company currently offer FIM - Same Corner Post Arrivals?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	1	20%
Yes, other	0	0%
No offering	4	80%
Missing	0	
N	5	

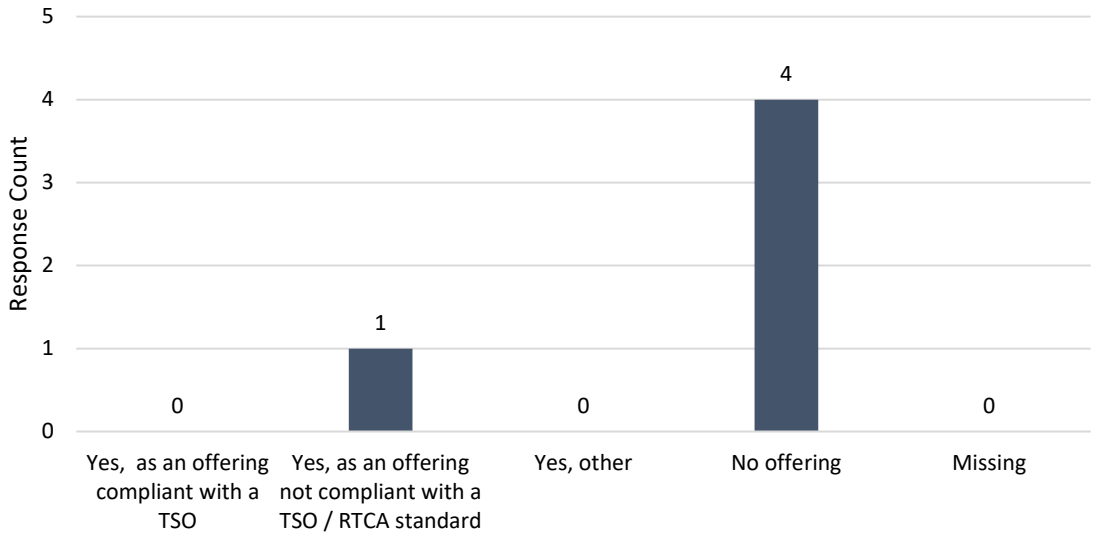


Figure H-1. Responses to "Does your company currently offer FIM - Same Corner Post Arrivals?"

QH.3.OEM Comments

- Interval Management application certified via FAA Issue Paper. Supports Same Corner Post Arrival operations. Available now via STC.

QH.4. My company is interested in offering FIM - Same Corner Post Arrivals.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	3	60%
N	5	
Total Agreement	5	100%
Total Disagreement	0	0%

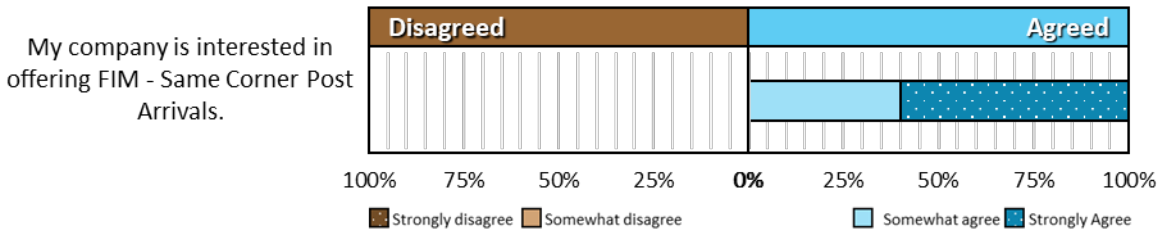


Figure H-2. Responses to "My company is interested in offering FIM - Same Corner Post Arrivals."

QH.4.OEM Comments

- The avionics equipment for IM will provide this capability.

QH.5. Rate your company's priority for FIM - Same Corner Post Arrivals amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	2	40%
High	3	60%
Missing	0	
N	5	

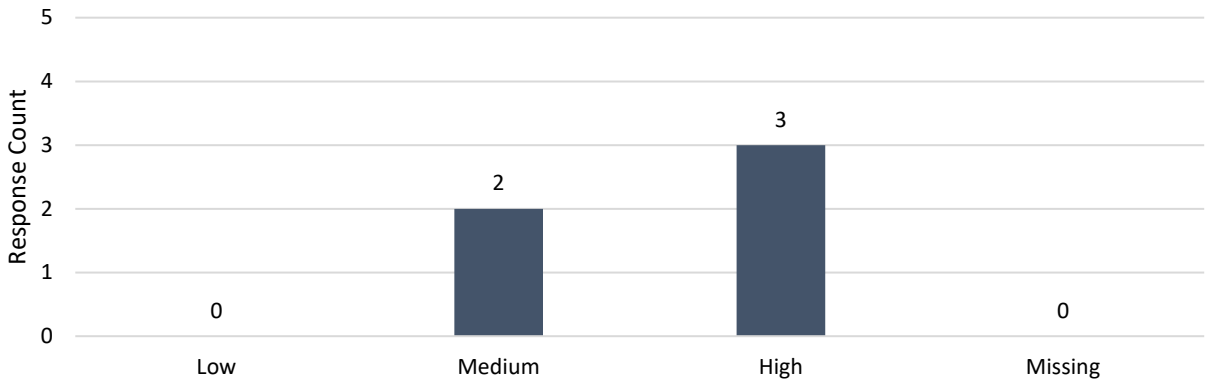


Figure H-3. Rate your company's priority for FIM - Same Corner Post Arrivals amongst the set of ADS-B In applications

QH.5.OEM Comments

- None

QH.6. If your company decides to offer FIM - Same Corner Post, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	2	40%
5 - 10 years	2	40%
10 - 15 years	1	20%
> 15 years	0	0%
NA	0	0%
Missing	0	
N	5	

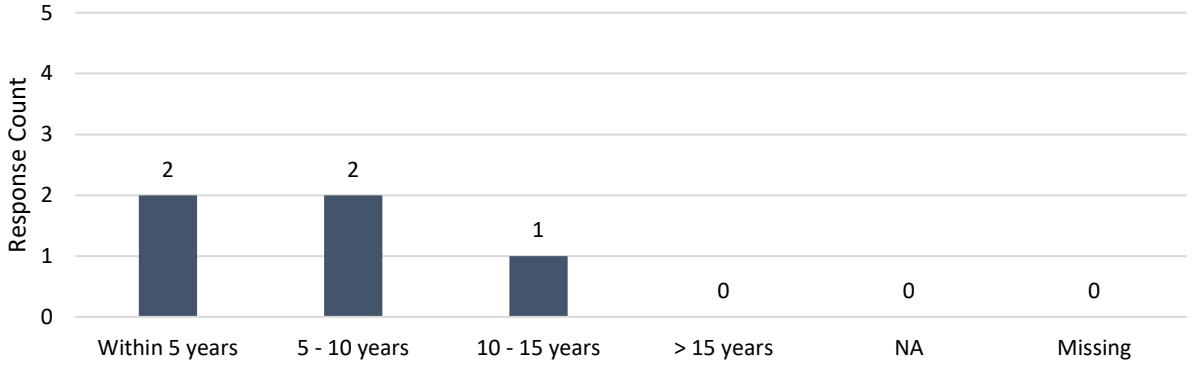


Figure H-4. Responses to " If your company decides to offer FIM - Same Corner Post, in what timeframe do you expect to offer it?"

QH.6.OEM Comments

- Interval Management application supporting Same Corner Post Arrival operations is available now via STC.
- This timeline is based on the understanding that Same Corner Post Arrivals does not require knowing the designated aircrafts flight plan beyond being cleared direct to "Same Corner Post".

QH.7. What is it about FIM - Same Corner Post Arrivals that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	3	60%	1	20%	1	20%
Applicability with a sufficient number of customers	4	80%	1	20%	0	0%
Increase new aircraft/avionics sales	3	60%	2	40%	0	0%
Concept	0	0%	1	20%	2	40%
Other	0	0%	0	0%	0	0%
Nothing about FIM - Same Corner Post Arrivals interests my company	0	0%				
N	5					

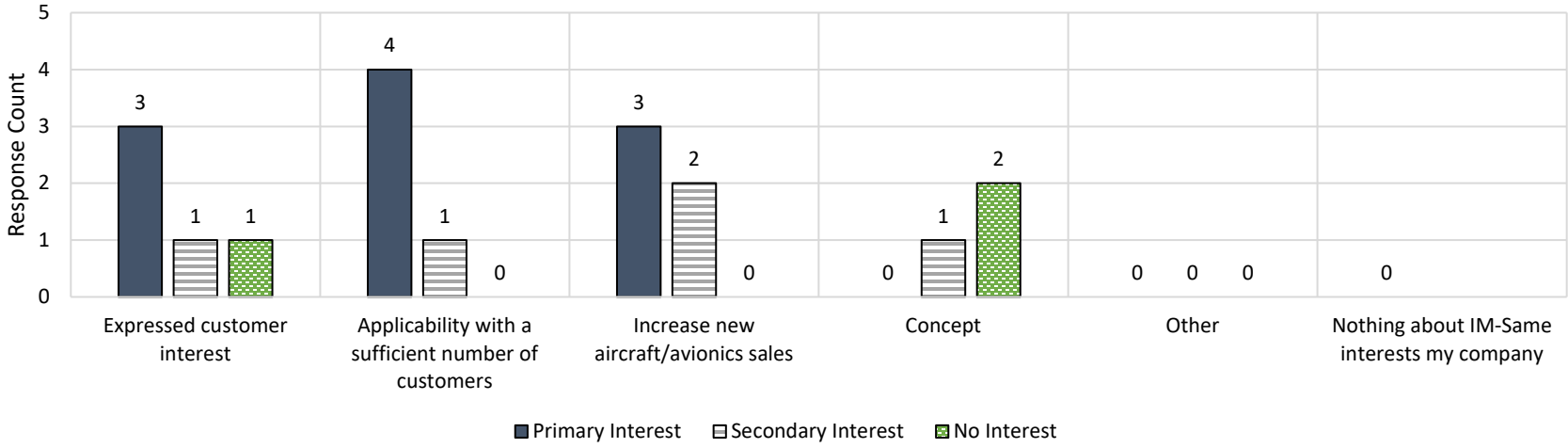


Figure H-5. Responses to "What is it about FIM - Same Corner Post Arrivals that interests your company?"

QH.7.OEM Comments

- None

QH.8. What is it about FIM - Same Corner Post Arrivals that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	1	20%	2	40%
Cost	3	60%	0	0%	1	20%
Insufficient customer interest	3	60%	0	0%	1	20%
Concept complexity	1	20%	1	20%	2	40%
Necessary procedural changes	3	60%	1	20%	0	0%
Necessary controller automation	3	60%	1	20%	0	0%
Other	1	20%	0	0%	0	0%
No concerns	0					
N	5					

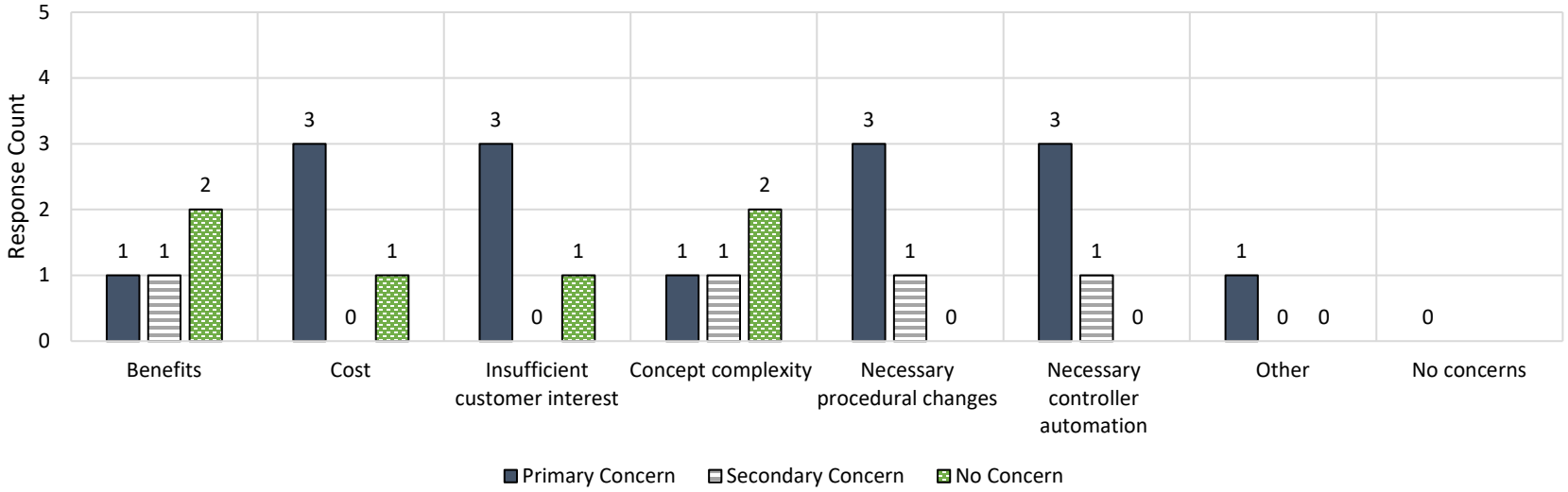


Figure H-6. Responses to "What is it about FIM - Same Corner Post Arrivals that concerns your company?"

QH.8.OEM Comments

- Ability to deploy non DO-361A solution

QH.9. If your company is interested in FIM - Same Corner Post Arrivals, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	4	80%	0	0%	0	0%
FAA Investment decision to proceed with FIM Phase 2	1	20%	1	20%	2	40%
FAA investment decision to proceed with FIM Phase 3	1	20%	0	0%	3	60%
FAA Automation enhancements and corresponding procedures deployed	3	60%	0	0%	1	20%
Implementation of a two-rate Ground Delay Program (GDP)*	2	40%	0	0%	1	20%
Industry and FAA agreement on an application adoption timeline	1	20%	3	60%	0	0%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	1	20%	0	0%	2	40%
Sufficient customer commitment	3	60%	1	20%	0	0%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	1	20%				
N	5					

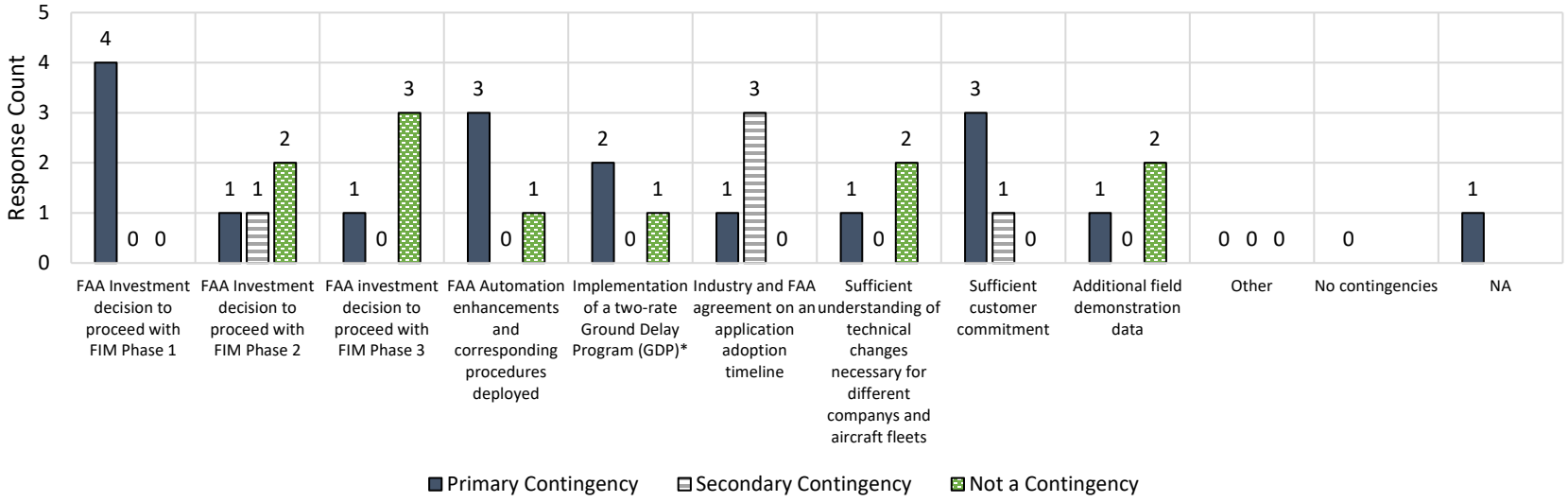


Figure H-7. Responses to "If your company is interested in FIM - Same Corner Post Arrivals, are there contingencies on an investment?"

QH.9.OEM Comments

- assuming Phase 1 for same corner approach / Phase 2 DCCR/DSA/multiple corner approach / Phase 3 paired approach

QH.10. If your company is interested but not willing to commit to an investment in FIM - Same Corner Post Arrivals, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	1	20%	2	40%
Insufficient understanding of the ADS-B In application benefits	2	40%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	1	20%	0	0%	2	40%
Insufficient funds	2	40%	1	20%	0	0%
Lack of benefits data	1	20%	1	20%	1	20%
Lack of field demonstration data	1	20%	1	20%	1	20%
Unclear interest from customers	2	40%	2	40%	0	0%
Unclear FAA commitments on automation investments	2	40%	2	40%	0	0%
Unclear FAA commitments on necessary procedural changes	1	20%	3	60%	0	0%
Lack of information on avionics installation requirements	1	20%	0	0%	2	40%
Pilot acceptability issues	0	0%	2	40%	1	20%
Controller acceptability issues	0	0%	2	40%	1	20%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	1	20%				
N	5					

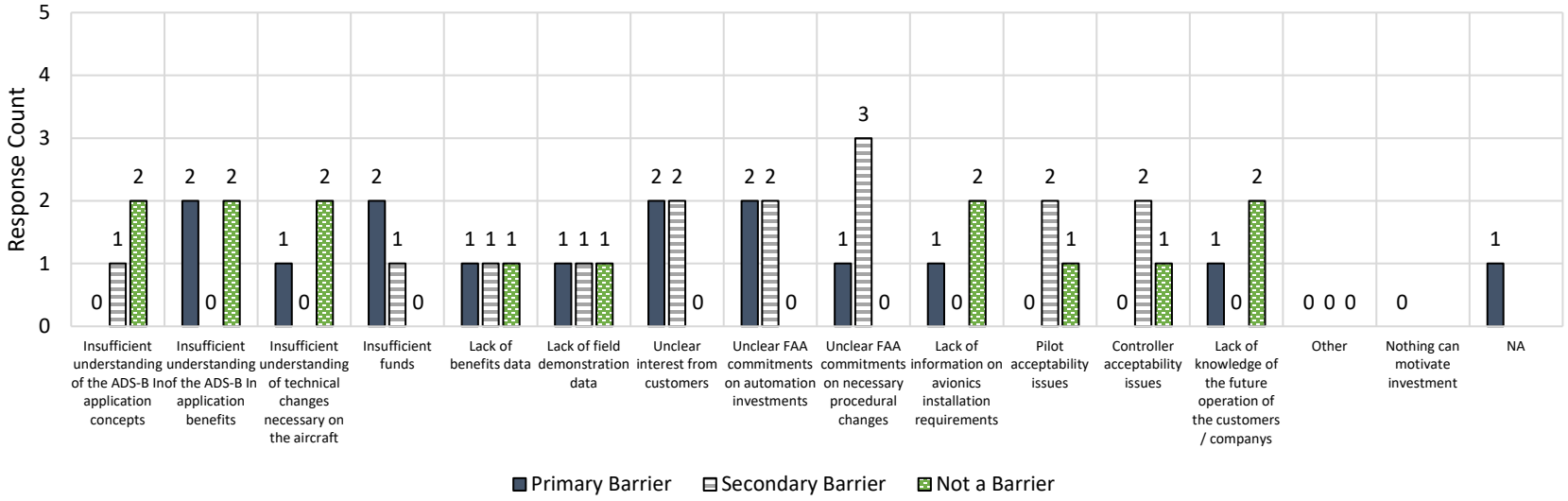


Figure H-8. Responses to "If your company is interested but not willing to commit to an investment in FIM - Same Corner Post Arrivals, what barriers could be removed to incentivize your company to invest?"

QH.10.OEM Comments

- possible pilot acceptability concern in case of manual selection of IM speeds in dense TMA.
- Interval Management application supporting Same Corner Post Arrival operations is available now via STC.

QH.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - Same Corner Post Arrivals.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	1	25%
Strongly Agree	3	75%
NA	1	
N	5	
Total Agreement	4	100%
Total Disagreement	0	0%

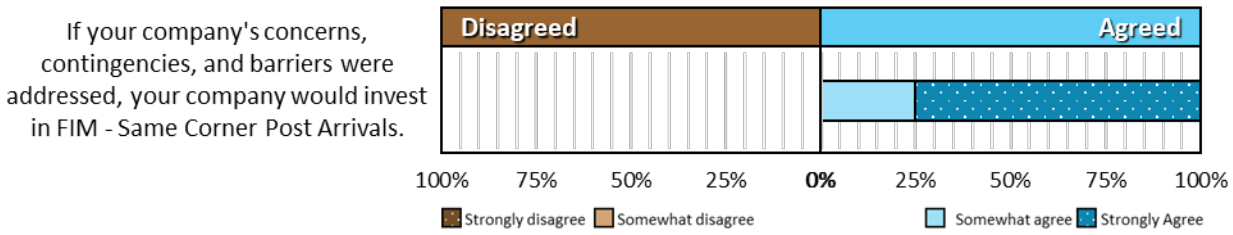


Figure H-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - Same Corner Post Arrivals."

QH.11.OEM Comments

- None

QH.12. When would your company expect to offer FIM - Same Corner Post Arrivals?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	1	25%
In a later offering of avionics providing ADS-B In applications	2	50%
Other	1	25%
Never	0	0%
NA	1	
N	5	

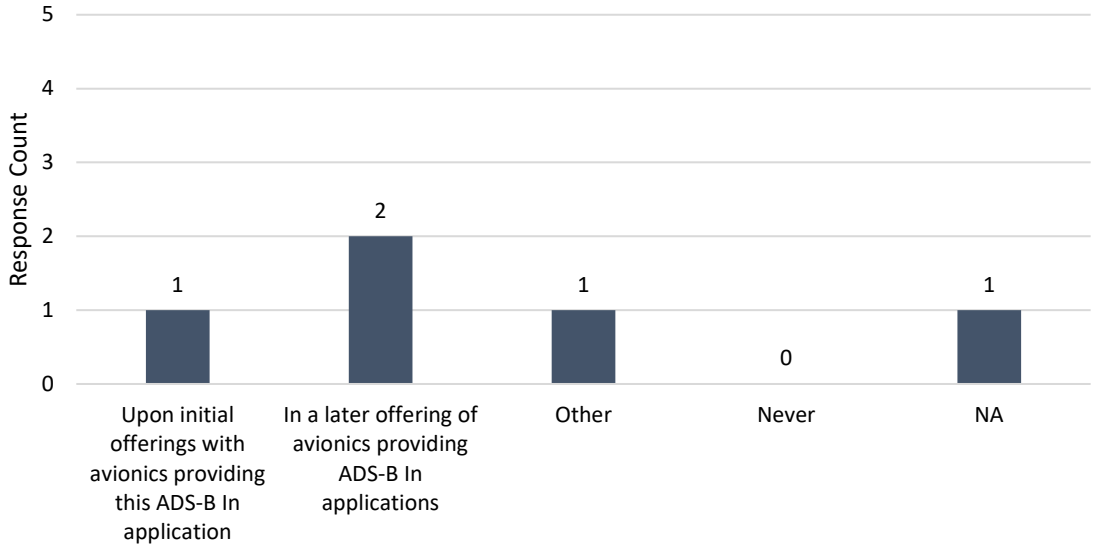


Figure H-10. Responses to "When would your company expect to offer FIM – Same Corner Post Arrivals?"

QH.12.OEM Comments

- Interval Management application supporting Same Corner Post
- Market demand will drive offerability.

QH.13. If your company decides to offer FIM - Same Corner Post Arrivals, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	1
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	1	2	1
Gen 0: Most recent TCAS / ADS-B In product offering	1	0	4	0
Gen +1: At least one ADS-B Application would require a new product offering	1	2	2	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	1	1	1	0

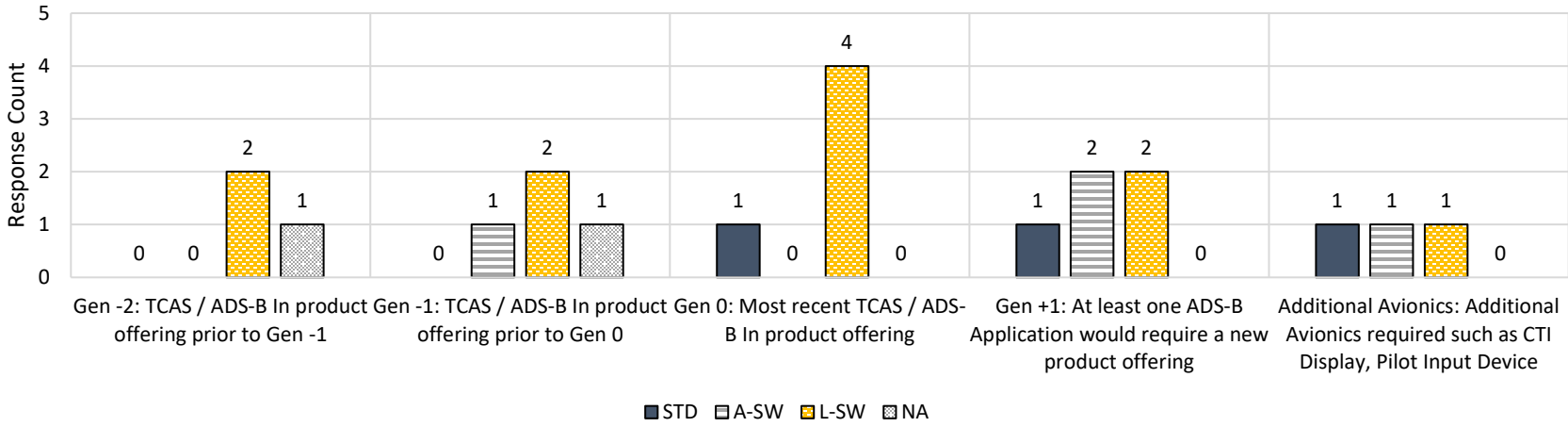


Figure H-11. Responses to "If your company decides to offer FIM - Same Corner Post Arrivals, how do you plan to offer the ADS-B In application avionics capabilities?"

QH14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - Same Corner Post Arrivals?

- "For Gen 0, -1, -2: Additional trajectory generator algorithm for track to follow and speed control algorithm to be hosted in non TCAS hardware.

  Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

  [OEM] would likely agree to start FIM product development and certification to achieve an entry into service date to align with the initial FAA ground system deployment for this application if: (1) The FAA makes a positive investment decision for development of FIM ground infrastructure and operational procedures, and (2) The FAA or airlines provide development funding offsets to mitigate against the risk that market demand for the product doesn't develop. Otherwise, [OEM] is likely to await FAA ground infrastructure and operational procedure deployment and sufficient market demand before committing to product development and certification."

Flight-deck Based Interval Management (FIM) – IM.308

QI.3. Does your company currently offer FIM - IM.308?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	5	100%
Missing	0	
N	5	

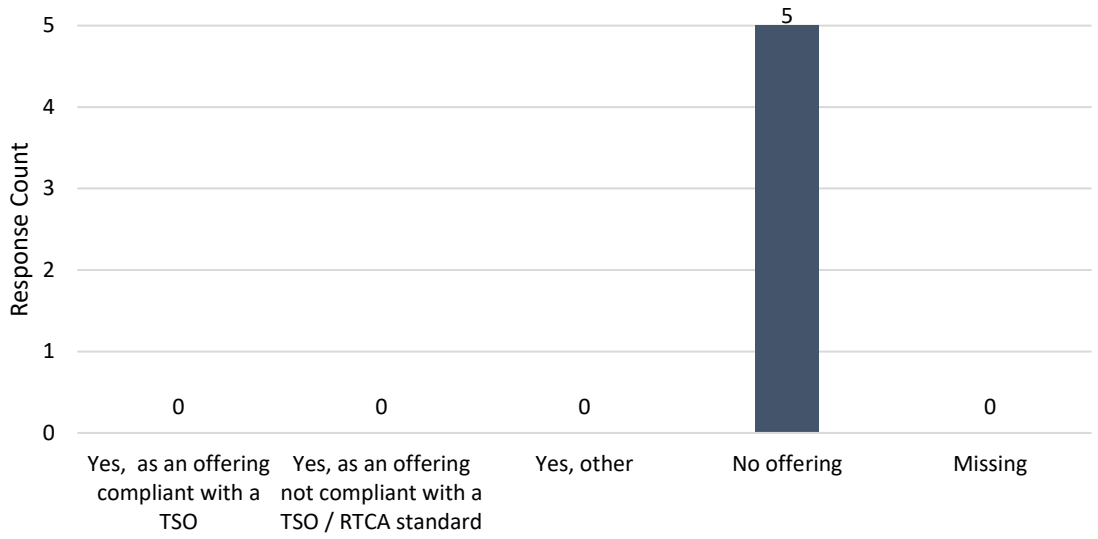


Figure I-1. Responses to "Does your company currently offer FIM - IM.308?"

QI.3.OEM Comments

- None

QI.4. My company is interested in offering FIM - IM.308.

	Count	Percentage
Strongly Disagree	1	20%
Somewhat Disagree	0	0%
Neither	1	20%
Somewhat Agree	1	20%
Strongly Agree	2	40%
N	5	
Total Agreement	3	60%
Total Disagreement	1	20%

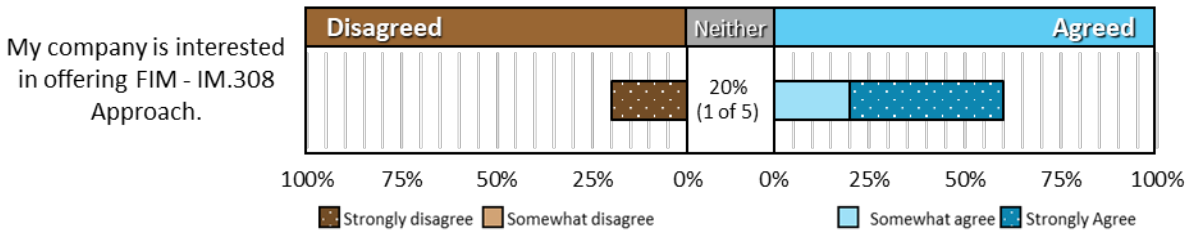


Figure I-2. Responses to "My company is interested in offering FIM - IM.308."

QI.4.OEM Comments

- None

QI.5. Rate your company's priority for FIM - IM.308 amongst the set of ADS-B In applications

	Count	Percentage
Low	2	40%
Medium	1	20%
High	2	40%
Missing	0	
N	5	

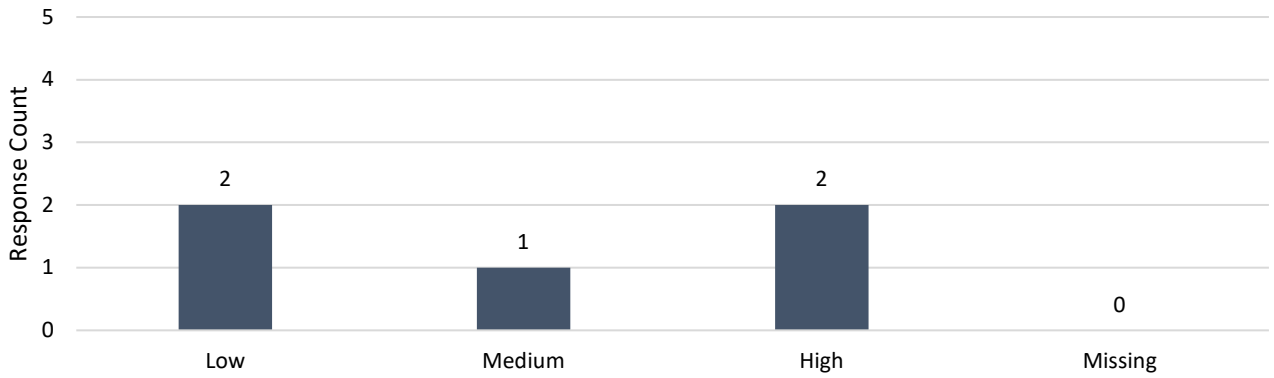


Figure I-3. Rate your company's priority for FIM - IM.308 amongst the set of ADS-B In applications

QI.5.OEM Comments

- None

QI.6. If your company decides to offer FIM - IM.308, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	1	33%
5 - 10 years	1	33%
10 - 15 years	0	0%
> 15 years	0	0%
NA	1	33%
Missing	2	
N	3	

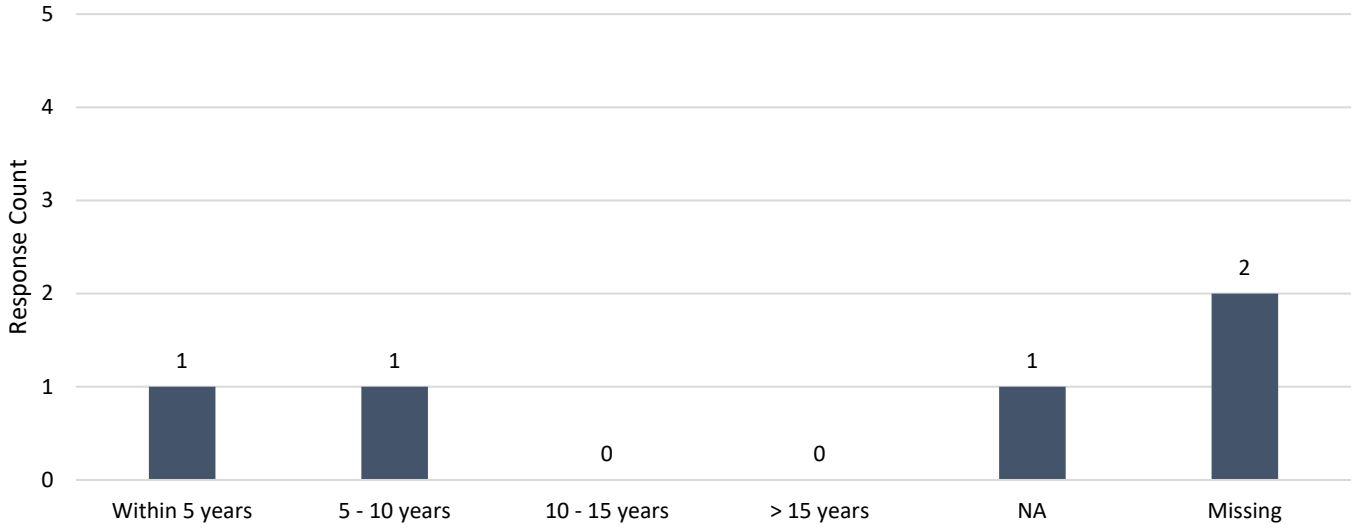


Figure I-4. Responses to " If your company decides to offer FIM - IM.308, in what timeframe do you expect to offer it?"

QI.6.OEM Comments

- Offering would be dependent on available MOPS and business case with operator.
- IM.308 seems to be more of an extension from CAVS than from Interval Management. There has been some market interest in IM.308 and my company is evaluating options.

QI.7. What is it about FIM - IM.308 that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	3	60%	1	20%	0	0%
Applicability with a sufficient number of customers	2	40%	1	20%	1	20%
Increase new aircraft/avionics sales	2	40%	2	40%	0	0%
Concept	0	0%	1	20%	2	40%
Other	0	0%	0	0%	0	0%
Nothing about FIM - IM.308 interests my company	0	0%				
N	5					

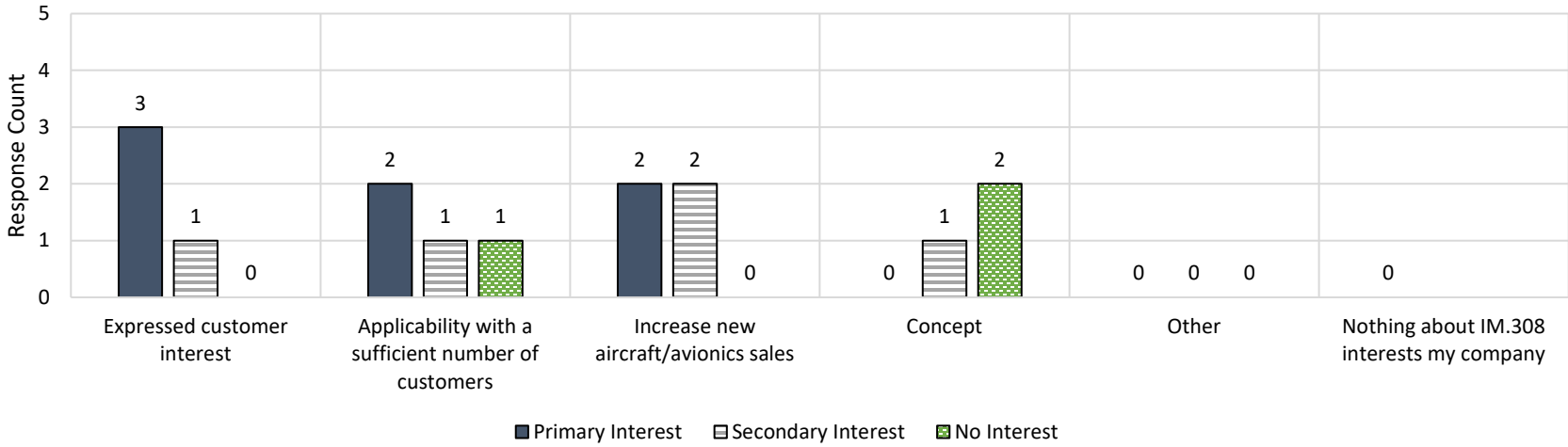


Figure I-5. Responses to "What is it about FIM - IM.308 that interests your company?"

QI.7.OEM Comments

- None

QI.8. What is it about FIM - IM.308 that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	1	20%	1	20%
Cost	2	40%	0	0%	1	20%
Insufficient customer interest	2	40%	0	0%	1	20%
Concept complexity	1	20%	1	20%	2	40%
Necessary procedural changes	3	60%	1	20%	0	0%
Necessary controller automation	3	60%	1	20%	0	0%
Other	0	0%	0	0%	0	0%
No concerns	0					
N	5					

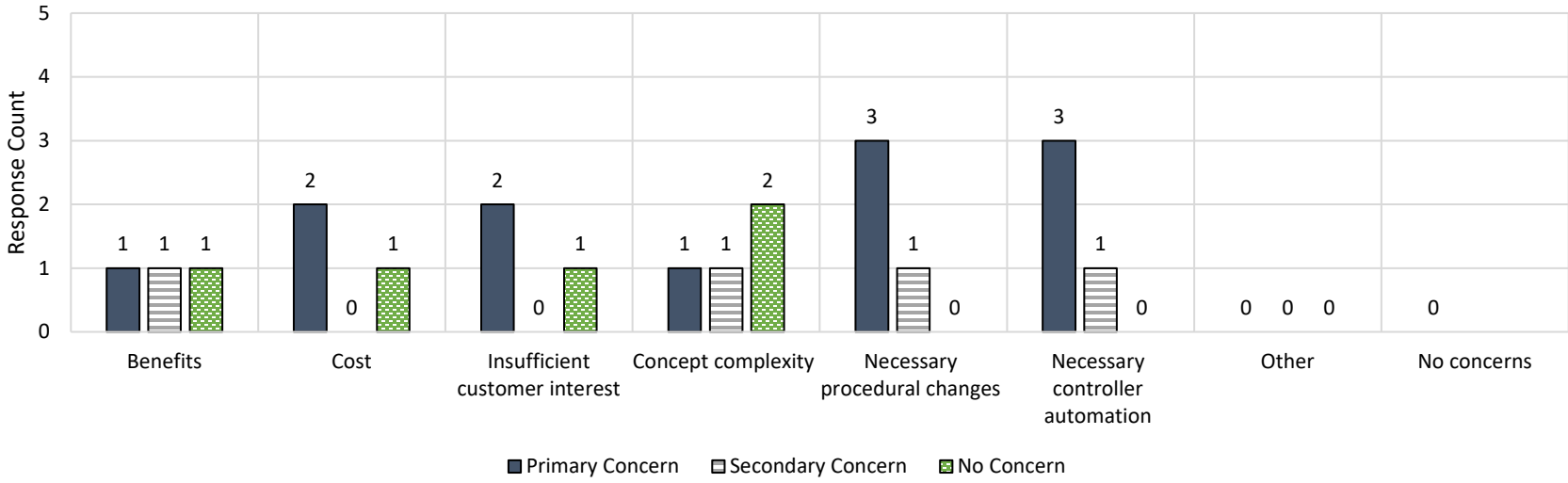


Figure I-6. Responses to "What is it about FIM - IM.308 that concerns your company?"

QI.8.OEM Comments

- None

QI.9. If your company is interested in FIM - IM.308, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	4	80%	0	0%	0	0%
FAA Investment decision to proceed with FIM Phase 2	2	40%	1	20%	1	20%
FAA investment decision to proceed with FIM Phase 3	0	0%	0	0%	3	60%
FAA Automation enhancements and corresponding procedures deployed	3	60%	0	0%	1	20%
Implementation of a two-rate Ground Delay Program (GDP)*	2	40%	0	0%	1	20%
Industry and FAA agreement on an application adoption timeline	1	20%	3	60%	0	0%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	1	20%	2	40%	1	20%
Sufficient customer commitment	2	40%	2	40%	0	0%
Additional field demonstration data	1	20%	1	20%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	0	0%				
N	5					

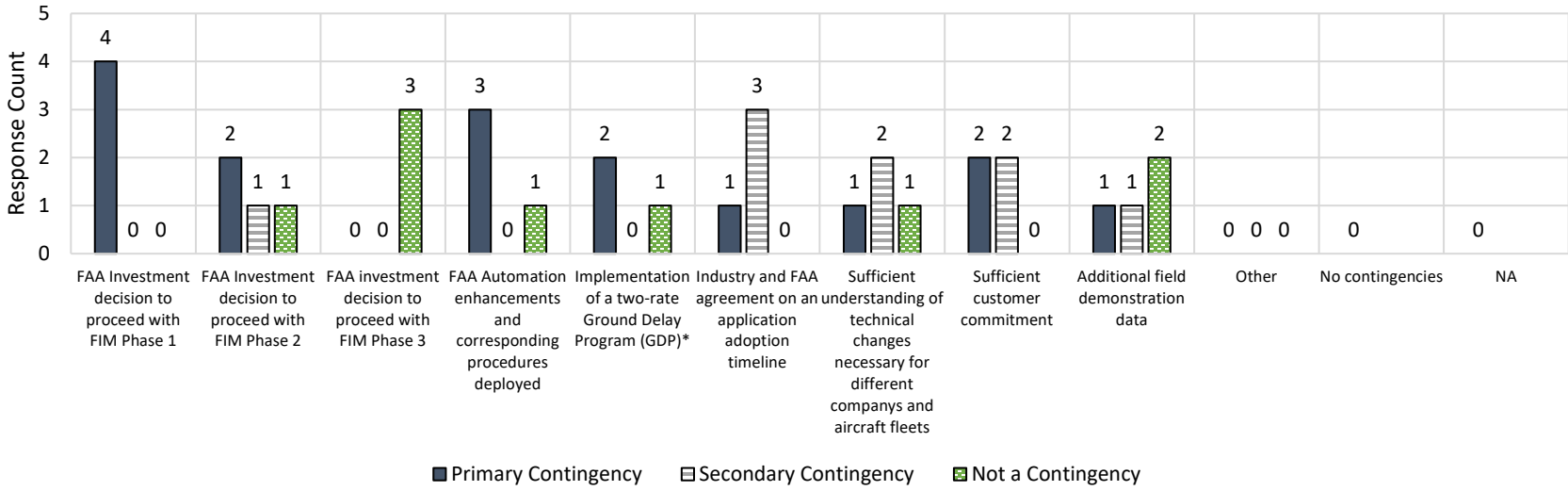


Figure I-7. Responses to "If your company is interested in FIM - IM.308, are there contingencies on an investment?"

QI.9.OEM Comments

- None

QI.10. If your company is interested but not willing to commit to an investment in FIM - IM.308, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	1	20%	0	0%	2	40%
Insufficient understanding of the ADS-B In application benefits	1	20%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	1	20%	0	0%	2	40%
Insufficient funds	2	40%	1	20%	0	0%
Lack of benefits data	1	20%	1	20%	1	20%
Lack of field demonstration data	1	20%	1	20%	1	20%
Unclear interest from customers	2	40%	1	20%	0	0%
Unclear FAA commitments on automation investments	2	40%	1	20%	0	0%
Unclear FAA commitments on necessary procedural changes	2	40%	1	20%	0	0%
Lack of information on avionics installation requirements	1	20%	0	0%	2	40%
Pilot acceptability issues	1	20%	1	20%	1	20%
Controller acceptability issues	1	20%	1	20%	1	20%
Lack of knowledge of the future operation of the customers / companies	0	0%	0	0%	2	40%
Other	1	20%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	0	0%				
N	5					

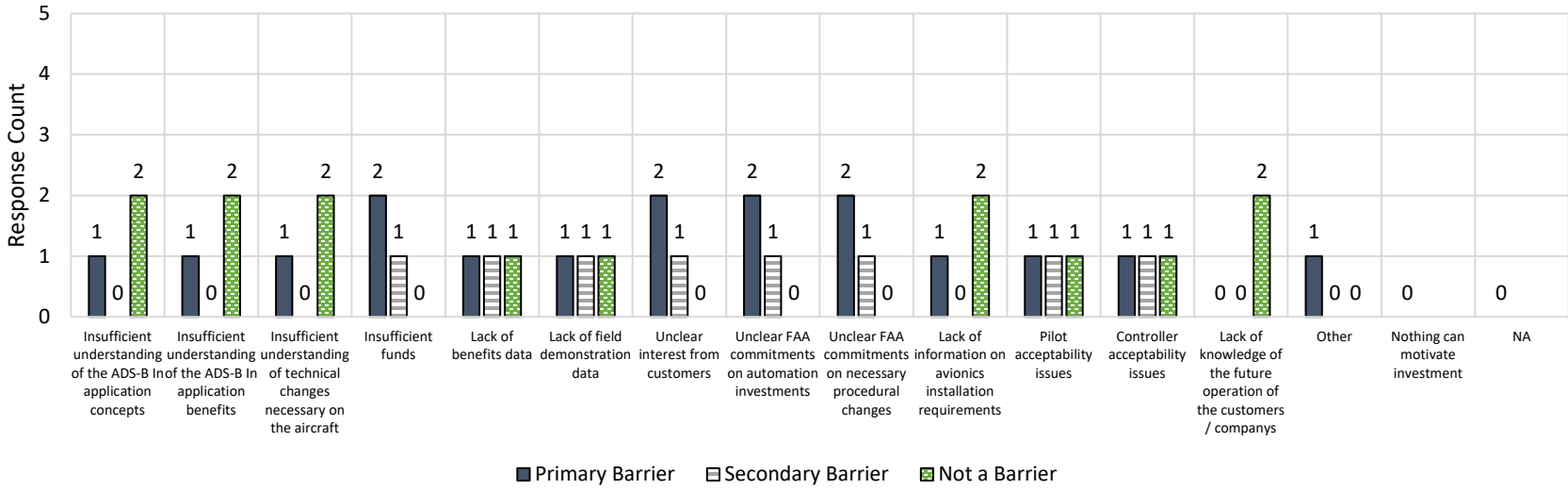


Figure I-8. Responses to "If your company is interested but not willing to commit to an investment in FIM - IM.308, what barriers could be removed to incentivize your company to invest?"

QI.10.OEM Comments

- Business case with interested customer

QI.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - IM.308.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	25%
Somewhat Agree	1	25%
Strongly Agree	2	50%
NA	0	
N	4	
Total Agreement	3	75%
Total Disagreement	0	0%

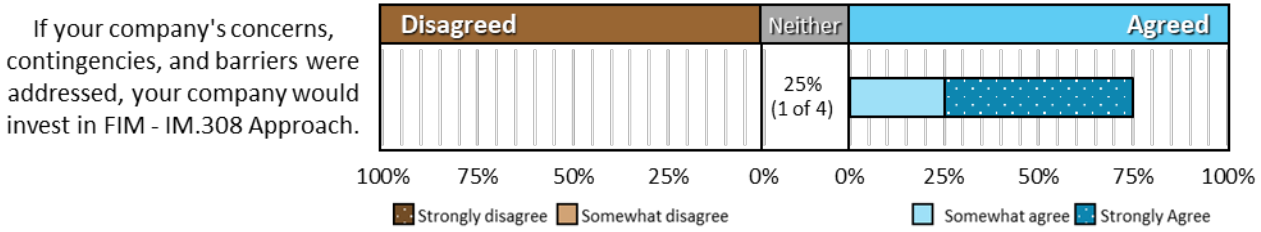


Figure I-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - IM.308."

QI.11.OEM Comments

- None

QI.12. When would your company expect to offer FIM - IM.308?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	2	40%
Other	2	40%
Never	1	20%
NA	0	
N	5	

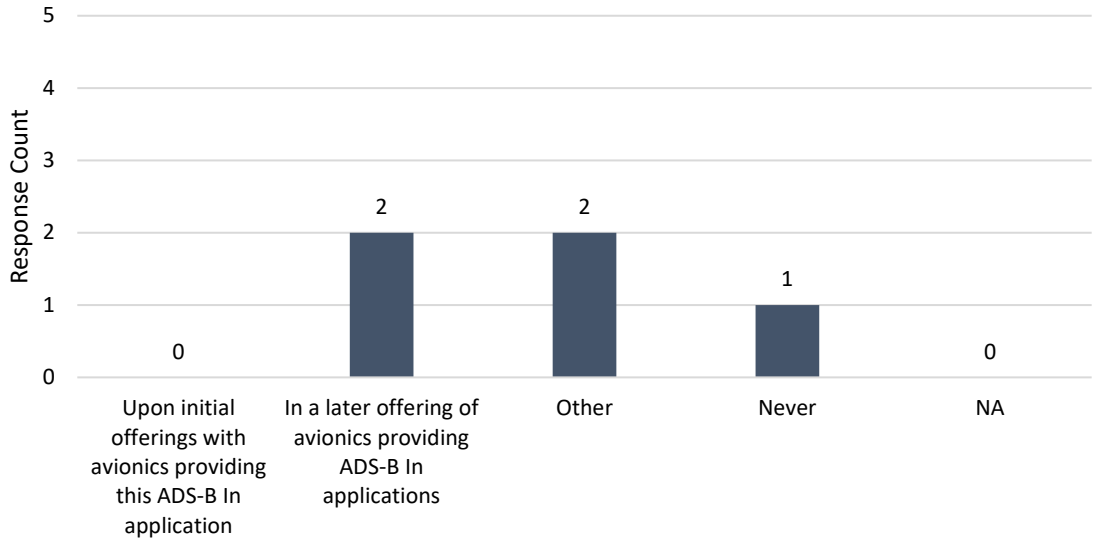


Figure I-10. Responses to "When would your company expect to offer FIM – IM.308?"

QI.12.OEM Comments

- Market demand will drive offerability
- Depends on concept convergence

QI.13. If your company decides to offer FIM - IM.308, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	1
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	0	3	1
Gen 0: Most recent TCAS / ADS-B In product offering	1	0	2	1
Gen +1: At least one ADS-B Application would require a new product offering	1	1	1	1
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	1	1	0	1

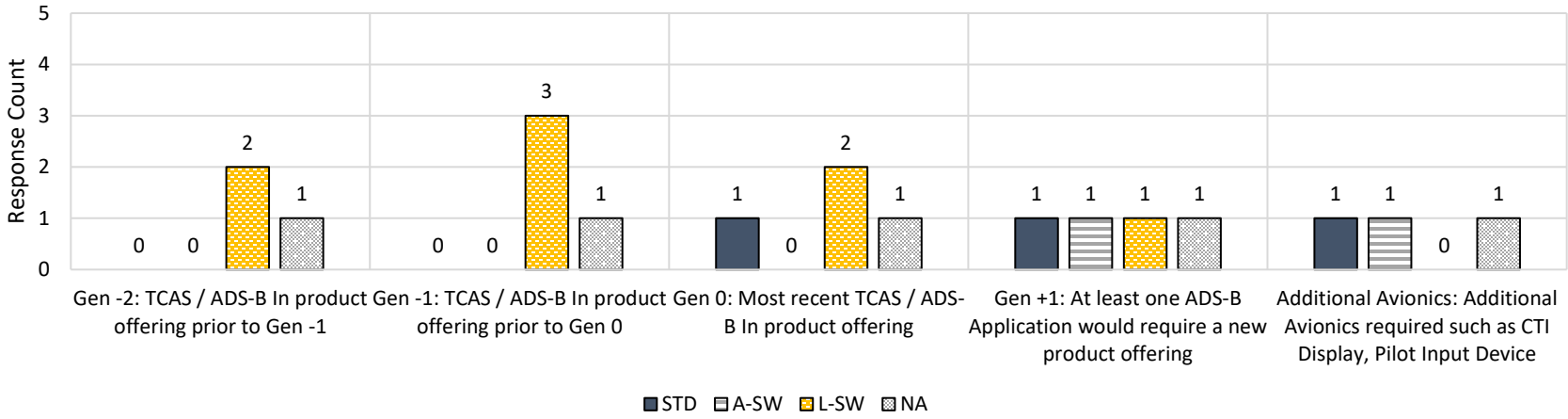


Figure I-11. Responses to "If your company decides to offer FIM - IM.308, how do you plan to offer the ADS-B In application avionics capabilities?"

QI14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - IM.308?

- "For Gen 0, -1, -2: Additional trajectory generator algorithm for track to follow and speed control algorithm to be hosted in non TCAS hardware.

  Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

  [OEM] would likely agree to start FIM product development and certification to achieve an entry into service date to align with the initial FAA ground system deployment for this application if: (1) The FAA makes a positive investment decision for development of FIM ground infrastructure and operational procedures, and (2) The FAA or airlines provide development funding offsets to mitigate against the risk that market demand for the product doesn't develop. Otherwise, [OEM] is likely to await FAA ground infrastructure and operational procedure deployment and sufficient market demand before committing to product development and certification."

Flight-deck Based Interval Management (FIM) – Multiple Corner Post Arrivals

QJ.3. Does your company currently offer FIM - Multiple Corner Post Arrivals?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	5	100%
Missing	0	
N	5	

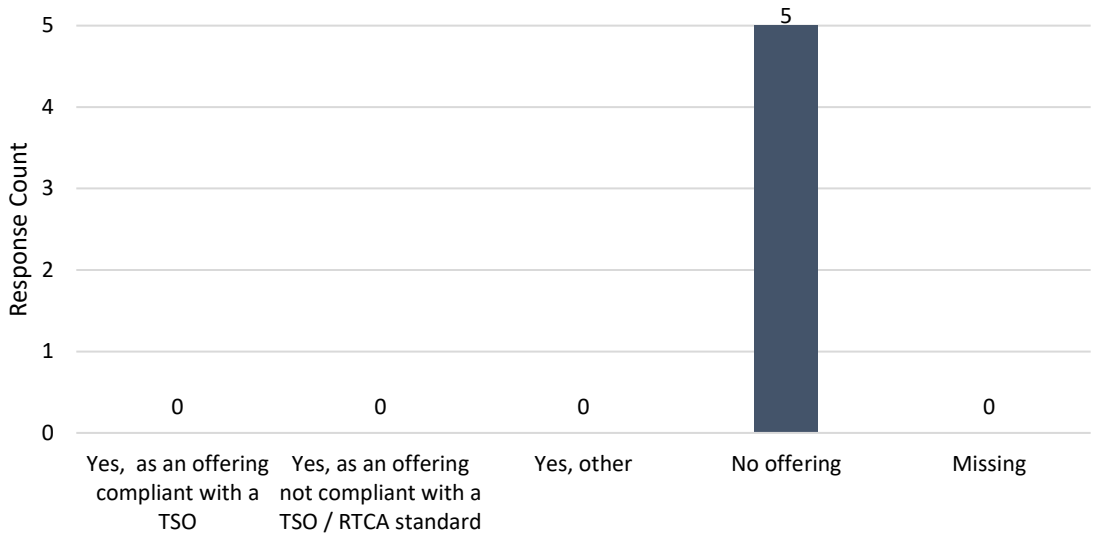


Figure J-1. Responses to "Does your company currently offer FIM - Multiple Corner Post Arrivals?"

QJ.3.OEM Comments

- None

QJ.4. My company is interested in offering FIM - Multiple Corner Post Arrivals.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	1	20%
Neither	0	0%
Somewhat Agree	1	20%
Strongly Agree	3	60%
N	5	
Total Agreement	4	80%
Total Disagreement	1	20%

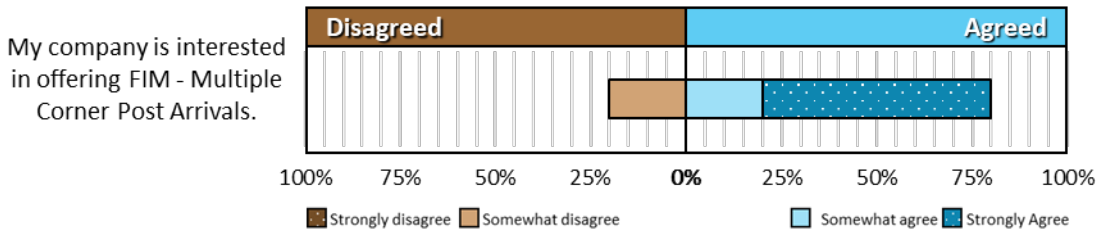


Figure J-2. Responses to "My company is interested in offering FIM - Multiple Corner Post Arrivals."

QJ.4.OEM Comments

- The avionics equipment for IM will provide this capability.

QJ.5. Rate your company's priority for FIM - Multiple Corner Post Arrivals amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	3	60%
High	2	40%
Missing	0	
N	5	

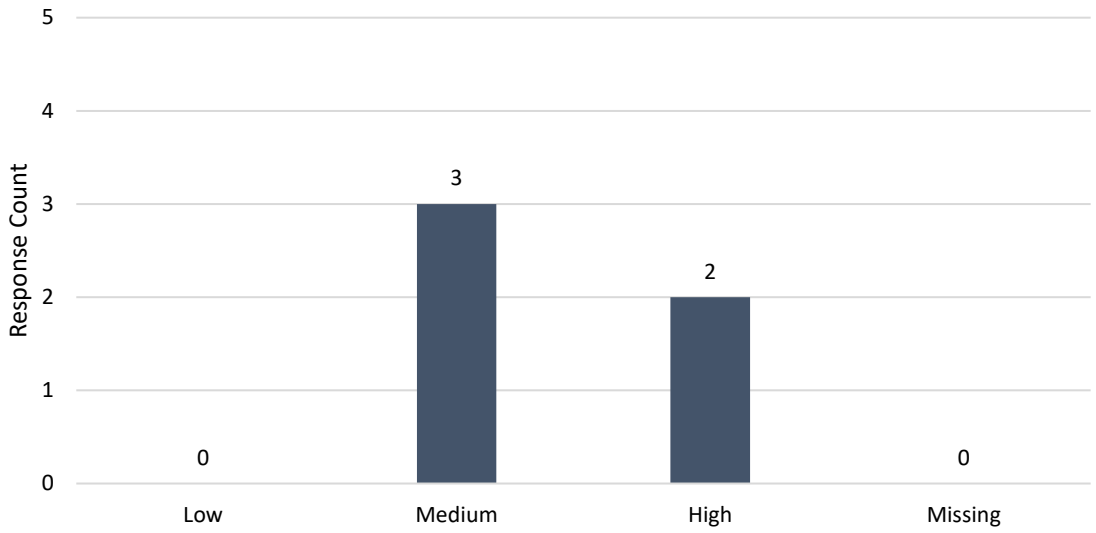


Figure J-3. Rate your company's priority for FIM - Multiple Corner Post Arrivals amongst the set of ADS-B In applications

QJ.5.OEM Comments

- FIM avionics product for Multiple Corner approach assessed as not technically realistic considering its complexity and the impacts on the avionics architectures currently installed on Air Transport aircraft. Indeed this application adds navigation functionalities in the Surveillance equipment for the purpose of estimating the target's 4D trajectory. Similar functionalities already exist in current FMS but for the ownship 4D trajectory predictions and they can be fairly accurate owing to the FMS knowledge of ownship weight, selected Cost Index, energy management, turn anticipation control law. All these information [sic] will be missing from the target and should result in a very un-accurate [sic] estimation of its 4D trajectory. The accuracy of aircraft 4D predictions is still a challenge in the ATC ground systems and to the extend [sic] we understand this concept, it pushes this challenge to the airborne segment
- Offering would be dependent on available MOPS and business case with operator.

QJ.6. If your company decides to offer FIM - Multiple Corner Post Arrivals, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	0	0%
5 - 10 years	2	50%
10 - 15 years	1	25%
> 15 years	0	0%
NA	1	25%
Missing	0	
N	4	

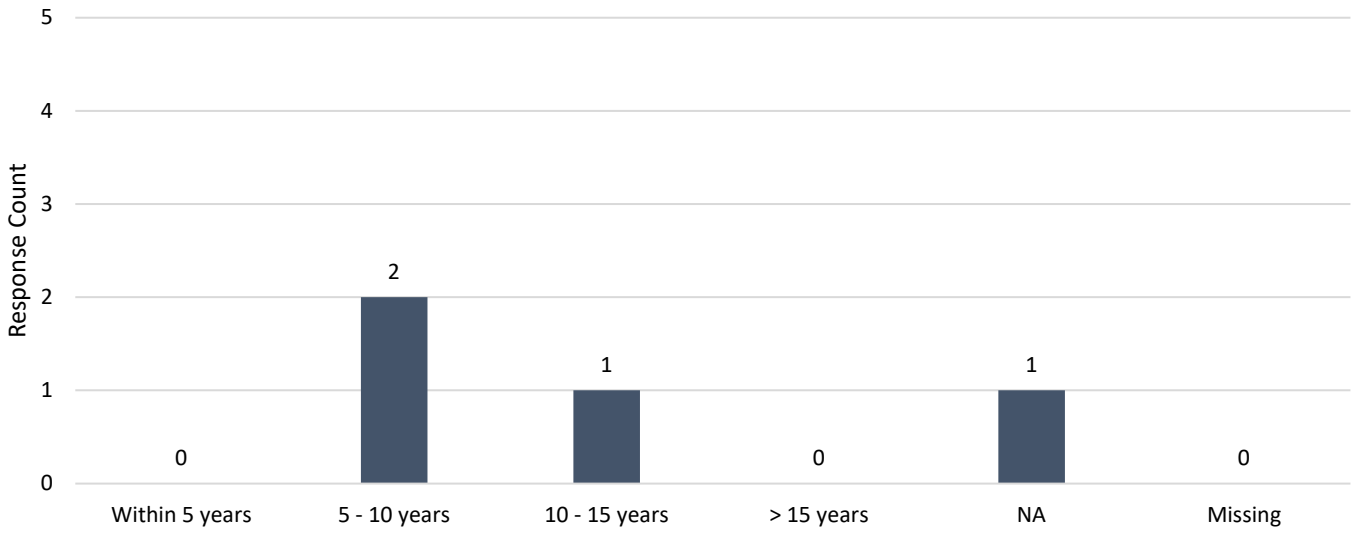


Figure J-4. Responses to " If your company decides to offer FIM - Multiple Corner Post Arrivals, in what timeframe do you expect to offer it?"

QJ.6.OEM Comments

- None

QJ.7. What is it about FIM - Multiple Corner Post Arrivals that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	2	40%	1	20%	1	20%
Applicability with a sufficient number of customers	2	40%	1	20%	1	20%
Increase new aircraft/avionics sales	3	60%	2	40%	0	0%
Concept	0	0%	1	20%	2	40%
Other	0	0%	0	0%	0	0%
Nothing about FIM - Multiple Corner Post Arrivals interests my company	0	0%				
N	5					

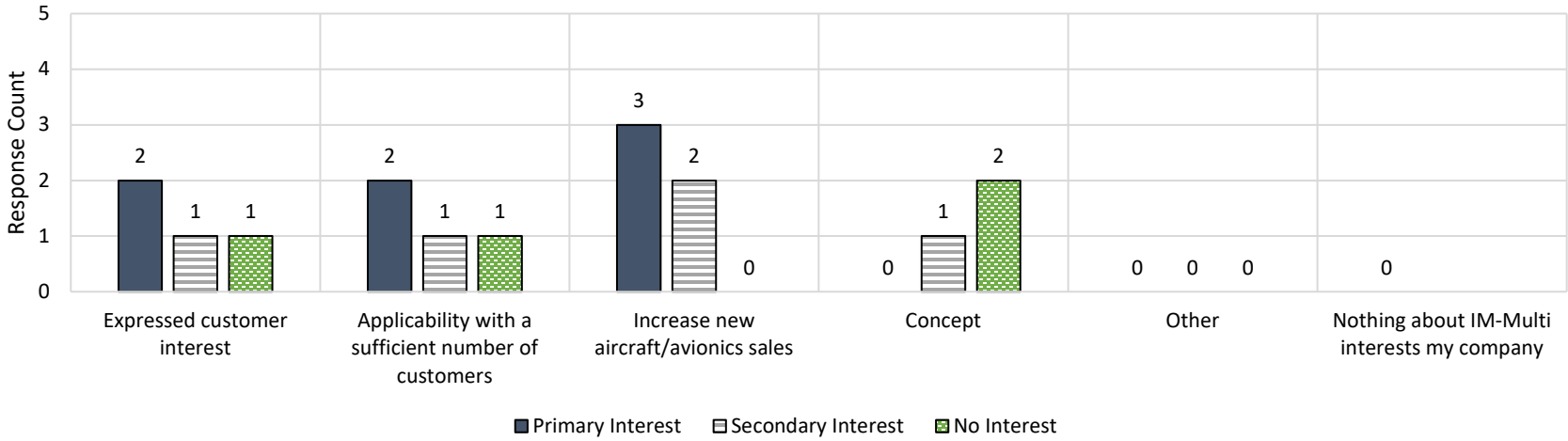


Figure J-5. Responses to "What is it about FIM - Multiple Corner Post Arrivals that interests your company?"

QJ.7.OEM Comments

- interest in the concept but on a different implementation/solution

QJ.8. What is it about FIM - Multiple Corner Post Arrivals that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	2	40%	2	40%
Cost	3	60%	2	40%	0	0%
Insufficient customer interest	3	60%	2	40%	0	0%
Concept complexity	3	60%	0	0%	2	40%
Necessary procedural changes	4	80%	1	20%	0	0%
Necessary controller automation	3	60%	2	40%	0	0%
Other	0	0%	0	0%	0	0%
No concerns	0					
N	5					

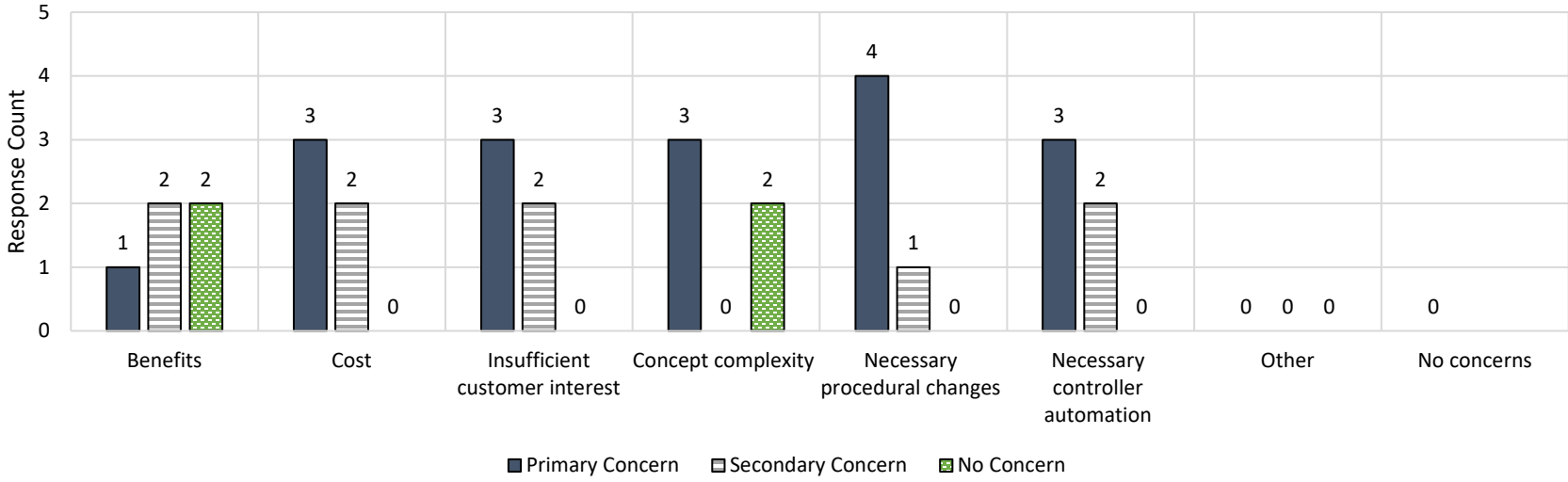


Figure J-6. Responses to "What is it about FIM - Multiple Corner Post Arrivals that concerns your company?"

QJ.8.OEM Comments

- None

QJ.9. If your company is interested in FIM - Multiple Corner Post Arrivals, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	4	80%	0	0%	1	20%
FAA Investment decision to proceed with FIM Phase 2	5	100%	0	0%	0	0%
FAA investment decision to proceed with FIM Phase 3	2	40%	1	20%	2	40%
FAA Automation enhancements and corresponding procedures deployed	4	80%	1	20%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)*	2	40%	1	20%	1	20%
Industry and FAA agreement on an application adoption timeline	1	20%	4	80%	0	0%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	2	40%	1	20%	1	20%
Sufficient customer commitment	4	80%	1	20%	0	0%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	0	0%				
N	5					

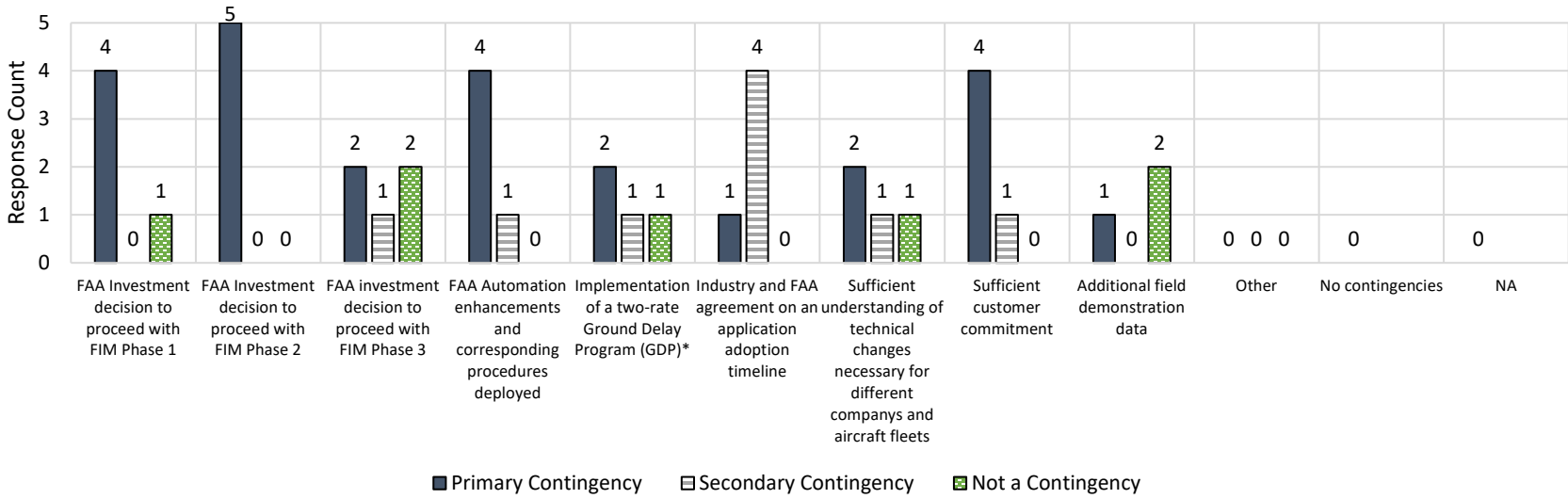


Figure J-7. Responses to "If your company is interested in FIM - Multiple Corner Post Arrivals, are there contingencies on an investment?"

QJ.9.OEM Comments

- None

QJ.10. If your company is interested but not willing to commit to an investment in FIM - Multiple Corner Post Arrivals, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	1	20%	2	40%
Insufficient understanding of the ADS-B In application benefits	2	40%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	1	20%	0	0%	2	40%
Insufficient funds	2	40%	2	40%	0	0%
Lack of benefits data	1	20%	1	20%	1	20%
Lack of field demonstration data	2	40%	1	20%	1	20%
Unclear interest from customers	2	40%	2	40%	0	0%
Unclear FAA commitments on automation investments	2	40%	3	60%	0	0%
Unclear FAA commitments on necessary procedural changes	1	20%	4	80%	0	0%
Lack of information on avionics installation requirements	2	40%	0	0%	2	40%
Pilot acceptability issues	2	40%	2	40%	1	20%
Controller acceptability issues	2	40%	2	40%	1	20%
Lack of knowledge of the future operation of the customers / companies	1	20%	2	40%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	0	0%				
N	5					

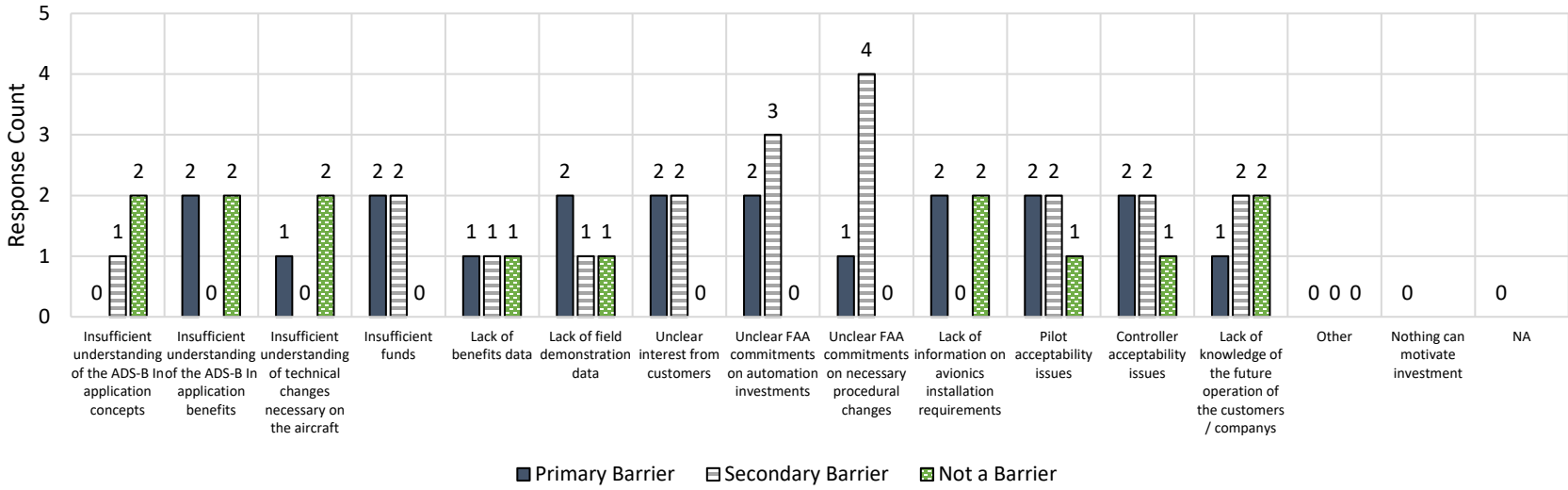


Figure J-8. Responses to "If your company is interested but not willing to commit to an investment in FIM - Multiple Corner Post Arrivals, what barriers could be removed to incentivize your company to invest?"

QJ.10.OEM Comments

- None

QJ.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - Multiple Corner Post Arrivals.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	1	20%
Neither	0	0%
Somewhat Agree	1	20%
Strongly Agree	3	60%
NA	0	
N	5	
Total Agreement	4	80%
Total Disagreement	1	20%

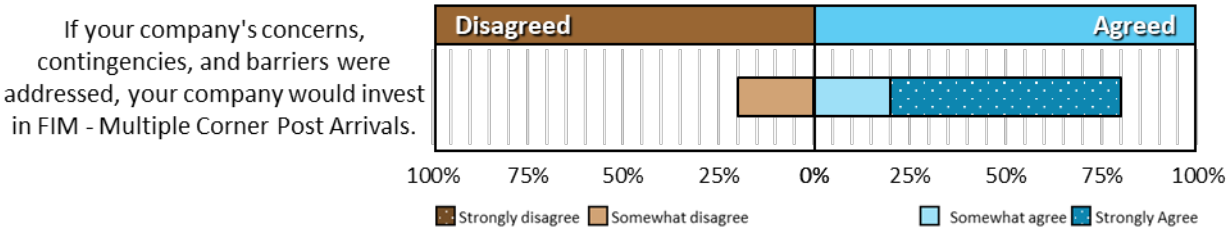


Figure 0-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - Multiple Corner Post Arrivals."

QJ.11.OEM Comments

- None

QJ.12. When would your company expect to offer FIM - Multiple Corner Post Arrivals?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	3	60%
Other	2	40%
Never	0	0%
NA	0	
N	5	

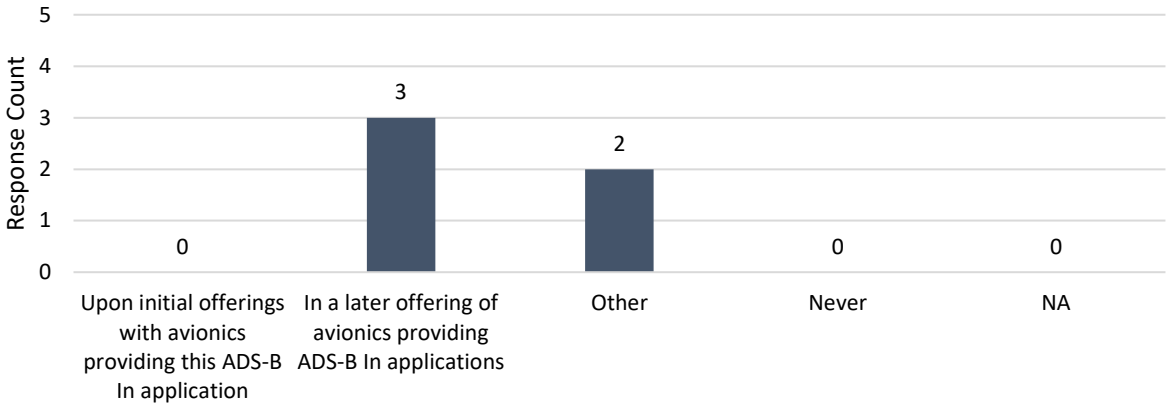


Figure J-10. Responses to "When would your company expect to offer FIM – Multiple Post Arrivals?"

QJ.12.OEM Comments

- Market demand will drive offerability
- depends on concept convergence

QJ.13. If your company decides to offer FIM - Multiple Corner Post Arrivals, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	1
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	0	3	1
Gen 0: Most recent TCAS / ADS-B In product offering	0	0	4	1
Gen +1: At least one ADS-B Application would require a new product offering	0	1	3	1
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	0	1	2	1

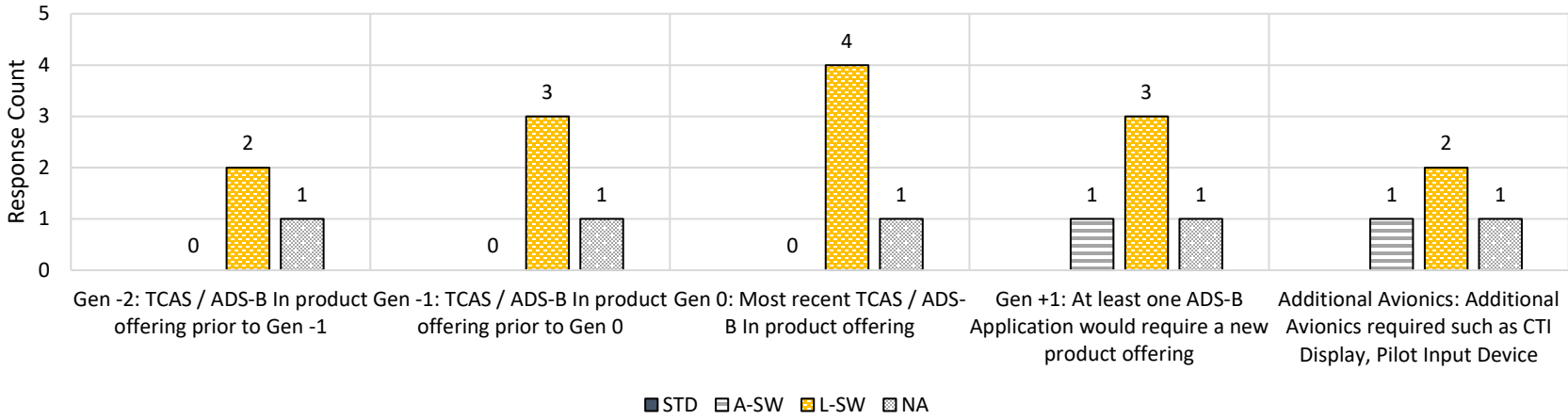


Figure J-11. Responses to "If your company decides to offer FIM - Multiple Corner Post Arrivals, how do you plan to offer the ADS-B In application avionics capabilities?"

QJ14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - Multiple Corner Post Arrivals?

- "For Gen 0, -1, -2: Additional trajectory generator algorithm for track to follow and speed control algorithm to be hosted in non TCAS hardware.

  Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

  [OEM] would likely agree to start FIM product development and certification to achieve an entry into service date to align with the initial FAA ground system deployment for this application if: (1) The FAA makes a positive investment decision for development of FIM ground infrastructure and operational procedures, and (2) The FAA or airlines provide development funding offsets to mitigate against the risk that market demand for the product doesn't develop. Otherwise, [OEM] is likely to await FAA ground infrastructure and operational procedure deployment and sufficient market demand before committing to product development and certification."

Flight-deck-based Interval Management (FIM) – Converging/Crossing Runways (DCCR) Arrival

QK.3. Does your company currently offer FIM - DCCR?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	5	100%
Missing	0	
N	5	

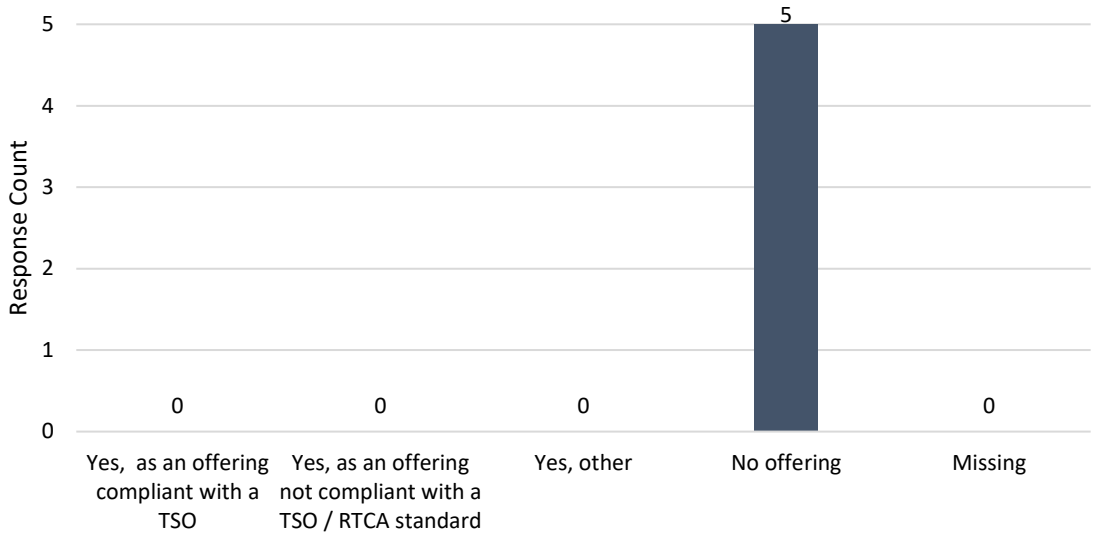


Figure K-1. Responses to "Does your company currently offer FIM - DCCR?"

QK.3.OEM Comments

- None

QK.4. My company is interested in offering FIM - DCCR.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	1	20%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	2	40%
N	5	
Total Agreement	4	80%
Total Disagreement	1	20%

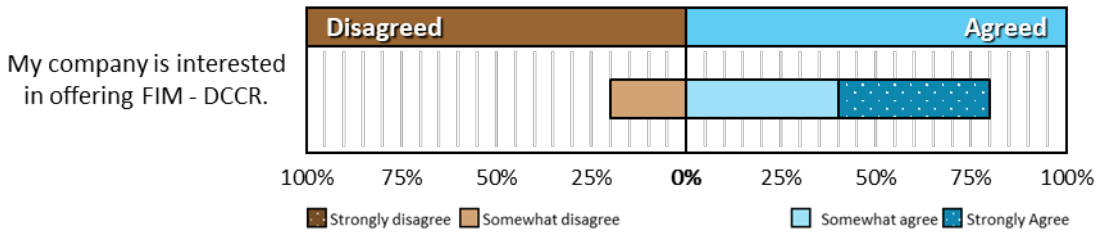


Figure K-2. Responses to "My company is interested in offering FIM - DCCR."

QK.4.OEM Comments

- The avionics equipment for IM will provide this capability.

QK.5. Rate your company's priority for FIM - DCCR amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	3	60%
High	2	40%
Missing	0	
N	5	

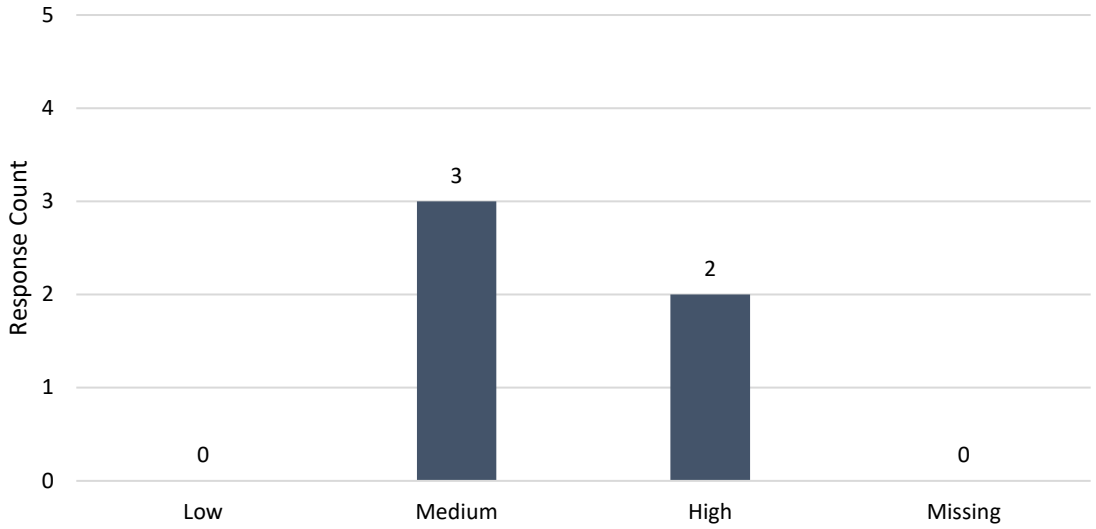


Figure K-3. Rate your company's priority for FIM - DCCR amongst the set of ADS-B In applications

QK.5.OEM Comments

- None

QK.6. If your company decides to offer FIM - DCCR, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	0	0%
5 - 10 years	2	50%
10 - 15 years	1	25%
> 15 years	0	0%
NA	1	25%
Missing	1	
N	4	

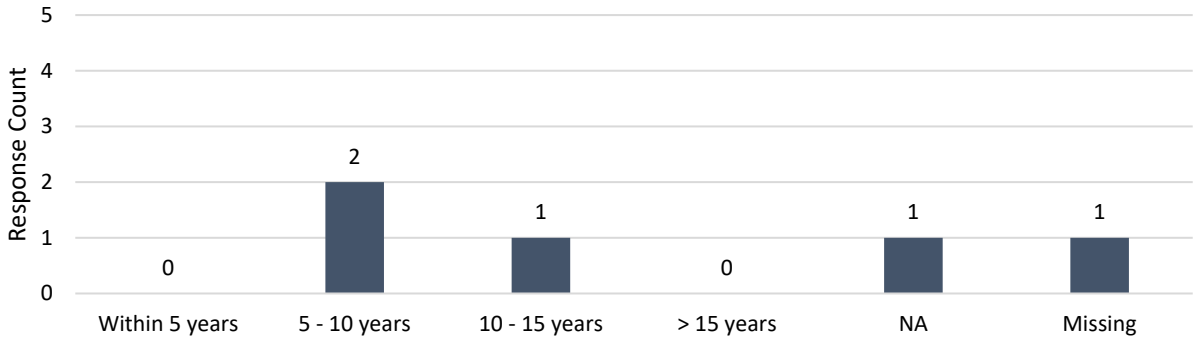


Figure K-4. Responses to " If your company decides to offer FIM - DCCR, in what timeframe do you expect to offer it?"

QK.6.OEM Comments

- Offering would be dependent on available MOPS and business case with operator.

QK.7. What is it about FIM - DCCR that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	2	40%	2	40%	1	20%
Applicability with a sufficient number of customers	2	40%	1	20%	1	20%
Increase new aircraft/avionics sales	2	40%	3	60%	0	0%
Concept	0	0%	1	20%	2	40%
Other	0	0%	0	0%	0	0%
Nothing about FIM - DCCR interests my company	0	0%				
N	5					

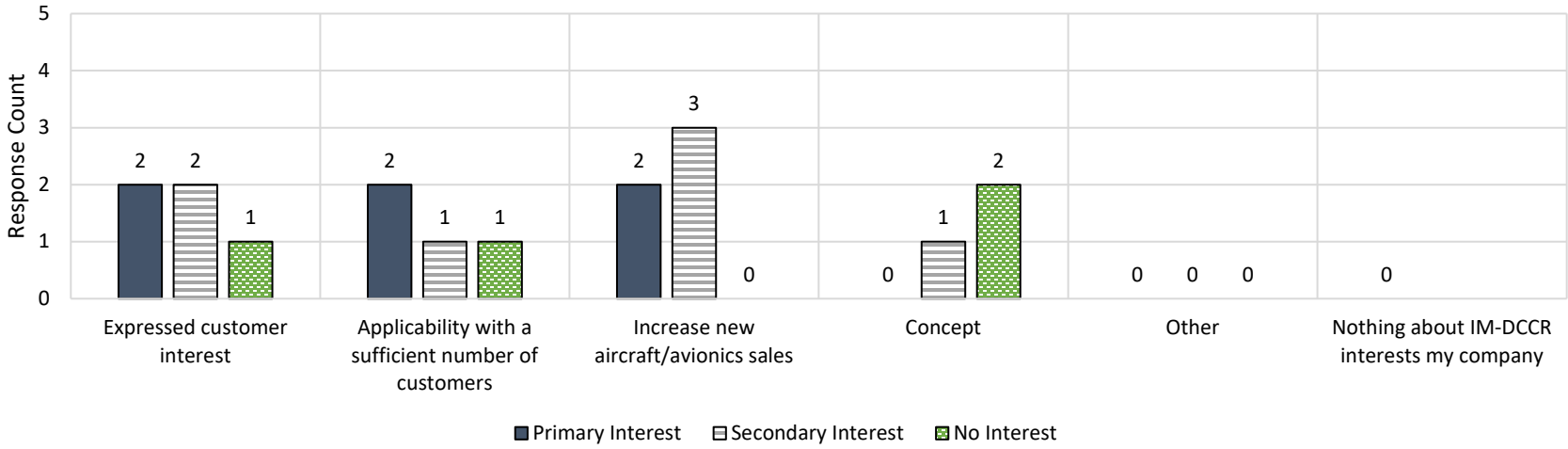


Figure K-5. Responses to "What is it about FIM - DCCR that interests your company?"

QK.7.OEM Comments

- None

QK.8. What is it about FIM - DCCR that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	1	20%	2	40%
Cost	3	60%	1	20%	0	0%
Insufficient customer interest	3	60%	2	40%	0	0%
Concept complexity	3	60%	0	0%	2	40%
Necessary procedural changes	4	80%	1	20%	0	0%
Necessary controller automation	3	60%	2	40%	0	0%
Other	0	0%	0	0%	0	0%
No concerns	0					
N	5					

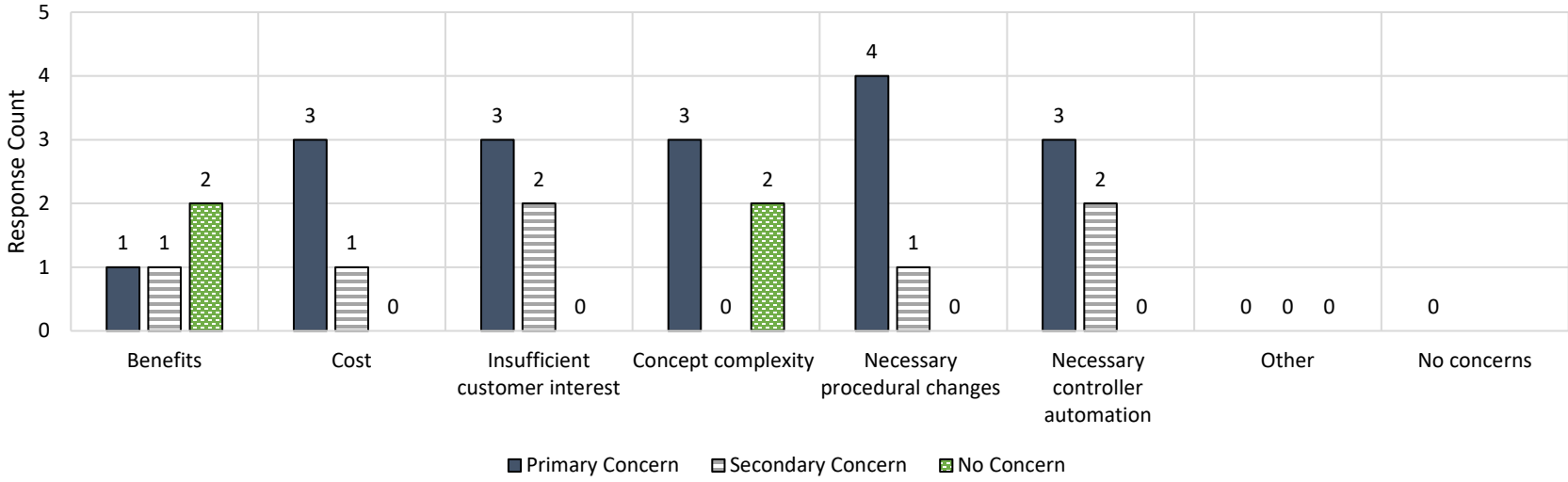


Figure K-6. Responses to "What is it about FIM - DCCR that concerns your company?"

QK.8.OEM Comments

- None

QK.9. If your company is interested in FIM - DCCR, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	4	80%	0	0%	1	20%
FAA Investment decision to proceed with FIM Phase 2	5	100%	0	0%	0	0%
FAA investment decision to proceed with FIM Phase 3	2	40%	1	20%	2	40%
FAA Automation enhancements and corresponding procedures deployed	4	80%	1	20%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)*	2	40%	0	0%	1	20%
Industry and FAA agreement on an application adoption timeline	2	40%	3	60%	0	0%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	2	40%	1	20%	1	20%
Sufficient customer commitment	4	80%	1	20%	0	0%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	0	0%				
N	5					

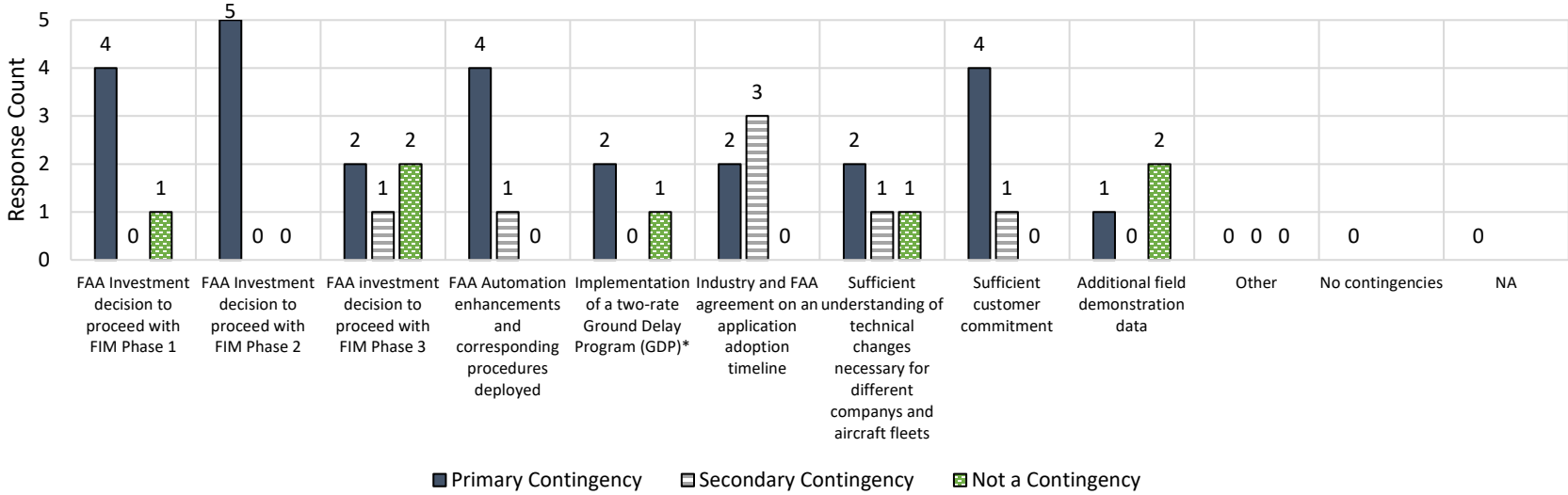


Figure K-7. Responses to "If your company is interested in FIM - DCCR, are there contingencies on an investment?"

QK.9.OEM Comments

- None

QK.10. If your company is interested but not willing to commit to an investment in FIM - DCCR, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	1	20%	2	40%
Insufficient understanding of the ADS-B In application benefits	2	40%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	2	40%	0	0%	2	40%
Insufficient funds	2	40%	2	40%	0	0%
Lack of benefits data	1	20%	1	20%	1	20%
Lack of field demonstration data	2	40%	1	20%	1	20%
Unclear interest from customers	3	60%	2	40%	0	0%
Unclear FAA commitments on automation investments	3	60%	2	40%	0	0%
Unclear FAA commitments on necessary procedural changes	2	40%	3	60%	0	0%
Lack of information on avionics installation requirements	2	40%	0	0%	2	40%
Pilot acceptability issues	2	40%	2	40%	1	20%
Controller acceptability issues	2	40%	2	40%	1	20%
Lack of knowledge of the future operation of the customers / companies	1	20%	1	20%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	0	0%				
N	5					

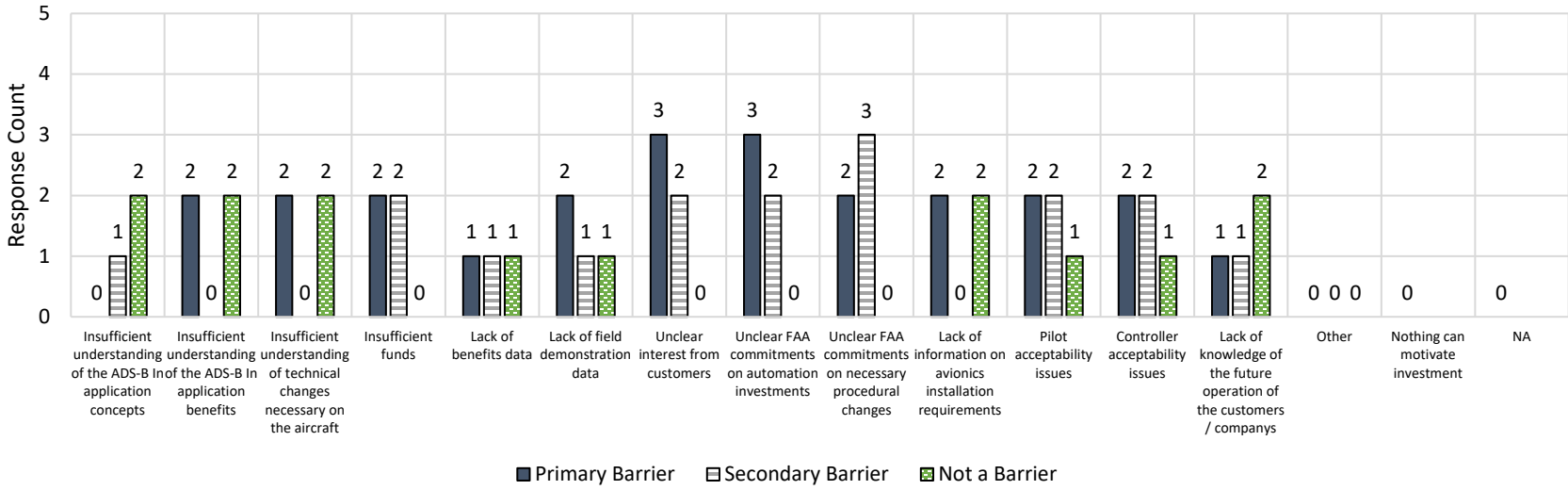


Figure K-8. Responses to "If your company is interested but not willing to commit to an investment in FIM - DCCR, what barriers could be removed to incentivize your company to invest?"

QK.10.OEM Comments

- None

QK.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - DCCR.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	1	20%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	2	40%
NA	0	
N	5	
Total Agreement	4	80%
Total Disagreement	1	20%

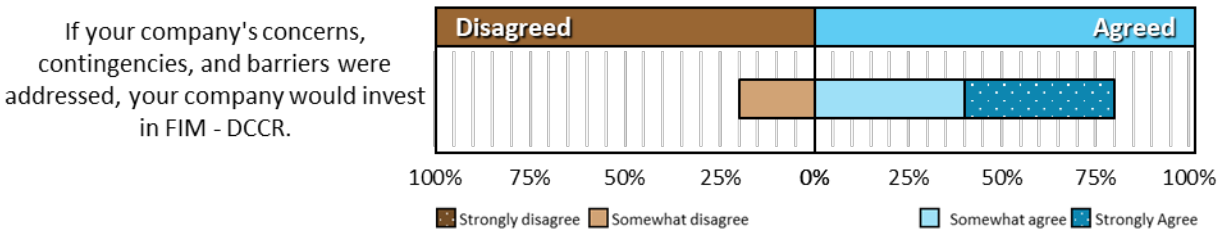


Figure K-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - DCCR."

QK.11.OEM Comments

- None

QK.12. When would your company expect to offer FIM - DCCR?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	3	60%
Other	2	40%
Never	0	0%
NA	0	
N	5	

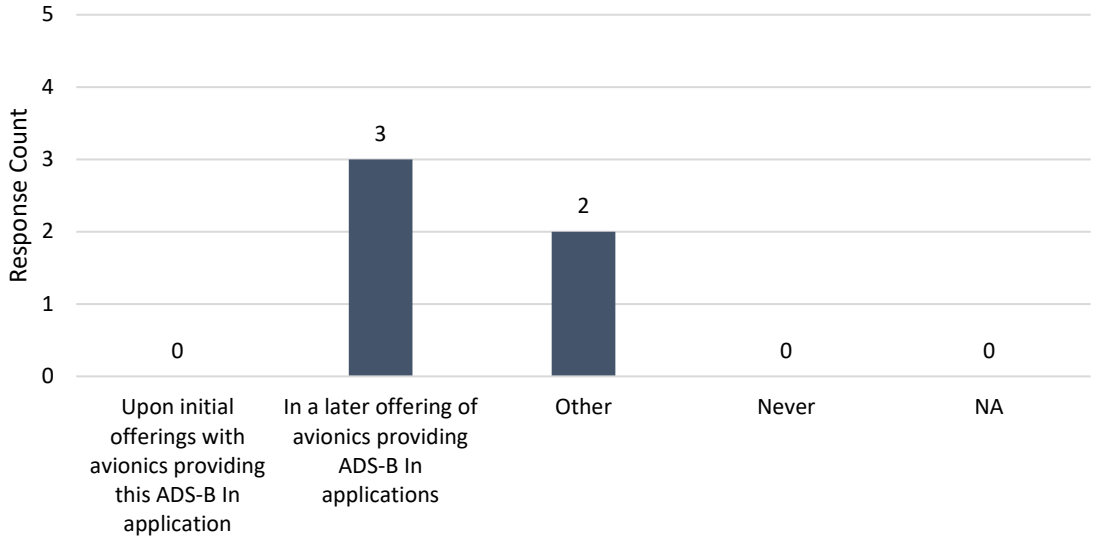


Figure K-10. Responses to "When would your company expect to offer FIM –DCCR?"

QK.12.OEM Comments

- depends on concept convergence
- Market demand will drive offerability

QK.13. If your company decides to offer FIM - DCCR, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	1
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	0	3	1
Gen 0: Most recent TCAS / ADS-B In product offering	0	0	4	1
Gen +1: At least one ADS-B Application would require a new product offering	0	1	3	1
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	0	1	2	1

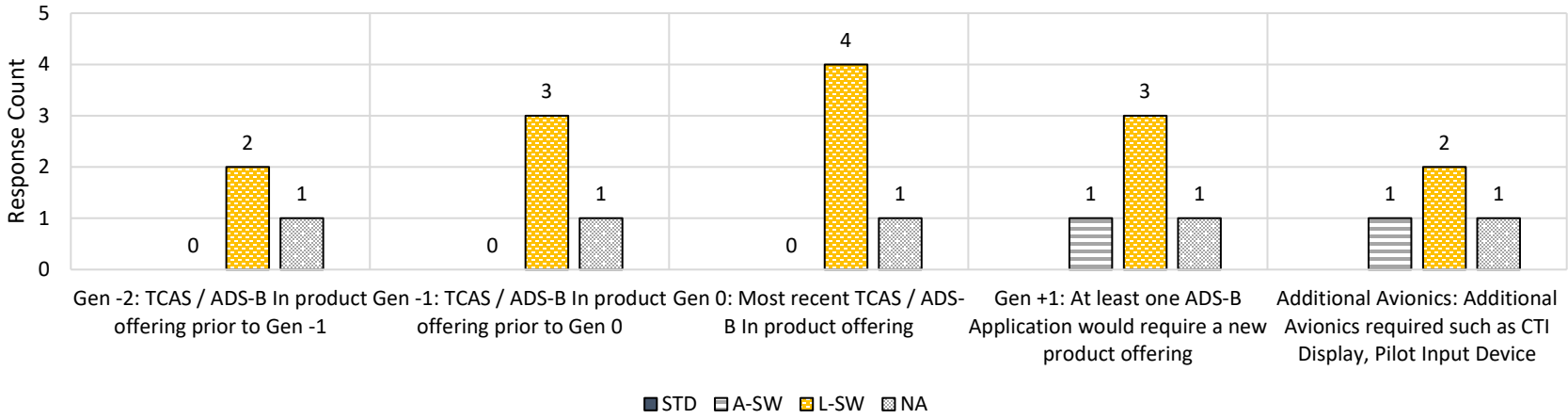


Figure K-11. Responses to "If your company decides to offer FIM - DCCR, how do you plan to offer the ADS-B In application avionics capabilities?"

QK14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - DCCR?

- "For Gen 0, -1, -2: Additional trajectory generator algorithm for track to follow and speed control algorithm to be hosted in non TCAS hardware.

  Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

  [OEM] would likely agree to start FIM product development and certification to achieve an entry into service date to align with the initial FAA ground system deployment for this application if: (1) The FAA makes a positive investment decision for development of FIM ground infrastructure and operational procedures, and (2) The FAA or airlines provide development funding offsets to mitigate against the risk that market demand for the product doesn't develop. Otherwise, [OEM] is likely to await FAA ground infrastructure and operational procedure deployment and sufficient market demand before committing to product development and certification."

Flight-deck Based Interval Management (FIM) – Dependent Staggered Arrivals (DSA)

QL.3. Does your company currently offer FIM - DSA?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	5	100%
Missing	0	
N	5	

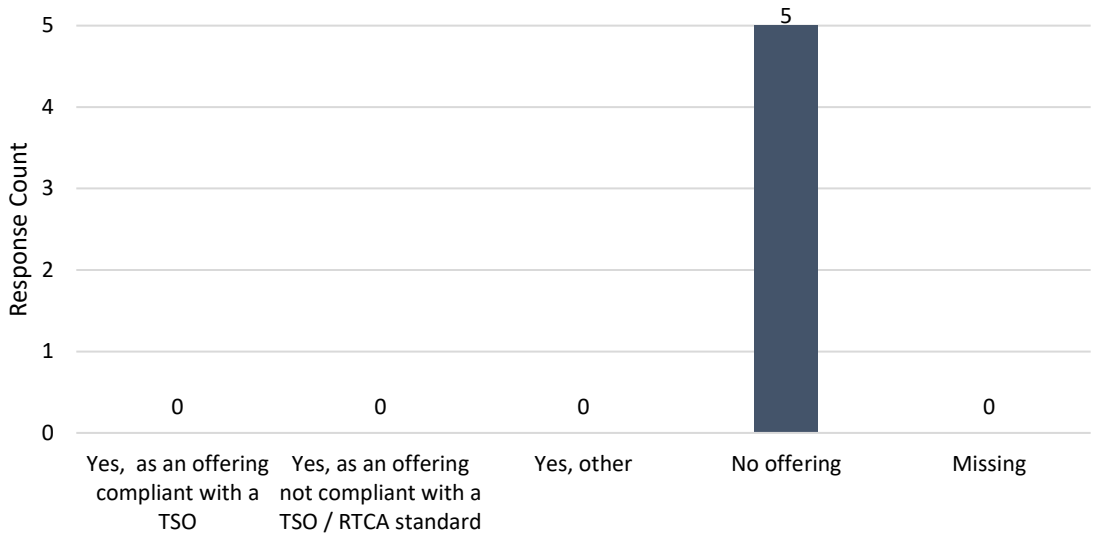


Figure L-1. Responses to "Does your company currently offer FIM - DSA?"

QL.3.OEM Comments

- None

QL.4. My company is interested in offering FIM - DSA.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	1	20%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	2	40%
N	5	
Total Agreement	4	80%
Total Disagreement	1	20%

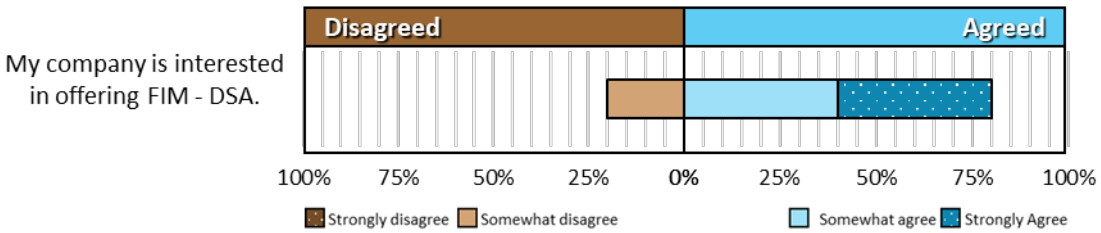


Figure L-2. Responses to "My company is interested in offering FIM - DSA."

QL.4.OEM Comments

- The avionics equipment for IM will provide this capability.

QL.5. Rate your company's priority for FIM - DSA amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	3	60%
High	2	40%
Missing	0	
N	5	

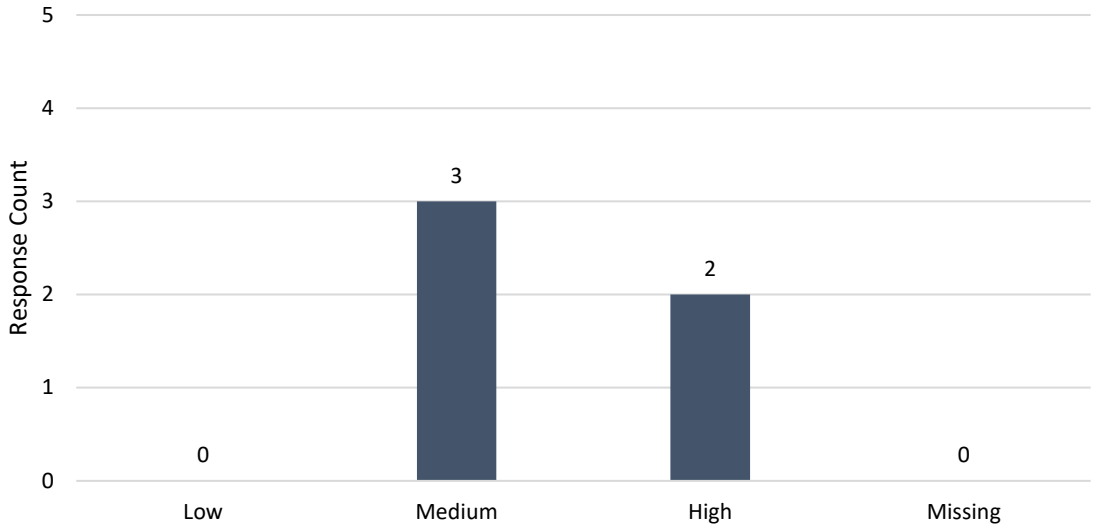


Figure L-3. Rate your company's priority for FIM - DSA amongst the set of ADS-B In applications

QL.5.OEM Comments

- None

QL.6. If your company decides to offer FIM - DSA, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	0	0%
5 - 10 years	2	50%
10 - 15 years	1	25%
> 15 years	0	0%
NA	1	25%
Missing	1	
N	4	

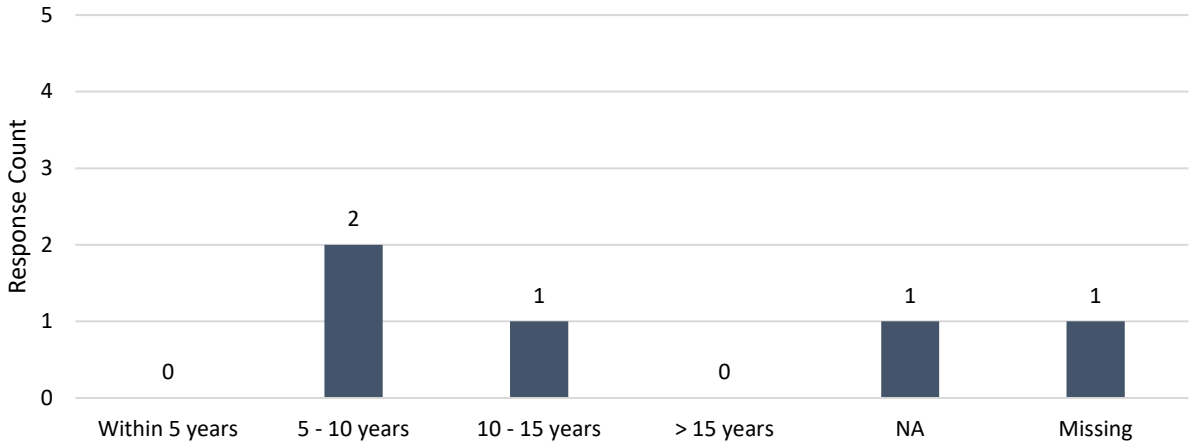


Figure L-4. Responses to " If your company decides to offer FIM - DSA, in what timeframe do you expect to offer it?"

QL.6.OEM Comments

- Offering would be dependent on available MOPS and business case with operator.

QL.7. What is it about FIM - DSA that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	4	80%	0	0%	1	20%
Applicability with a sufficient number of customers	3	60%	1	20%	1	20%
Increase new aircraft/avionics sales	3	60%	2	40%	0	0%
Concept	0	0%	1	20%	2	40%
Other	0	0%	0	0%	0	0%
Nothing about FIM - DSA interests my company	0	0%				
N	5					

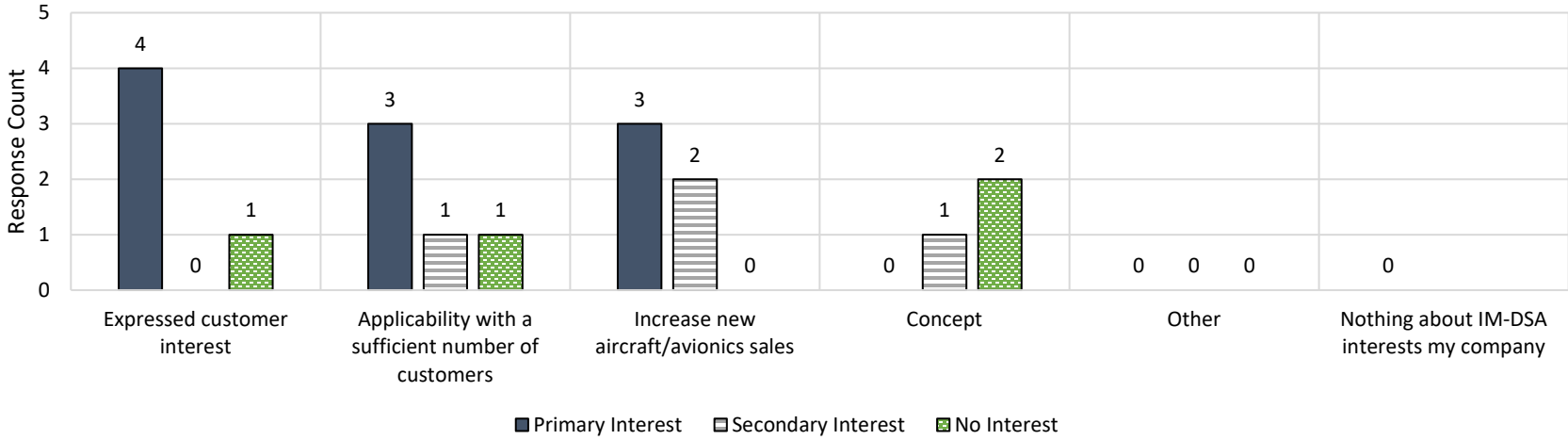


Figure L-5. Responses to "What is it about FIM - DSA that interests your company?"

QL.7.OEM Comments

- None

QL.8. What is it about FIM - DSA that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	1	20%	2	40%
Cost	4	80%	1	20%	0	0%
Insufficient customer interest	5	100%	0	0%	0	0%
Concept complexity	2	40%	2	40%	1	20%
Necessary procedural changes	3	60%	1	20%	0	0%
Necessary controller automation	3	60%	1	20%	0	0%
Other	0	0%	0	0%	0	0%
No concerns	0					
N	5					

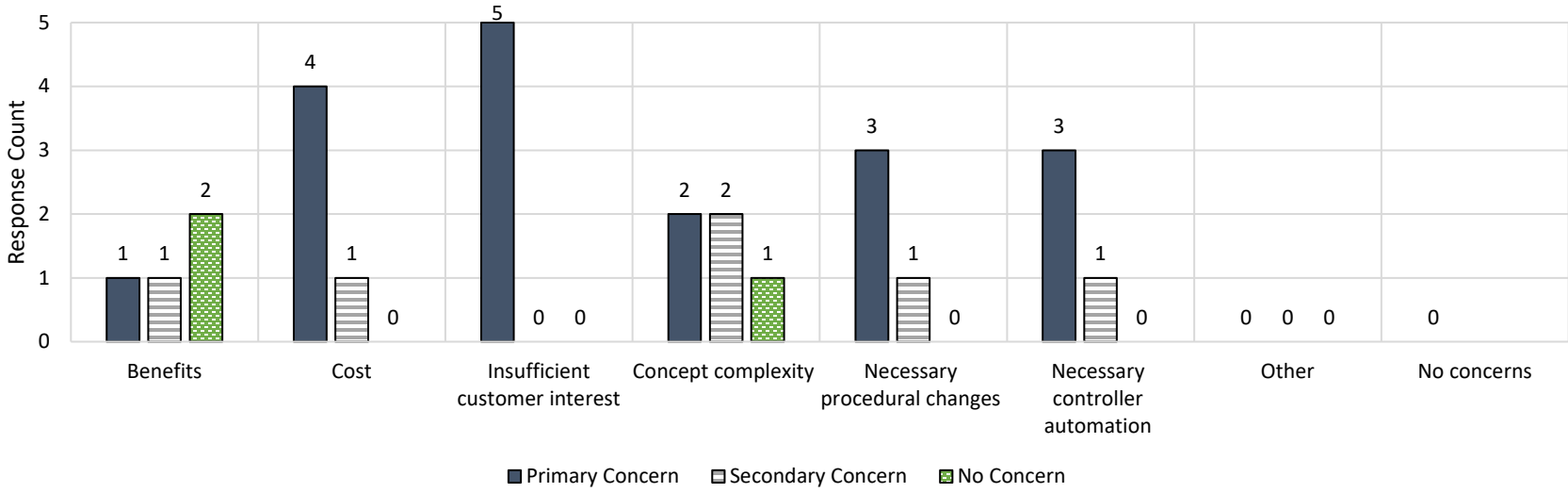


Figure L-6. Responses to "What is it about FIM - DSA that concerns your company?"

QL.8.OEM Comments

- None

QL.9. If your company is interested in FIM - DSA, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	4	80%	0	0%	1	20%
FAA Investment decision to proceed with FIM Phase 2	5	100%	0	0%	0	0%
FAA investment decision to proceed with FIM Phase 3	3	60%	0	0%	2	40%
FAA Automation enhancements and corresponding procedures deployed	4	80%	1	20%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)*	2	40%	0	0%	1	20%
Industry and FAA agreement on an application adoption timeline	2	40%	3	60%	0	0%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	2	40%	1	20%	1	20%
Sufficient customer commitment	4	80%	1	20%	0	0%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	0	0%				
N	5					

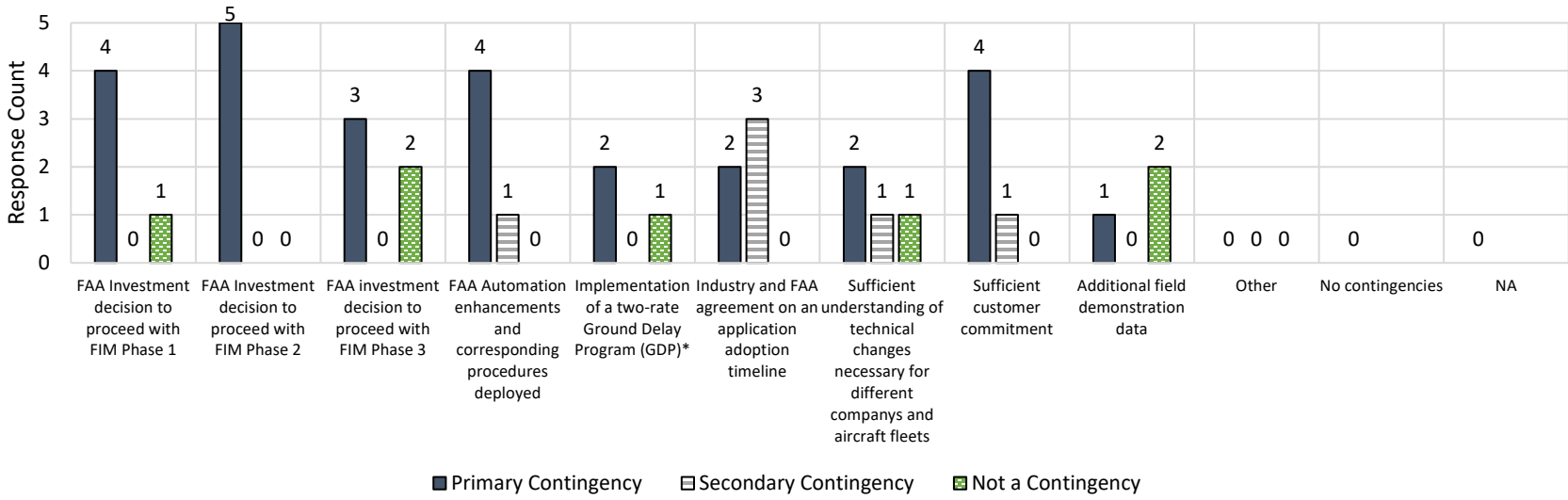


Figure L-7. Responses to "If your company is interested in FIM - DSA, are there contingencies on an investment?"

QL.9.OEM Comments

- None

QL.10. If your company is interested but not willing to commit to an investment in FIM - DSA, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	1	20%	2	40%
Insufficient understanding of the ADS-B In application benefits	2	40%	0	0%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	2	40%	0	0%	2	40%
Insufficient funds	2	40%	2	40%	0	0%
Lack of benefits data	1	20%	1	20%	1	20%
Lack of field demonstration data	1	20%	1	20%	1	20%
Unclear interest from customers	3	60%	2	40%	0	0%
Unclear FAA commitments on automation investments	3	60%	2	40%	0	0%
Unclear FAA commitments on necessary procedural changes	2	40%	3	60%	0	0%
Lack of information on avionics installation requirements	2	40%	0	0%	2	40%
Pilot acceptability issues	1	20%	2	40%	1	20%
Controller acceptability issues	1	20%	2	40%	1	20%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	0	0%				
N	5					

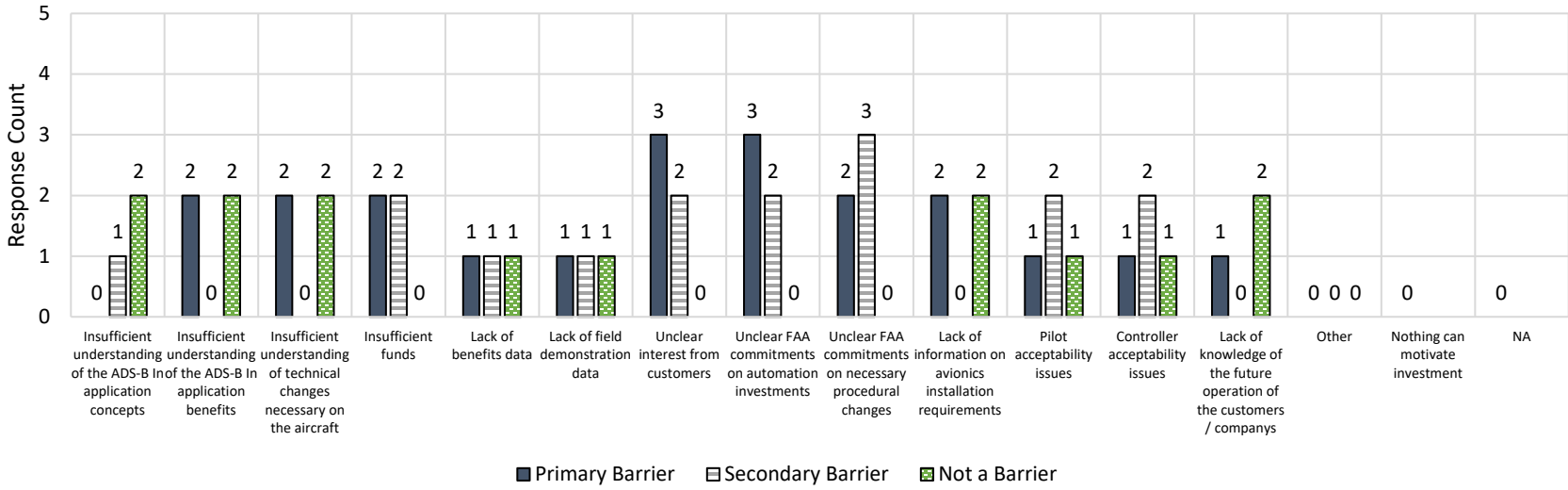


Figure L-8. Responses to "If your company is interested but not willing to commit to an investment in FIM - DSA, what barriers could be removed to incentivize your company to invest?"

QL.10.OEM Comments

- None

QL.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - DSA.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	1	20%
Neither	0	0%
Somewhat Agree	2	40%
Strongly Agree	2	40%
NA	0	
N	5	
Total Agreement	4	80%
Total Disagreement	1	20%

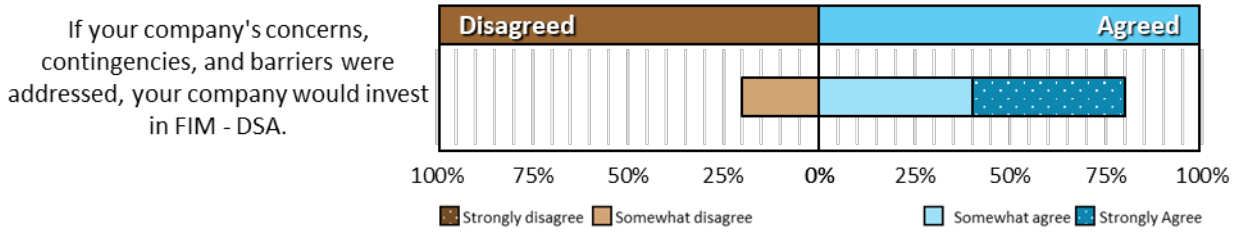


Figure L-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - DSA."

QL.11.OEM Comments

- None

QL.12. When would your company expect to offer FIM - DSA?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	3	60%
Other	2	40%
Never	0	0%
NA	0	
N	5	

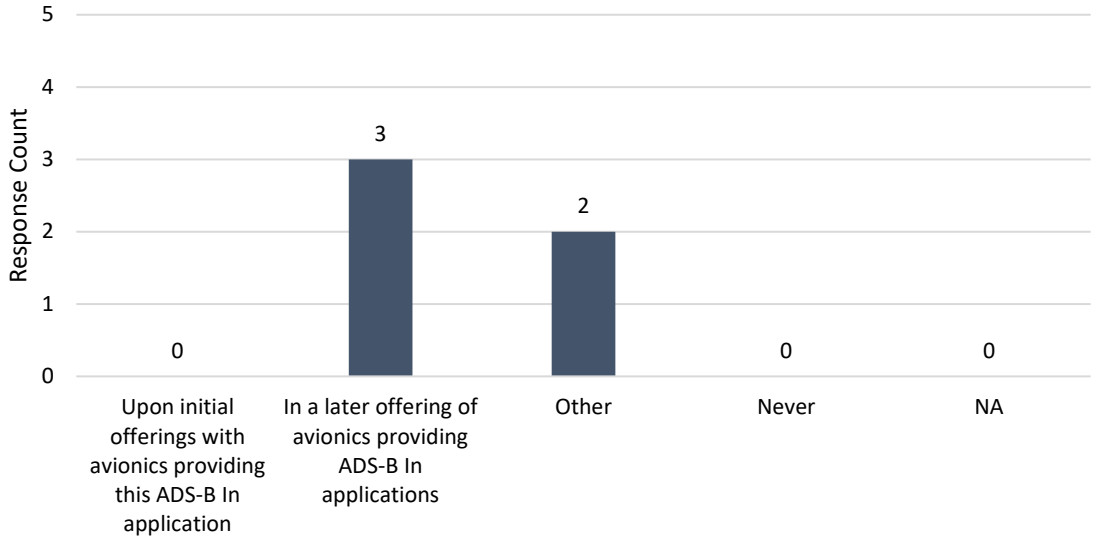


Figure L-10. Responses to "When would your company expect to offer FIM –DSA?"

QL.12.OEM Comments

- Market demand will drive offerability

QL.13. If your company decides to offer FIM - DSA, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	1
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	0	3	1
Gen 0: Most recent TCAS / ADS-B In product offering	0	0	3	1
Gen +1: At least one ADS-B Application would require a new product offering	0	1	3	1
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	0	1	2	1

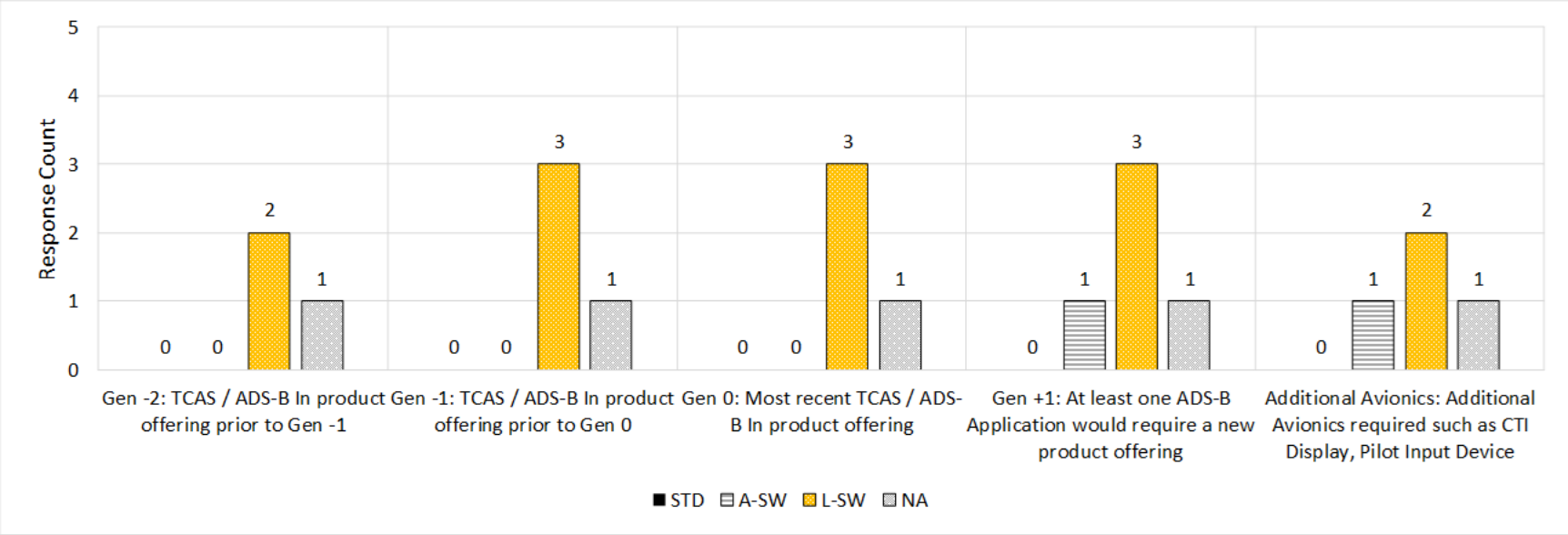


Figure L-11. Responses to "If your company decides to offer FIM - DSA, how do you plan to offer the ADS-B In application avionics capabilities?"

QL14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - DSA?

- "For Gen 0, -1, -2: Additional trajectory generator algorithm for track to follow and speed control algorithm to be hosted in non TCAS hardware.

  Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

  [OEM] would likely agree to start FIM product development and certification to achieve an entry into service date to align with the initial FAA ground system deployment for this application if: (1) The FAA makes a positive investment decision for development of FIM ground infrastructure and operational procedures, and (2) The FAA or airlines provide development funding offsets to mitigate against the risk that market demand for the product doesn't develop. Otherwise, [OEM] is likely to await FAA ground infrastructure and operational procedure deployment and sufficient market demand before committing to product development and certification."

Flight-deck Based Interval Management (FIM) – Paired Approach (PA)

QM.3. Does your company currently offer FIM - PA?

	Count	Percentage
Yes, as an offering compliant with a TSO	0	0%
Yes, as an offering not compliant with a TSO / RTCA standard	0	0%
Yes, other	0	0%
No offering	5	100%
Missing	0	
N	5	

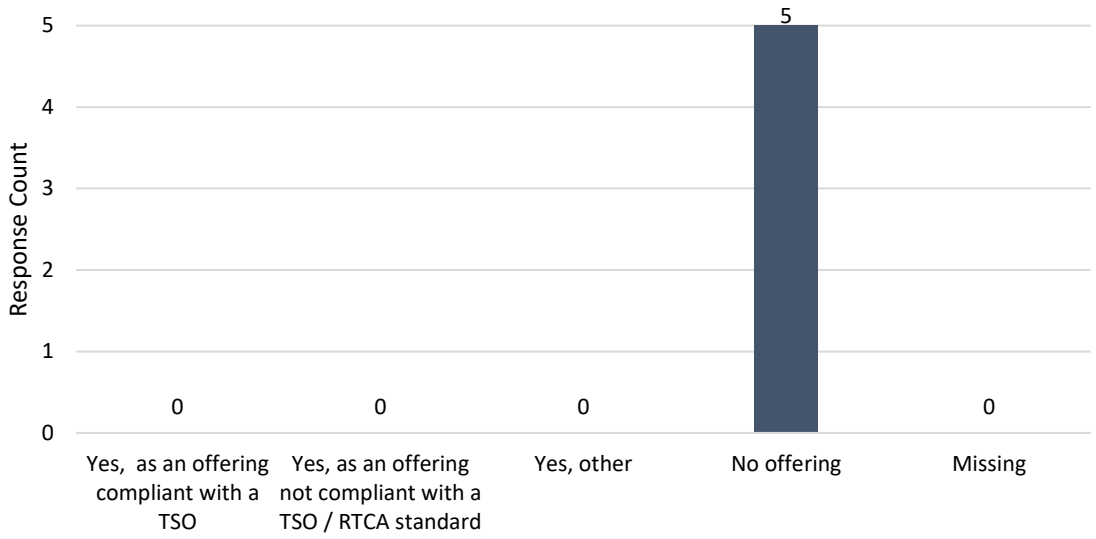


Figure M-1. Responses to "Does your company currently offer FIM - PA?"

QM.3.OEM Comments

- None

QM.4. My company is interested in offering FIM - PA.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	1	20%
Somewhat Agree	2	40%
Strongly Agree	2	40%
N	5	
Total Agreement	4	80%
Total Disagreement	0	0%

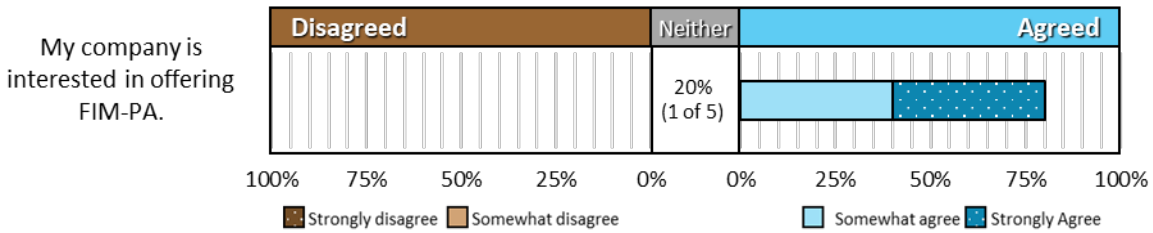


Figure M-2. Responses to "My company is interested in offering FIM - PA."

QM.4.OEM Comments

- The avionics equipment for IM will provide this capability.

QM.5. Rate your company's priority for FIM - PA amongst the set of ADS-B In applications

	Count	Percentage
Low	0	0%
Medium	3	60%
High	2	40%
Missing	0	
N	5	

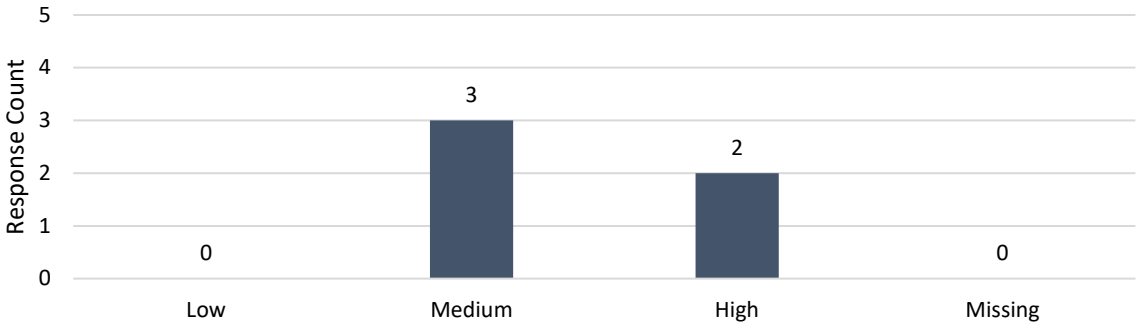


Figure M-3. Rate your company's priority for FIM - PA amongst the set of ADS-B In applications

QM.5.OEM Comments

- None

QM.6. If your company decides to offer FIM - PA, in what timeframe do you expect to offer it?

	Count	Percentage
Within 5 years	0	0%
5 - 10 years	3	75%
10 - 15 years	1	25%
> 15 years	0	0%
NA	0	0%
Missing	1	
N	4	

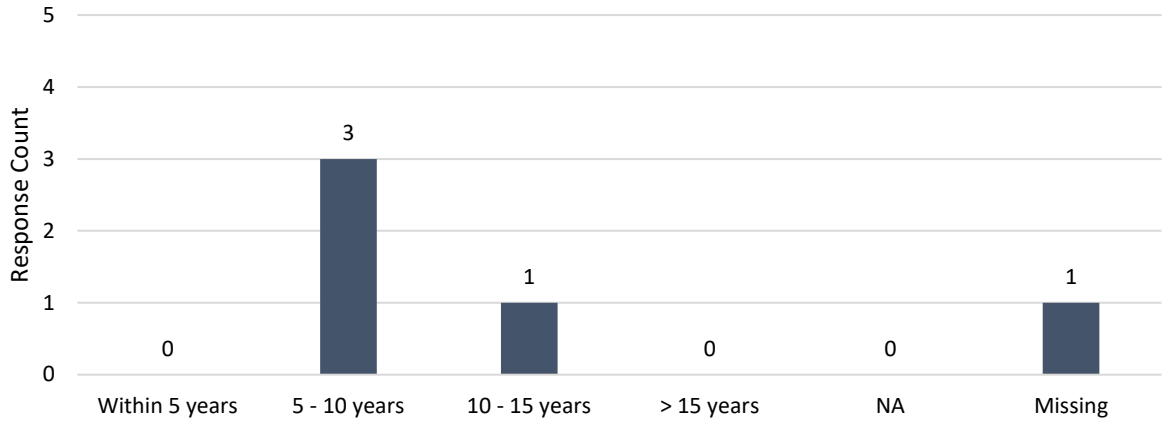


Figure M-4. Responses to " If your company decides to offer FIM - PA, in what timeframe do you expect to offer it?"

QM.6.OEM Comments

- Offering would be dependent on available MOPS and business case with operator.

QM.7. What is it about FIM - PA that interests your company?

	Primary Interest		Secondary Interest		No Interest	
Expressed customer interest	5	100%	0	0%	0	0%
Applicability with a sufficient number of customers	4	80%	0	0%	1	20%
Increase new aircraft/avionics sales	3	60%	2	40%	0	0%
Concept	1	20%	1	20%	1	20%
Other	0	0%	0	0%	0	0%
Nothing about FIM - PA interests my company	0	0%				
N	5					

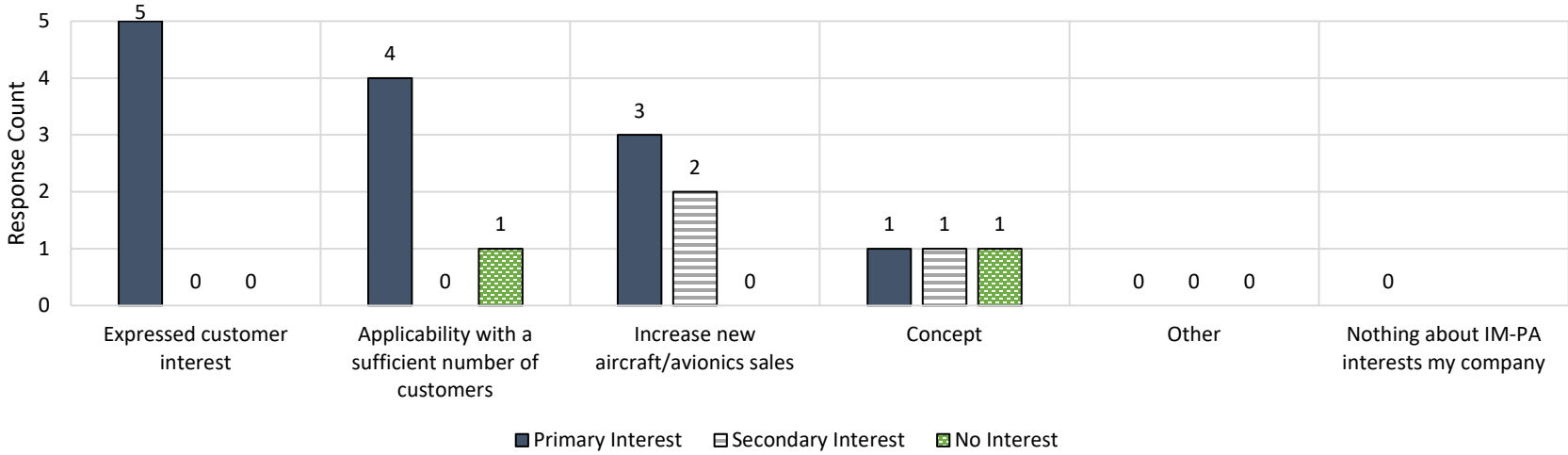


Figure M-5. Responses to "What is it about FIM - PA that interests your company?"

QM.7.OEM Comments

- None

QM.8. What is it about FIM - PA that concerns your company?

	Primary Concern		Secondary Concern		No Concern	
Benefits	1	20%	2	40%	1	20%
Cost	3	60%	1	20%	0	0%
Insufficient customer interest	3	60%	1	20%	0	0%
Concept complexity	1	20%	2	40%	2	40%
Necessary procedural changes	3	60%	1	20%	0	0%
Necessary controller automation	3	60%	1	20%	0	0%
Other	0	0%	0	0%	0	0%
No concerns	0					
N	5					

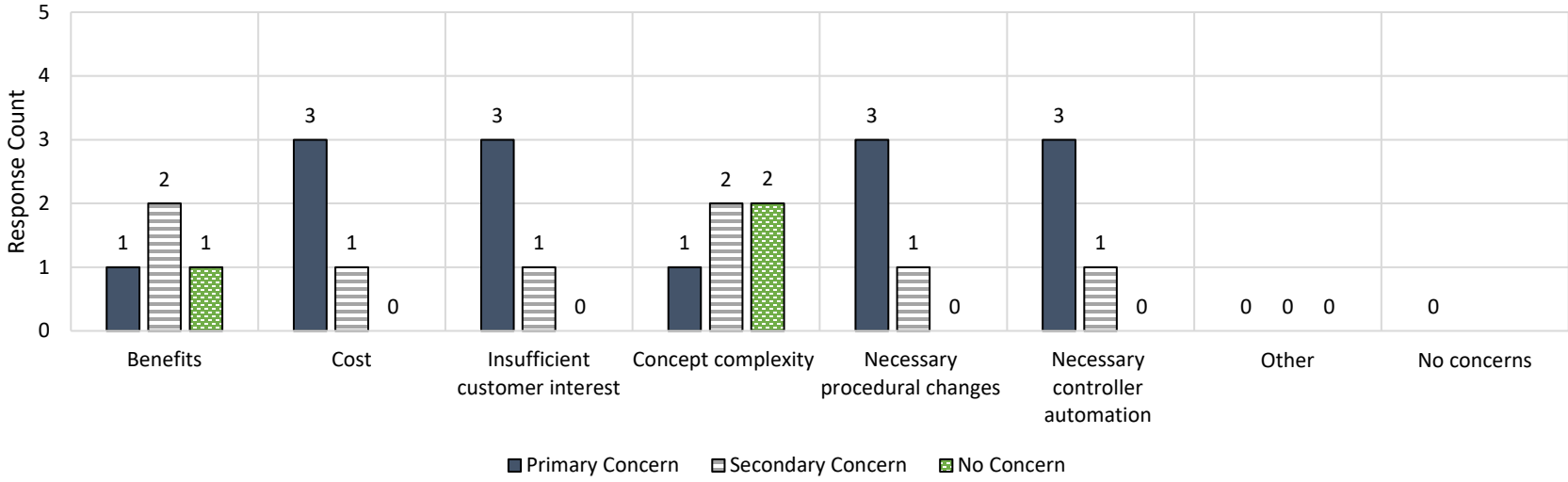


Figure M-6. Responses to "What is it about FIM - PA that concerns your company?"

QM.8.OEM Comments

- None

QM.9. If your company is interested in FIM - PA, are there contingencies on an investment?

	Primary Contingency		Secondary Contingency		Not a Contingency	
FAA Investment decision to proceed with FIM Phase 1	4	80%	0	0%	1	20%
FAA Investment decision to proceed with FIM Phase 2	4	80%	0	0%	1	20%
FAA investment decision to proceed with FIM Phase 3	5	100%	0	0%	0	0%
FAA Automation enhancements and corresponding procedures deployed	4	80%	1	20%	0	0%
Implementation of a two-rate Ground Delay Program (GDP)*	2	40%	0	0%	1	20%
Industry and FAA agreement on an application adoption timeline	2	40%	3	60%	0	0%
Sufficient understanding of technical changes necessary for different companies and aircraft fleets	2	40%	1	20%	1	20%
Sufficient customer commitment	4	80%	1	20%	0	0%
Additional field demonstration data	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
No contingencies	0	0%				
NA	0	0%				
N	5					

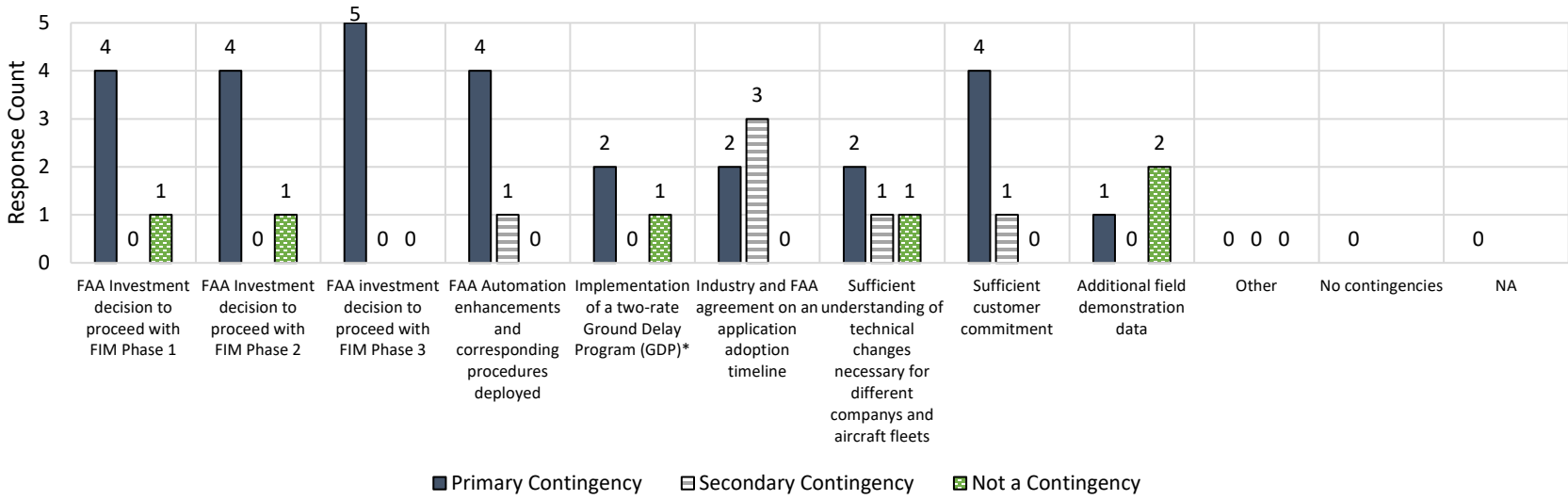


Figure M-7. Responses to "If your company is interested in FIM - PA, are there contingencies on an investment?"

QM.9.OEM Comments

- None

QM.10. If your company is interested but not willing to commit to an investment in FIM - PA, what barriers could be removed to incentivize your company to invest?

	Primary Barrier		Secondary Barrier		Not a Barrier	
Insufficient understanding of the ADS-B In application concepts	0	0%	1	20%	2	40%
Insufficient understanding of the ADS-B In application benefits	1	20%	1	20%	2	40%
Insufficient understanding of technical changes necessary on the aircraft	2	40%	0	0%	2	40%
Insufficient funds	2	40%	2	40%	0	0%
Lack of benefits data	1	20%	2	40%	0	0%
Lack of field demonstration data	1	20%	1	20%	1	20%
Unclear interest from customers	3	60%	2	40%	0	0%
Unclear FAA commitments on automation investments	3	60%	2	40%	0	0%
Unclear FAA commitments on necessary procedural changes	2	40%	3	60%	0	0%
Lack of information on avionics installation requirements	2	40%	1	20%	1	20%
Pilot acceptability issues	1	20%	2	40%	1	20%
Controller acceptability issues	1	20%	2	40%	1	20%
Lack of knowledge of the future operation of the customers / companies	1	20%	0	0%	2	40%
Other	0	0%	0	0%	0	0%
Nothing can motivate investment	0	0%				
NA	0	0%				
N	5					

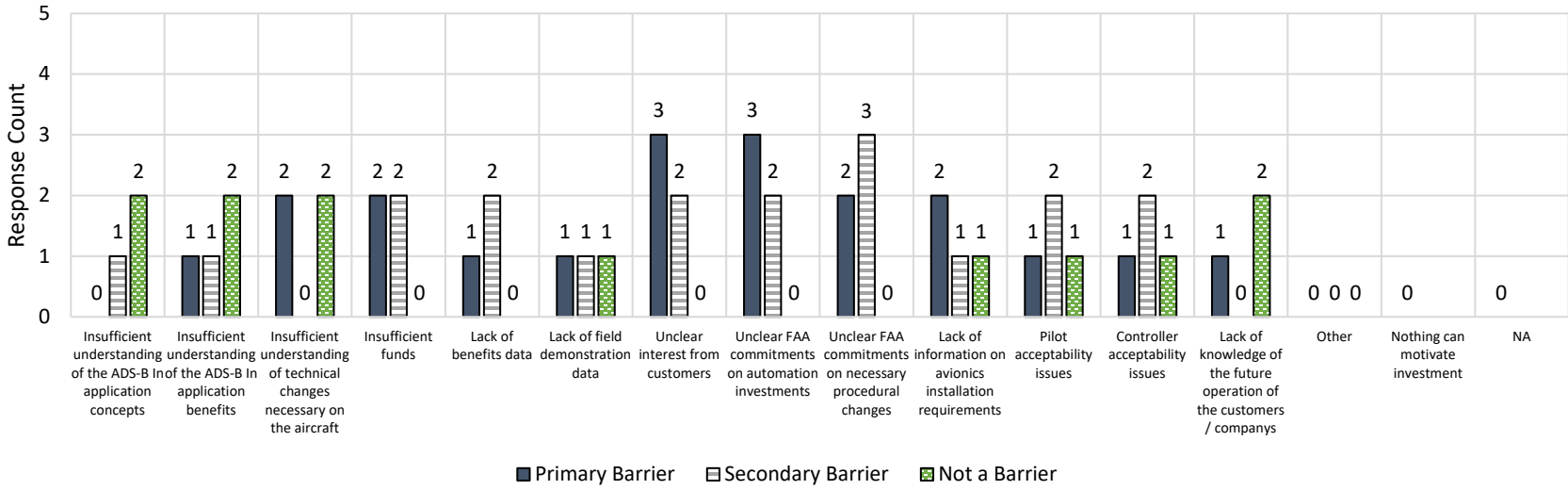


Figure M-8. Responses to "If your company is interested but not willing to commit to an investment in FIM - PA, what barriers could be removed to incentivize your company to invest?"

QM.10.OEM Comments

- None

QM.11. If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - PA.

	Count	Percentage
Strongly Disagree	0	0%
Somewhat Disagree	0	0%
Neither	0	0%
Somewhat Agree	3	60%
Strongly Agree	2	40%
NA	0	
N	5	
Total Agreement	5	100%
Total Disagreement	0	0%

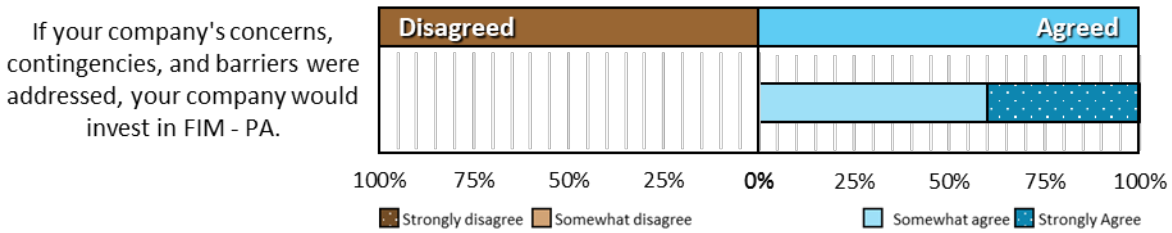


Figure M-9. Responses to "If your company's concerns, contingencies, and barriers were addressed, your company would invest in FIM - PA."

QM.11.OEM Comments

- None

QM.12. When would your company expect to offer FIM - PA?

	Count	Percentage
Upon initial offerings with avionics providing this ADS-B In application	0	0%
In a later offering of avionics providing ADS-B In applications	4	80%
Other	1	20%
Never	0	0%
NA	0	
N	5	

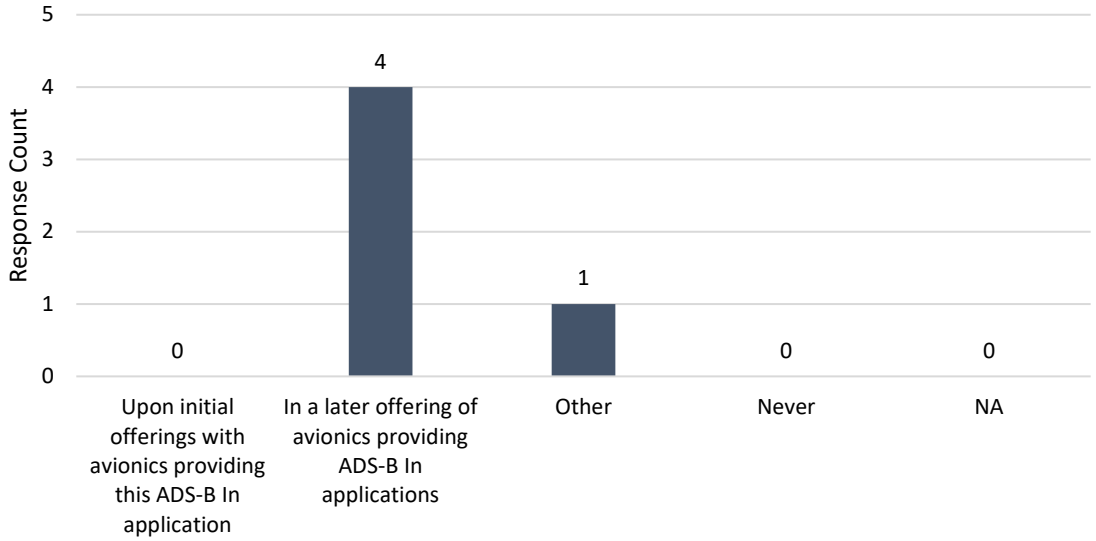


Figure M-10. Responses to "When would your company expect to offer FIM –PA?"

QM.12.OEM Comments

- Market demand will drive offerability

QM.13. If your company decides to offer FIM - PA, how do you plan to offer the ADS-B In application avionics capabilities?

	STD	A-SW	L-SW	NA
Gen -2: TCAS / ADS-B In product offering prior to Gen -1	0	0	2	1
Gen -1: TCAS / ADS-B In product offering prior to Gen 0	0	0	3	1
Gen 0: Most recent TCAS / ADS-B In product offering	0	0	5	0
Gen +1: At least one ADS-B Application would require a new product offering	0	2	3	0
Additional Avionics: Additional Avionics required such as CTI Display, Pilot Input Device	0	1	2	0

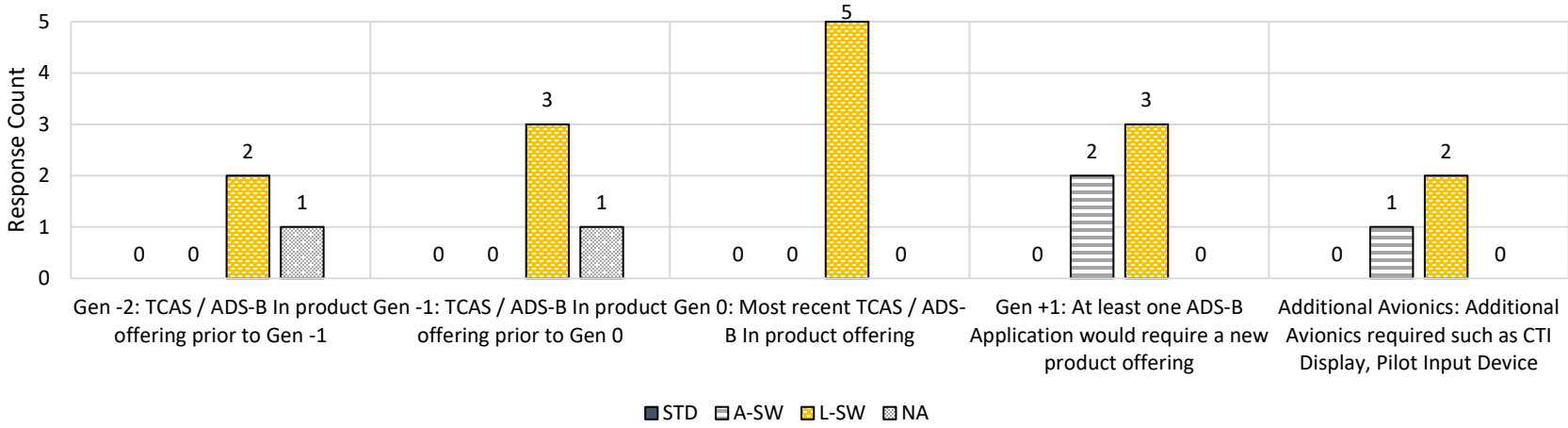


Figure M-11. Responses to "If your company decides to offer FIM - PA, how do you plan to offer the ADS-B In application avionics capabilities?"

QM14. Do you have any additional thoughts for the NAC to share with the FAA related to FIM - PA?

- "For Gen 0, -1, -2: Additional trajectory generator algorithm for track to follow and speed control algorithm to be hosted in non TCAS hardware.

  Gen -1 and Gen -2 would require a small hardware upgrade in addition to the L-SW. All Gen offerings would also need a CDTI display in addition to the TCAS/ADS-B In avionics.

  [OEM] would likely agree to start FIM product development and certification to achieve an entry into service date to align with the initial FAA ground system deployment for this application if: (1) The FAA makes a positive investment decision for development of FIM ground infrastructure and operational procedures, and (2) The FAA or airlines provide development funding offsets to mitigate against the risk that market demand for the product doesn't develop. Otherwise, [OEM] is likely to await FAA ground infrastructure and operational procedure deployment and sufficient market demand before committing to product development and certification."

Final Comments

15. Do you have any final comments or thoughts for the NAC to share with the FAA? (e.g., any other uses of ADS-B In that have not been mentioned)

- FAA needs a ConOps describing where and how the Flight deck Interval Management (FIM) applications and the Time of Arrival Control (ToAC) flight deck TBO capabilities will be utilized in the NAS. The treatment of published speed constraints by FIM and ToAC are incompatible for effective operation in the same airspace as currently published in the respective RTCA standards.

Appendix G: Acronyms

A4A	Airlines for America
ADS-B	Automatic Dependent Surveillance - Broadcast
CAS	CDTI Assisted Separation
CAVS	CDTI Assisted Visual Separation
CDTI	Cockpit Display of Traffic Information
DCCR	Dependent Converging and Crossing Runways
DSA	Dependent Staggered Approaches
FIM	Flight-deck Interval Management
GAMA	General Aviation Manufacturers Association
GDP	Ground Delay Program
IM	Interval Management
ITP	In-Trail Procedures
LRU	Line Replaceable Unit
NAC	NextGen Advisory Committee
MOPS	Minimum Operational Performance Standards
NAC SC	NextGen Advisory Committee Subcommittee
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association
OEM	Original Equipment Manufacturer
PA	Paired Approach
RAA	Regional Airline Association
RTA	Required Time of Arrival
SBS	Surveillance and Broadcast Services
SME	Subject Matter Expert
SURF	Surface
SURF-A	Surface – Alerting
SURF-IA	Surface – Indicating and Alerting
TBFM	Time Based Flow Management
TBO	Trajectory Based Operations
TCAS	Traffic Alert and Collision Avoidance System
ToAC	Time of Arrival Control

Attachment 5

Vertical Navigation (VNAV)

NAC Task 20-2 Report

To be presented to the NextGen Advisory Committee

June 21, 2021

Table of Contents

Executive Summary

When Vertical Navigation capability (VNAV) was introduced in aircraft equipage, it brought a fundamental change to the National Airspace System (NAS). VNAV offers a host of improvements to aircraft operations, ranging from safety enhancements to improved efficiencies. By far, VNAV's greatest benefit was the ability to fly stable, vertically guided approaches to all runway ends. Prior to VNAV, only the Instrument Landing Systems (ILS) provided vertical guidance to touchdown.

In the NextGen era, efficiency and reduction of carbon emissions are added VNAV benefits, captured by enabling idle descent paths on terminal arrival procedures and participating in Established on RNP (EoR) operations at airports with widely spaced runways. VNAV also enables more resilient low visibility approaches when an ILS facility is out of service. The presence of LNAV and VNAV on an aircraft implies that the operator is no longer dependent on a ground-based Navigation Aid infrastructure. More and more, industry has innovated new solutions through which VNAV improves airline operations.

At the time of this report, there are approximately 7,351 Title 14, Code of Federal Regulations (14 CFR) part 121 aircraft, roughly 1,245 of which lack VNAV capability. Seventy-four percent of these aircraft are regional aircraft. While regional jets were hailed as a "game-changer" for passenger comfort, being able to fly quieter and higher than the turboprops they replaced, they were also equipped with avionics similar to those turboprops, which flew low and slow. This lack of advanced equipage left the small regional and older mainline aircraft unable to realize VNAV benefits.

While many aging mainline aircraft continue to be retired, this is not the case with the 50-seat regional jet. Many will operate through this decade and, lacking VNAV capability, continue to present a barrier to safe, stable approaches and achievement of key NextGen benefits.

Some of the key impediments to VNAV upgrades include: continual threat of aircraft retirement, cost of avionics, lack of perceived Return on Investment (ROI), and the nature of mainline/regional short-term capacity purchase contracts. These impediments have translated to increased pilot workload, lack of efficiency, and reduced safety when ILS is out of service or not offered at an airport.

It’s also worth noting that while the focus of this report is on VNAV capability, many aircraft without VNAV also lack other key NextGen capabilities. This group encourages the reader to also review the NAC Tasking 19-01, Minimum Capabilities List (MCL), to better understand the impediments caused by equipage gaps.

Introduction

The FAA's Next Generation Air Transportation System, or NextGen, is a complex airspace modernization effort, requiring the collaboration of many stakeholders in pursuit of "emphasizing safety, increasing efficiency, improving environmental performance, and enhancing the customer experience."[1] This report is the official response to a NAC tasking that seeks to understand barriers to the use of VNAV, as they have become a stumbling block to further implementation of Performance-Based Navigation (PBN) procedures in the National Airspace System (NAS).

Background

PBN is an advanced, satellite-based form of navigation which creates precise 3D flight paths from takeoff to landing. The flight paths an aircraft is permitted to fly depend on its avionics capabilities, both laterally and vertically. While the concept of lateral guidance is more intuitive (that is, what path we fly from A to B), vertical guidance concerns when an aircraft climbs or descends, and how fast. Vertical guidance is useful in optimizing climbs and descents, minimizing environmental impact, and reducing greenhouse gases. It also provides guidance on how low an aircraft can descend in the clouds when trying to land.

Where legacy Instrument Landing Systems (ILS) provide guidance based on radio navigation signals transmitted from the ground, PBN Area Navigation (RNAV) approaches rely on Distance Measuring Equipment (DME) or Global Navigation Satellite System (GNSS) positioning for lateral guidance, and barometric altimeter systems for vertical guidance. This guidance is internal, calculated by the aircraft's Flight Management System (FMS) computer.

The "quality," or fidelity, of internal guidance is based on the capability of the aircraft computer and its validation process. While older equipment is often only capable of providing Lateral Navigation (LNAV) guidance, newer aircraft also provide Lateral Navigation + Vertical Navigation (LNAV/VNAV) guidance. Localizer Precision with Vertical (LPV) guidance offers even more accuracy due to an

[1] "What is NextGen?" Federal Aviation Administration (FAA), May 26, 2021, https://www.faa.gov/nextgen/what_is_nextgen/.

additional Global Positioning System (GPS) enhancement. Applying the familiar "good/better/best" comparison to these categories, LNAV (or LNAV Only) guidance = "Good," LNAV/VNAV guidance = "Better," and LPV guidance = "Best." (Figure 1)

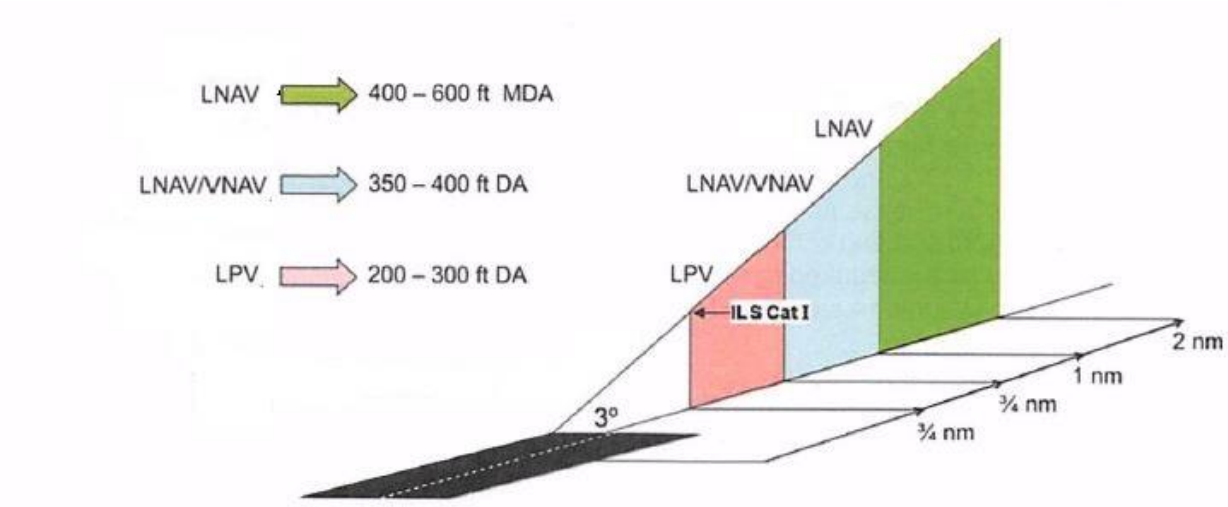


Figure 1

The Issue

Most major U.S. airports employ multiple runways to maximize arrival and departure capacities. Termed "simultaneous parallel operations," these airport configurations are complex. Two or more streams of arriving and departing aircraft require precise navigation, both lateral and vertical, in addition to active engagement with terminal approach controllers.

Due to this complexity, the FAA's criteria for evaluating Terminal Instrument Procedures (TERPS) during simultaneous parallel operations prohibits the use of LNAV Only guidance on RNAV approach procedures.

So, what does this mean? What is the impact of this? Two things:

1) Aircraft with less-capable LNAV guidance systems cannot execute RNAV (GPS) instrument approaches when multiple runways are in use. Often, the only alternatives are either an ILS approach (ground-based guidance) or a visual approach. If it's a cloudy/foggy day and the aircraft is operating in Instrument Meteorological Conditions (IMC), then visual approaches are not an option. If an ILS system is inoperative on a parallel runway on this same cloudy day, then an LNAV aircraft requires "special

handling" to land on the other ILS-equipped runway. At some airports where there are concentrations of LNAV aircraft, this creates "friction," creating more work for controllers, increasing risk, and slowing airport operations.

2) RNAV approaches are critically important to realizing NextGen benefits. RNAV procedures offer flexibility for aircraft to avoid noise-sensitive and environmental areas. They also can shorten airport approach patterns, saving time and fuel while increasing predictability in the NAS. Airports are beginning to deploy RNAV (RNP) approaches in a highly efficient configuration termed, "Established on RNP," or EoR. In this configuration, LNAV Only aircraft are unable to "mix in" with VNAV aircraft due to the TERPS constraint. The result is that LNAV aircraft cannot fly EoR approaches with most of the other traffic, resulting in more track-miles, time, fuel, noise, and emissions. Additionally, due to the complexity of managing multiple arrival flows, one LNAV aircraft often drags multiple, VNAV equipped aircraft behind it on a much longer, less efficient path. This negates any PBN benefit not only for itself, but also for many aircraft behind it.

This report will examine this "equipage gap" in vertical guidance capability between those capable of providing LNAV/VNAV or LPV vertical guidance, and those which provide only LNAV lateral guidance.

Tasking and Deliverables

On August 10, 2020, the FAA requested the NextGen Advisory Committee (NAC) provide advice on Vertical Navigation. Tasking 20-2, Vertical Navigation (VNAV) was the result.

Tasking Language

"The NAC is tasked to provide the FAA with an industry plan to address the existing equipage gap that prevents the full use of Required Navigation Performance (RNP) approaches for parallel operations. Currently, simultaneous operations cannot be used effectively by operators or air traffic control without a high participation rate. This change will allow the FAA to move forward and unlock larger safety and efficiency benefits associated with initiatives such as, Performance-Based Navigation (PBN) paths to final approach and Established on RNP (EoR).

The NAC advice should include the following:

- *A comprehensive assessment of mainline and regional airline impediments to equipage for full VNAV operations.*
- *Achieve consensus on a plan to eliminate impediments to equipage for VNAV operations.*
- *Where complete consensus cannot be achieved, identify those operators or industry organizations which cannot come to consensus agreement and provide a minority opinion on any objections.*

Scope:

- *FAA will provide the SMEs.*
- *MITRE may be used as a trusted clearing house for data (considered sensitive in nature to the operators).*
- *Include other stakeholder organizations to include relevant manufacturers and pilot unions.*
- *Complete work and provide a final recommendation report no later than the Fall 2020 NAC meeting."*

Clarification

In October 2020, the working group sought clarification from the FAA on the tasking with consideration towards the state of the industry.

At that time, the COVID–19 pandemic operational decline had drastically changed the commercial fleet. Many operators had more than 70 percent of their fleet in storage, and the scope and timeline of an aviation industry recovery was uncertain.

Operator finances were constrained. All major airlines were operating in a negative revenue environment. Scant remaining resources were focused on moving aircraft to and from storage and mandatory aircraft maintenance. Consequently, most operators were not in a financial position to consider equipment upgrades, as even pre-COVID upgrade efforts already underway were halted to preserve cash.

As industry's status was so fluid and its future unpredictable, a tasking response would be limited to those barriers existing prior to the COVID event.

These questions arose:

- How relevant would a response be based on pre-COVID fleet analysis after the drastic impact on the fleet and operator resources?
- What new impediments might the COVID-induced decline have introduced?

We regarded the impact of COVID on the commercial fleet as a potential game-changer. Any plan or conclusions drawn from pre-COVID impediments might be incomplete, inaccurate, or incompatible in a post-COVID market. We just didn't know what would happen.

Therefore, we focused on the present and considered how the working group could meaningfully respond considering the circumstances. After consultation with NAC leadership, we arrived at the following deliverables, which were reported to the NAC on November 17, 2020.

20-2 Vertical Navigation Updated Tasks

- Current Equipage Landscape
- Review of LNAV Aircraft
  - Models

  - Quantities
  - Retirement Plans
  - Upgrade Options Available
- Impediments to Equipage

Process and Development

Described below is the VNAV working group's process to identify relevant aircraft and select operators whom we would poll.

Plan of Attack

The working group sought to poll the operators of LNAV Only aircraft as to their plans for upgrading vertical navigation capabilities. From preliminary data, we targeted a group of 18 "impactful" operators whom we would engage, each of which operated ~ 20 or more affected aircraft. These represented ~ 85 percent of the estimated total LNAV Only fleet.

14 CFR Part 129 (foreign) and 14 CFR Part 135 operators were initially considered; however, their data was ultimately excluded from consideration due to the high foreign fleet equipage rate (~ 92 percent) and less concentrated nature of Part 135 operations.

Operator Poll Questions

The following polling questions were presented to our targeted operators:

- Validation of Fleet Data
  - Aircraft Model Type
  - Size of Model Fleet
  - Quantity of LNAV-Only Aircraft in Fleet
- Fleet Plan
  - Continue to Operate "Affected" Aircraft for 10+ Years
  - Continue to Operate "Affected" Aircraft for 5–10 Years
  - Plan to Retire "Affected" Aircraft in less than 5 Years
- Plan for Implementation of LNAV/VNAV or LPV
  - In Plan
  - Not in Plan
  - Undecided
  - Not Applicable
- If in Plan, Likelihood to Equip within 5 Years
  - Likely
  - Not Likely

  - Not Sure
- If Not in Plan, Primary Impediments/Rationale
  - High Cost of Solution
  - No Operational Benefit
  - Aircraft Down Time Too Long
  - Other
- Additional Remarks or Comments

Fleet Data

Op Specs Authorized VNAV Capability

We secured fleet data from D085 Op Spec data filtered for Part 121 aircraft.

It reflected a total Part 121 fleet size of 7351 aircraft.

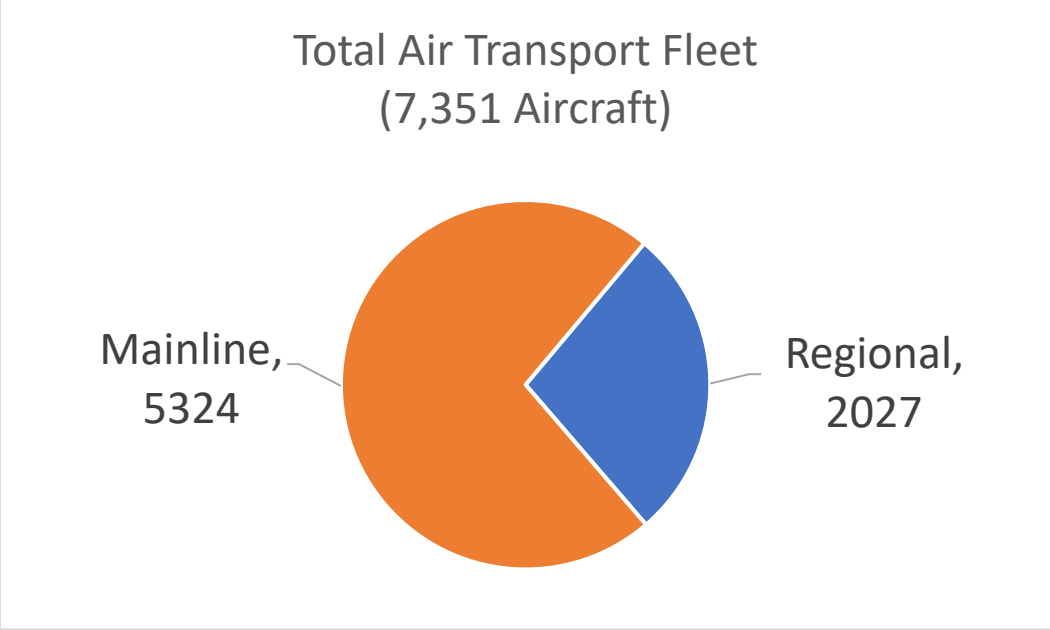
Of that total, 1245 were listed as capable of providing LNAV Only guidance.

More detailed analysis continues below.

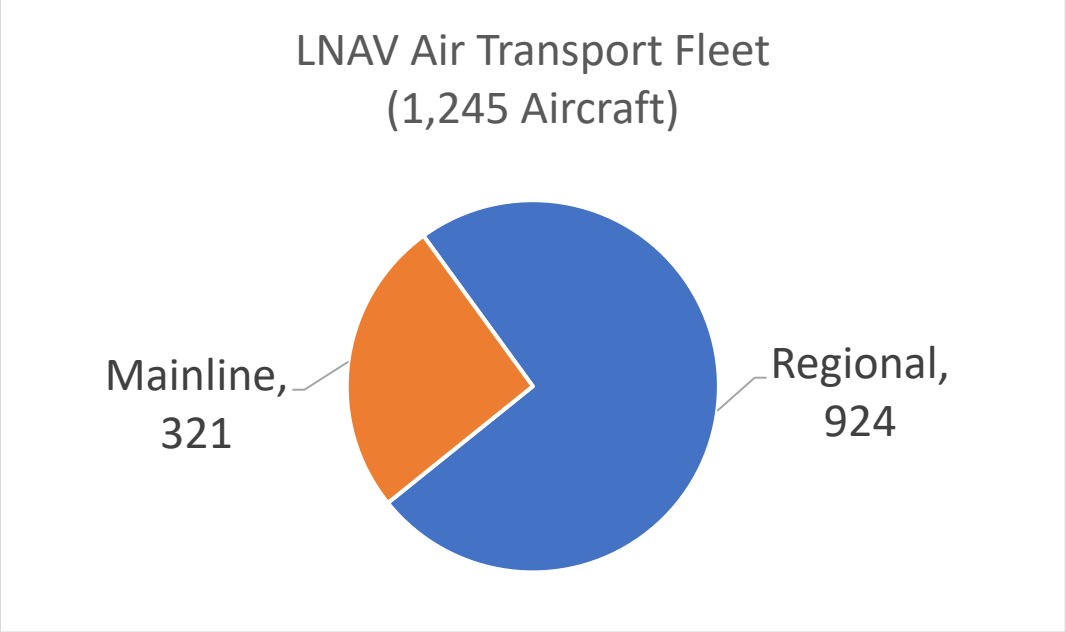
Fleet and Capability Analysis

The statistics regarding Mainline versus Regional airline LNAV aircraft are intriguing.

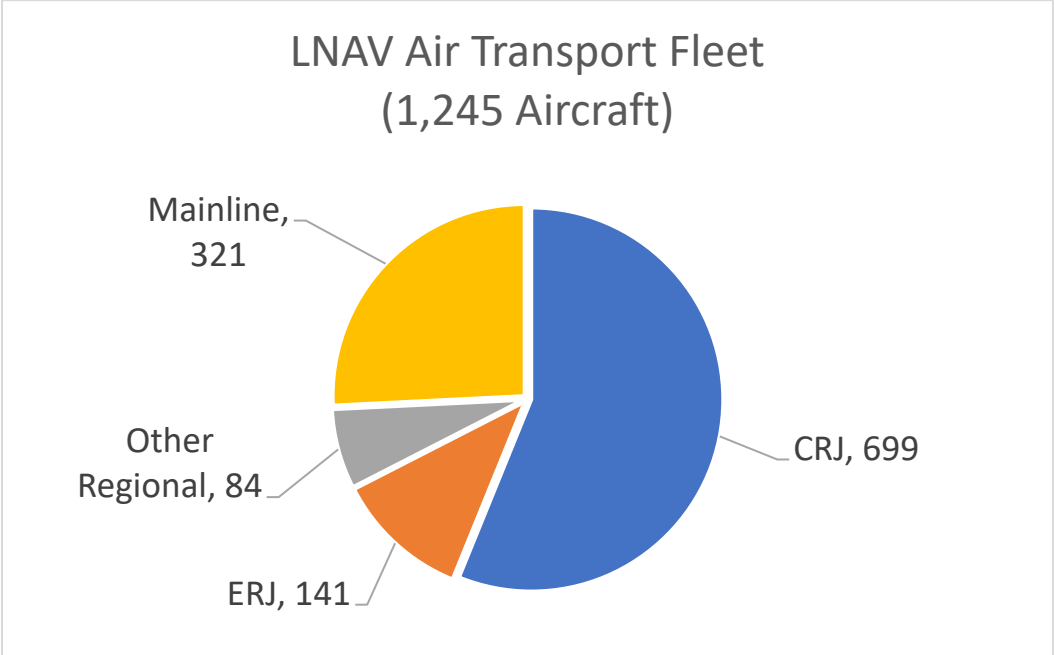
We tallied an approximate total U.S. part 121 fleet of 7351 aircraft: 5324 (72 percent) mainline and 2027 (28 percent) regional aircraft.



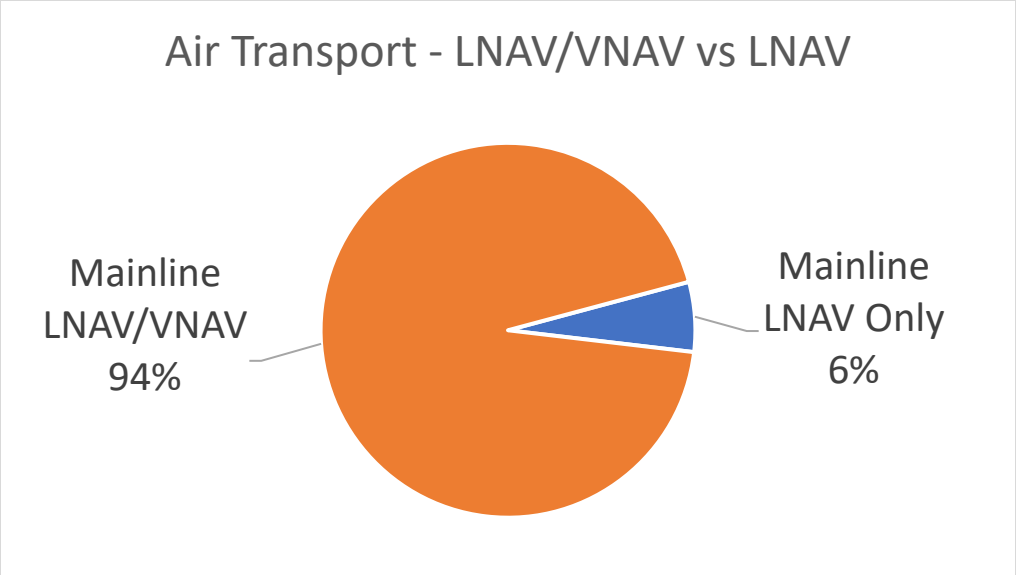
Of the 7351 fleet total, 1245 were indicated as LNAV aircraft: 924 (74 percent) Regional aircraft and 321 (26 percent) larger Mainline types.



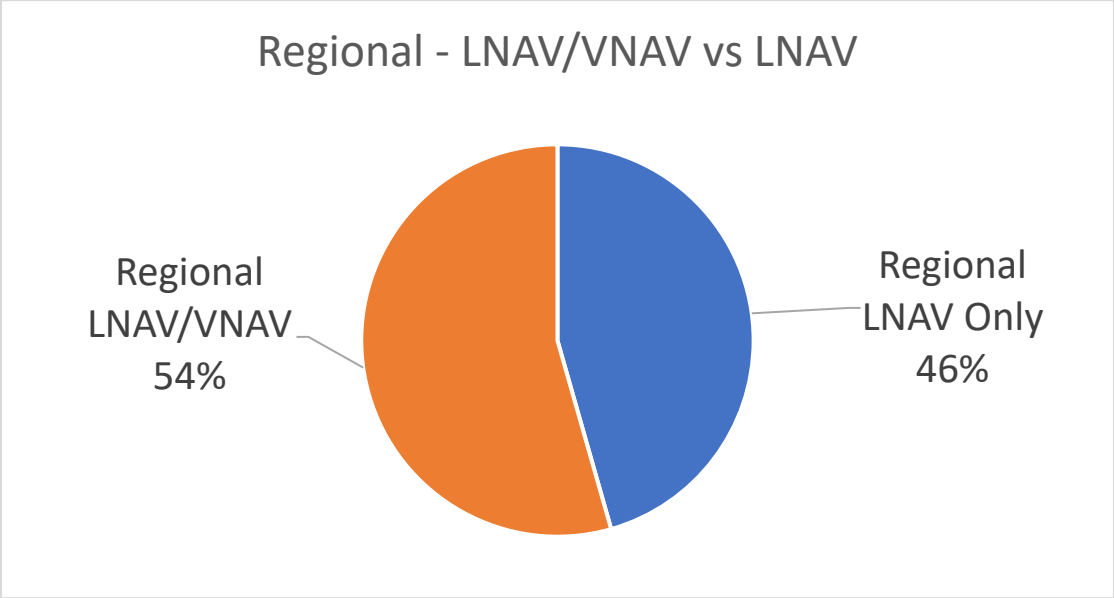
The Regional LNAV fleet can be further broken out by specific aircraft type:



While only 321/5324 (6 percent) of Mainline aircraft are LNAV equipped . . .



. . . 924/2027 (46 percent) of Regional aircraft are LNAV equipped.



These observations reveal two findings:

Finding #1: While Regional aircraft represent only 28 percent of the part 121 fleet, they represent 74 percent of LNAV-equipped aircraft.

Finding #2: Regional aircraft are almost eight times more likely (46 percent versus 6 percent) to be LNAV-equipped than their Mainline counterparts.

Survey Results

MITRE returned the following de-identified operator poll results:

A/C Type	***Pre-COVID LNAV-Only Fleet (Ops Specs)***	**Operator Reported LNAV-Only Fleet**	**Operator Plans to operate>5yr**	**Operator Plans to Equip**
CRJ	*704*	452	431	259
ERJ–135/145	*141*	113	113	0
Other	*408*	69	0	0
Total	*1253*	634	544	259

Assumptions

- The LNAV constraint on simultaneous parallel operations is most commonly observed at larger hub airports. As regional jets have significant operations at hubs, they disproportionally impact those operations as well. Our primary focus will therefore be on CRJ and ERJ operators due to this disproportionate impact.
- Any reference to ERJ aircraft in this analysis concerns only ERJ–135/145 models. As the newer ERJ–170/190 family is more fully equipped, those aircraft have no impact on this issue. No analysis in this document concerns or includes the ERJ–170/190 family of aircraft.
- This effort does not address any possibility that the U.S. Regional fleet may *increase* in future years. Although most new regional aircraft are indeed LNAV/VNAV capable, some new models are not suitable for the U.S. market with regard to labor agreement scope clauses. It is conceivable regional jet operators outside the U.S. may purchase new equipment, freeing up their older LNAV-equipped yet scope-compliant aircraft for deployment in the U.S.

Analysis

- The large decrease in LNAV "Other" aircraft may be largely attributed to mainline MD–80 retirements, under-classification errors in the database, and mainline aircraft operators who did not return a survey response.
- The decrease in CRJ and ERJ aircraft from pre–COVID–19 to the Operator Reported values can be partially attributed to two regional jet operators who did not return a survey response. Another possible cause might reflect post-drawdown retirements.
- Operator plans to retire aircraft may not be conclusively considered as leaving the commercial fleet. "Retired" regional aircraft are often purchased and returned to service by other operators. Considering the recent increased demand for these aircraft to serve smaller markets (ref Additional Perspective), we believe redeployment is more likely than not.

Fleet Impact Conclusions

- Although only 610 of the 845 CRJ/ERJ aircraft were represented in our survey, the fleet size will likely remain closer to its present size due to market trends favoring smaller markets served by these aircraft.

- Approximately 259 (31 percent) are currently planned for upgrade.

Upgrade Solutions

Aircraft and Avionics Manufacturers provided information associated with currently available upgrade solutions. This information focuses on the two most impactful platforms: the Canadair CRJ–200/700/900 and Embraer ERJ–135/145.

Impacted areas associated with upgrade to LNAV/VNAV or LPV capability include:

- Aircraft Systems
  - Flight Management System
  - Displays and Control Panels
  - Flight Director/Autopilot
  - Air Data and GNSS
  - Others, Depending on Configuration
- Simulation and Training
- Technical Publications

CRJ Solutions and Status

- CRJ–200
  - Avionics Manufacturer STC for LPV is Available
  - Autopilot Coupled VNAV is planned, Availability TBD
- CRJ–700/900/1000
  - OEM Service Bulletin for Autopilot Coupled VNAV/LPV is Available
- Challenges
  - Cost of STC and Service Bulletin are Highly Dependent on Aircraft Configuration
  - Component Obsolescence Limits Upgrade hardware availability

ERJ–135/145 Solutions

- Honeywell
  - Upgrade path for ERJ–145 is being developed as contracted by customers to include RNP, LPV, and VNAV capabilities.
  - This will be available for ERJ–145/135 equipped with Honeywell FMS and requires dual installation.
  - Upgrade availability TBD due to COVID delays.

Additional Perspective

Some added perspective was shared in group discussion which better informs the regional equipage issue.

Although LNAV/VNAV capability was delivered as basic on 757/767 and A–320 aircraft in the 1980s, their regional turboprop counterparts were not similarly equipped. Regional operators operated under contract to larger partners and the focus was on efficiency and low cost. When jet aircraft began to replace the older turboprop equipment, the low-cost efficiency model carried over to the newer platforms as 1:1 replacements.

As NextGen didn't begin to take shape until much later, the less-capable LNAV-equipped aircraft encountered no operating issues or impediments. Advanced capability wasn't required, so additional development wasn't demanded of the OEMs either.

This LNAV "stagnation" was overlooked by aviation planners as well, as this technology in regional aircraft largely stood still for a decade until increasing numbers of the LNAV/VNAV equipped EMB–170/190 family began to appear.

Where the COVID–19 pandemic appeared to be accelerating the retirement of the older LNAV aircraft, the characteristics of the recovery now strongly support their market viability once again. Therefore, we cannot rely on forecasts favoring LNAV aircraft retirements.

A more complete version of this discussion can be found in the Appendix.

Impediments to Upgrade

In addition to determining the status of fleet VNAV equipage currently operating in the NAS, the NAC tasking included an assessment of mainline and regional airline impediments to full VNAV operations. To determine this, the survey asked operators to describe the impediments associated with the implementation of LNAV/VNAV or LPV using the following questions in a drop-down menu:

1) Cost of Solution: Cost of existing solutions do not provide favorable return on investment.
2) No Operational Benefit: Benefit associated with LNAV/VNAV or LPV functionality does not warrant investment.
3) Long Aircraft Down Time: Aircraft down time associated with available solutions does not support operational needs.
4) Other: Other impediments exist, please capture any additional information in the Remarks column.

We gathered the following results from seven regional airline survey respondents:

Number of respondents	**Plan for VNAV/LPV**	**If not in plan—primary impediment**	**Likelihood of equipping in next 5 years**
2	In Plan	N/A	
2	Not in Plan	Cost	Not likely
1	Undecided	Cost	Not likely
1	Undecided	—	Not sure
1	Undecided	No operational benefit	Not likely

The cost of upgrading avionics equipment to enable LNAV/VNAV or LPV capability ranges from $75,000 to $350,000, depending on aircraft type, current configuration, and certification type (that is, service bulletin versus STC).

Although only one respondent mentioned an apparent lack of benefit from equipping, it is likely those who cited cost were not persuaded the operational benefit justifies the cost. The following areas could be investigated for potential operational benefits and resulting cost savings over time:

1) Savings from fewer weather diversions, averted by lower approach minima,
2) Time/fuel savings due to avoidance of additional vectoring required during an ILS outage during simultaneous parallel operations, and

3) More efficient climbs and descents if autopilot coupled VNAV (CVNAV) capability is acquired with lowered approach minimum capability.

These operational benefits were discussed by the working group, but it became clear it would require time and effort beyond the scope of this tasking to more clearly establish their applicability and impact on a cost/benefit analysis.

Although the clearly dominant impediment to upgrade was cost of solution, the working group also identified four other relevant impediments.

The Regional Airline—Network Carrier Business Relationship

Unlike the major carriers, which develop and execute their business plans with relative independence, the majority of regional carriers do not own their aircraft, but rather operate aircraft owned or leased by their code-share partner under the constraints of operating contracts. For this reason, the following are impediments to investment:

- Unable to establish ROI due to short length of contract, which precludes investment
- Length of remaining contract time and the region of operation often predicate equipage requirements
- Uncertainty of contract disposition past next renewal date can impede investment
- Competitive nature of the market makes an equipage investment difficult to execute while remaining a competitively attractive business partner
- If the regional airline does not own their aircraft, they are often minimally involved in aircraft equipage decisions, if at all
- Insulation from costs: It often occurs those bearing the cost are insulated from the negative effects of not equipping:
  - If the network carrier purchases fuel, then fuel economy is often not an emphasis item; the network carrier may also not have the granular visibility into their regional partners' operation to identify fuel savings opportunities.
  - If a regional airline is experiencing delays due to insufficient aircraft equipage or holding/vectoring in approach airspace, it may go undetected by their code-share partner if operational performance is within expectational bounds.

- Even if improvement opportunities are identified, the code-share partner may not be collecting sufficiently detailed data to clearly identify and correct the issue.

Training Device Configuration

Another impediment to equipage upgrade involves training support. Some regional carriers own their training devices; however, many purchase training device time from third-party vendors. Training devices can range from desk-top trainers to no-motion procedures trainers and full-flight simulators.

When upgrades to avionics systems require additional crew procedural training, and if the desired configuration is not yet widely available in the industry, the expense of upgrading training devices to the required standard must be borne by the carrier or its code-share partner.

Availability of Upgrade Hardware

Due to the age of manufacture of many of the aircraft types in use by the Regional carriers, there is a limited capability by the avionics equipment manufacturers to upgrade existing equipment due to component obsolescence. This is a significant challenge for two reasons:

1) The cost of re-design is driven by the high specifications associated with development, verification, and certification of aircraft equipment.
2) Unlike consumer products, aerospace avionics manufacturers do not typically justify a business case for components unless it is in association with a new aircraft type. Consequently, the modification of older equipment in legacy fleets becomes more and more difficult as component suppliers eventually abandon their older products to make room for newer equipment lines.

Monetization of Safety Improvements

There are additional safety benefits that accompany LNAV/VNAV capability, which add value but are difficult to quantify in a cost-benefit scenario:

1) In mixed fleets with some advanced vertical navigation capability and some without, there are demonstrated, operational improvements associated with aircraft capable of operating to LNAV/VNAV or LPV minimums.

2) It is widely acknowledged that autopilot coupled vertical guidance commonly available with LNAV/VNAV or LPV capability reduces unstable approaches.
3) The LPV SBAS receiver provides a more accurate present position solution, increasing safety margins in terrain-challenged environments.
4) LPV's lower minimums increase the likelihood of a successful approach and landing.
5) RNP + RF legs may be delivered with some of the modifications and would enable participation in RNAV (RNP) approaches, which simplify and stabilize downwind to final patterns, reducing ATC communications and saving time and fuel.

Final Comments and Closing

This NAC tasking was focused on Vertical Navigation, and specifically requested an assessment for full VNAV operations.

However, the resulting analysis of avionics upgrades made clear that enabling LNAV/VNAV or LPV capability alone does not represent all the capabilities required to fully leverage NextGen benefits. The FAA Minimum Capabilities List (MCL) Ad Hoc Team NAC Task 19-1 Report states on p15 that there are some, "… capabilities which, if absent on an aircraft, could be an impediment to the NAS." These include the following:

- Capability to fly curved Radius to Fix (RF) approach segments,
- Upgraded, resilient position sources,
- RNP position alerting and reporting features, and
- FANS 1/A over VDL Mode 2 Datacomm

The working group agreed that in order to address these requirements, executive leaders would require more specific, supportive benefit data to build a successful business case favoring NextGen equipage investments.

More study in this area is needed and should examine:

- All capabilities required to maximize NextGen benefits,
- How all navigational capabilities work together, including improvements that ensure safety at high density airports and reduce workload risks,
- Operational data from current NextGen implementations, and
- Projected data from planned implementations

The working group also agreed executive leaders will need to see:

- Benefits broken down in terms of which specific equipment provides which capabilities, delivering which benefits;
- Capabilities presented in such a way which will contribute to business analysis, such as where the additional capabilities are most beneficial, where and how cost savings may be achieved, or where markets may become more accessible; and
- Recommendations shaped for decision makers who may be less familiar with NextGen development and its goals.

Any follow-on efforts must draw on the expertise of operators, OEMs, and other stakeholders.

Closing

The working group would like to thank its members for their steadfast participation in its effort to move NextGen forward, and for their diligent collaboration in the development of this report.

Credits and Acknowledgments

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Glossary of Acronyms and Abbreviations

A-RNP	Advanced RNP
ATC	Air Traffic Control
CAST	Commercial Aviation Safety Team
CFIT	Controlled Flight Into Terrain
CRJ	Canadair Regional Jet
CVNAV	Autopilot Coupled Vertical Navigation
DA/MDA	Decision Altitude/Minimum Descent Altitude
Dep	Departure
DME	Distance-Measuring Equipment
EoR	Established on RNP
Equipage Gap	Difference between Aircraft Equipage/Capabilities
ERJ	Embraer Regional Jet
FMC	Flight Management Computer
FMS	Flight Management System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IAP	Instrument Approach Procedure
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
JSIT	Joint Safety Implementation Team
LNAV	Lateral Navigation
LNAV/VNAV	Lateral Navigation/Vertical Navigation

LPV	Localizer Performance with Vertical Guidance
Mins	Minimums
NAS	National Airspace System (U.S.)
NAC	NextGen Advisory Committee
Nav	Navigation
NextGen	Next Generation Air Transportation System
OEM	Original Equipment Manufacturer
Op Specs	Operations Specifications
PBN	Performance-Based Navigation
RF Legs	Radius-to-Fix (Curved) Approach Segments
RNAV	Area Navigation
RNP	Required Navigation Performance
ROI	Return on Investment
SBAS	Satellite-Based Augmentation System
SME	Subject Matter Expert
STC	Supplemental Type Certificate
TERPS	U.S. Standard for Terminal Instrument Procedures
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation

Appendix

Historical Perspective: How We Got Here

It's worth a pause to share some historical perspective disclosed in working group discussions.

LNAV/VNAV: Basic Capability or Upgrade?

Many of today's current generation aircraft were developed and purchased in the 1980s. As opposed to Classic 727s and DC–9s equipped with steam gauges and VOR/DME navigation, the 757, 767, and A–320 aircraft were all initially equipped with a digital Flight Management System (FMS) RNAV and electronic displays. LNAV/VNAV was the basic capability, not a selectable option that needed to be cost-justified by fleet managers. These technologies were developed as Boeing and Airbus engineers pushed the envelope on capabilities and delivered them as standard on new aircraft.

This paradigm changed with the advent of regional jets. As opposed to being equipped with new capabilities as an enticement to upgrade older, less capable aircraft, regional jets were developed as simple 1:1 replacements of the turboprop aircraft they were succeeding. One working group member who was then involved in his airline's aircraft selection process recalled his executives wanted, "a turboprop replacement with jet engines on the wings." An attempt at making a case for the benefits of VNAV was attempted but never seriously entertained, as decisions were purely cost-driven in that highly competitive environment.

Another working group member shared their experience while working for a regional jet manufacturer at that time. What minimal technical advances were designed into the aircraft were even sometimes requested to be removed by the customer for cost savings and standardized configuration with the aircraft it was replacing.

The takeaway here is that the LNAV CRJ and ERJ aircraft—which are constrained in today's airspace—were driven to less-capable configurations during a period driven by economic and market pressures. More advanced capabilities weren't offered on these aircraft because operators were asking neither the aircraft nor

avionics Original Equipment Manufacturers (OEMs) for them. The OEMs were simply reacting to their customers' demands at that time.

Failed Expectations

This effect of no demand for improved avionics capabilities failed to meet the expectations expressed by the Commercial Aviation Safety Team (CAST) in their Controlled Flight into Terrain (CFIT) report in 2000. In this "Results and Analysis" report dated June 1 of that year, the Joint Safety Implementation Team (JSIT) identified "Precision-Like Approach Implementation" as one of eight projects. On page 75 of this report, the authors stated, "The increased (operational) capabilities will occur naturally over time, because new production airplanes will come with better equipment installed and Standard or Classic airplanes will be retrofitted or retired. The challenge is to accelerate the introduction of increased capability." This acceleration never materialized as expected.

Where the JSIT expected commercial aircraft to migrate to VNAV-guided 3D approaches, this technological advancement largely stood still in regional aircraft for another 10 years, until increasing numbers of the better-equipped EMB–170/190 began to appear. The "Classic" category of aircraft (as the CAST report refers to them) continued to use the "Constant Angle" technology used by 727s and DC–9s, on which the report commented, "British Airways has been using this for 30 years. It works great."[2]

This JSIT expectation is also conveyed by a "Fleet Migration" graphic. (Figure 2) The timeline for the elements in this graphic was expected to "contribute to the safety goal of an 80 percent reduction in the commercial accident rate by 2007."[3] Although that goal was eventually met with an eventual 83 percent reduction, LNAV–equipped Regional aircraft continued to be delivered nearly 20 years later.

[2] Controlled Flight Into Terrain (CFIT) Joint Safety Implementation Team (JSIT), "CFIT JSIT Results and Analysis," June 1, 2000. p. 54.
[3] Controlled Flight Into Terrain (CFIT) Joint Safety Implementation Team (JSIT), "CFIT JSIT Results and Analysis," June 1, 2000. p. 75.

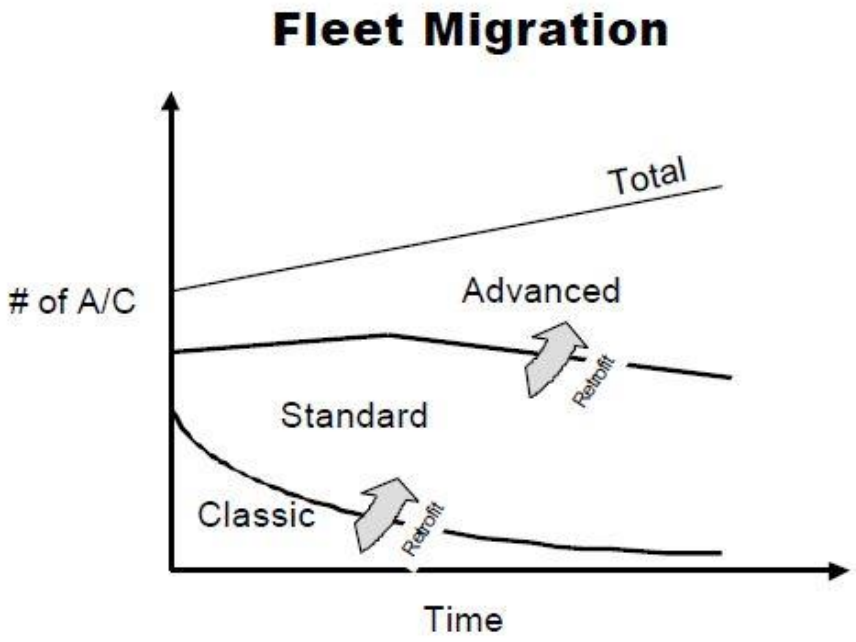

Figure 2

The FAA's "PBN NAS Navigation Strategy 2016" assumes a similar expectation. Table 7 on page 26 of this document clearly defines "RNAV (GPS) approach capability (LNAV/VNAV or LPV)" as a minimum PBN capability for Navigation Service Group 1 airports for the Mid Term. (Figure 3)

Table 7 – Minimum PBN Capabilities

	Near Term (2016–2020)	Mid Term (2021–2025)	Far Term (2026–2030)
Class A Airspace Above FL290	☐ RNAV 2, supported by GNSS or DME/DME	☐ GNSS and DME/DME navigation	
Class A Airspace Below FL290	☐ RNAV 2, supported by GNSS or DME/DME		
Navigation Service Group 1		☐ GNSS and DME/DME navigation ☐ RNAV (GPS) approach capability (LNAV/VNAV or LPV) ☐ RNP 1 capability ☐ RF capability	☐ Time of Arrival Control guidance and automation
Navigation Service Group 2		☐ GNSS and DME/DME navigation	☐ RNAV (GPS) approach capability (LNAV/VNAV or LPV) ☐ RF capability
All IFR Operations		☐ Early in the mid term, RNAV 2 and RNAV 1, supported by GNSS ☐ RNAV (GPS) approach capability (LNAV at minimum)	☐ RNAV (GPS) approach capability (LNAV/VNAV or LPV)*

Figure 3

While these policy expectations have been generally achieved by Mainline fleets, they have gone largely unmet by the Regional fleets; however, with the introduction of Embraer's more fully equipped ERJ–170/190 series and more recent deliveries of CRJs, Regional aircraft capabilities have begun to match Mainline equipage.

In summary, a cost/benefit case was never necessary to justify LNAV/VNAV capability on mainline aircraft because aircraft OEMs delivered it as standard equipment. A market shift coincided with the development of Regional aircraft, so the equipment shifted to less capable LNAV systems, failing to meet policy planning expectations, old and new.

Prior to the COVID–19 pandemic, the market was trending away from older, smaller, less capable Regional aircraft as their age progresses well into the latter years of their expected service life; however, the pandemic has driven many working professionals away from the larger cities in favor of tele-commuting from more remote areas. Where the smaller aircraft were only very recently being parked with little expectation of their return, they are now not only returning to the fleet, but are now in increasingly greater demand to serve these trending, newly popular smaller markets.