AUSTRALIA + CANADA + NEW ZEALAND + UNITED KINGDOM + UNITED STATES

NATIONAL AVIATION AUTHORITIES NETWORK

ROADMAP FOR ADVANCED AIR MOBILITY AIRCRAFT TYPE CERTIFICATION

EDITION 1.0

Front cover image: Sydney, Australia

April 2025.

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This Roadmap is supported by a Declaration of Intent, signed by the national aviation authorities listed on this page. The declaration recognises the importance of fostering cooperation and building resilience to keep pace with and meet the challenges of safely type certifying Advanced Air Mobility aircraft and other rapidly evolving aviation technologies.

Australian Government
Civil Aviation Safety Authority

Transport Canada

Transports Canada

Federal Aviation Administration

CAA
CIVIL AVIATION AUTHORITY OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

UK Civil Aviation Authority

Image: New York, United States of Amercia

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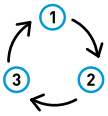
EXECUTIVE SUMMARY

The National Aviation Authorities (NAA) Network comprises authorities from Australia (Civil Aviation Safety Authority), Canada (Transport Canada Civil Aviation), New Zealand (Civil Aviation Authority), United Kingdom (Civil Aviation Authority), and the United States of America (Federal Aviation Administration).

The NAA Network's Roadmap for Advanced Air Mobility (AAM) Type Certification sets forth a unified and strategic approach to foster collaboration, safety assurance, technological innovation, and AAM inclusive bilateral agreements. In the face of emerging AAM technologies, including electric Vertical Take-Off and Landing (eVTOL) aircraft, the Roadmap outlines a clear path to align aircraft type certification standards, harmonize airworthiness requirements, and facilitate information sharing among network members to maximize the transferability of type certified AAM across the Network, whilst acknowledging an incremental approach to the type certification of AAM aircraft.

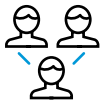
This Roadmap is centered on the NAA Network Authorities working towards the following six key principles:

Safety and innovation: Balance safety standards with technological advancement and promoting innovation within a safety-first framework.

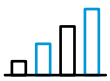


Harmonized type certification: Develop a three-phase approach focusing on use of performance-based requirements, seeking convergence on requirements where differences exist, and applying mutually accepted Means of Compliance to achieve the streamlined validation of AAM aircraft across the NAA Network.

Collaboration and alignment: Foster collaboration within the NAA Network and coordination with other key Authorities that have active domestic AAM certification projects.



Collaborative multi-authority validation: Leverage opportunities for collaborative multi-authority validation of AAM aircraft undergoing type certification by one of the NAA Network authorities.



Incremental approach: Recognize a crawl, walk, run approach for type certifying AAM aircraft, building first on piloted AAM, and then remotely piloted AAM with increasing levels of autonomy.

AAM inclusive bilateral agreements: Establish guiding principles and a comprehensive process for establishing new bilateral agreements and updating existing bilateral agreements, specifically regarding type certification and streamlined validation of AAM aircraft.

The Roadmap's foundation is built on agreed principles, collective action, strategic expansion, and a commitment to shaping a responsible and dynamic pathway for AAM certification. By working to align global standards, leveraging best practices, and engaging with industry stakeholders, the NAA Network aims to position itself at the forefront of AAM development and certification, driving progress and ensuring alignment within the ever-evolving landscape of aviation technology.

This Roadmap is considered a living document that details the guiding principles associated with certification and validation of AAM Aircraft within the NAA Network. The Roadmap will be updated with increasing detail as NAA Network authorities progress their AAM certification work and differences in certification standards are identified and minimized where possible.

The Roadmap's foundation is built on agreed principles, collective action, strategic expansion, and a commitment to shaping a responsible and dynamic pathway for AAM certification.

BACKGROUND AND CONTEXT

The emergence of AAM technologies, particularly eVTOL aircraft, has ushered in a new era of aviation, marked by nascent innovation and complexity. This section outlines the context within which the NAA Network's Roadmap is situated.

AAM Landscape:

- **Current technologies:** eVTOL, hydrogen-based propulsion systems, and other AAM technologies are revolutionizing urban mobility and offering new transportation solutions.
- **Global trends:** Increasing interest and investment in AAM technologies across various regions and industries culminating in type certification or supplemental type certification from NAAs to realize the capability inherent in these technologies.

NAA Network Regulatory Environment:

- **Existing regulations:** Existing NAA Network domestic regulations form the basis upon which bilateral agreements can mutually recognize comparable certification processes and airworthiness requirements enabling the validation and transferability of AAM aircraft across the Network. This includes the use of title 14, Code of Federal Regulations (14 CFR) 21.17(b) as the type certification approach for special class aircraft utilizing airworthiness criteria to identify additional airworthiness requirements as required for the AAM under type certification.
- **Federal Aviation Administration (FAA):** Under 14 CFR 21.17(b), the FAA used to develop the powered-lift certification basis with a project-by-project approach. Recently, the FAA has published draft general interim airworthiness criteria for powered-lift in Advisory Circular (AC) 21.17-4, Type Certification – Powered-lift. In conjunction with this AC, the FAA has also published Policy Statement PS-AIR-21.17-03, Safety Continuum for Powered-lift, which establishes certification levels including corresponding safety targets. Lastly, the FAA has published PS-AIR-21.17-02, Special class rotorcraft, which identifies certain rotorcraft as special class based on their designs.
- **Australian Civil Aviation Safety Authority (CASA):** CASA will use their equivalent regulation to 14 CFR 21.17(b) to establish the type certification basis for special class aircraft supplemented with airworthiness criteria as required. FAA published airworthiness criteria will be used, and additional or modified airworthiness criteria may be developed for any requirements unique to the AAM under type certification.
- **Transport Canada Civil Aviation (TCCA):** TCCA will use their equivalent processes and regulations to 14 CFR 21.17(b) to establish the type certification basis for AAM aircraft supplemented with airworthiness criteria as required. FAA published airworthiness criteria may be used, and additional airworthiness criteria may be developed for any requirements unique to the AAM under type certification.

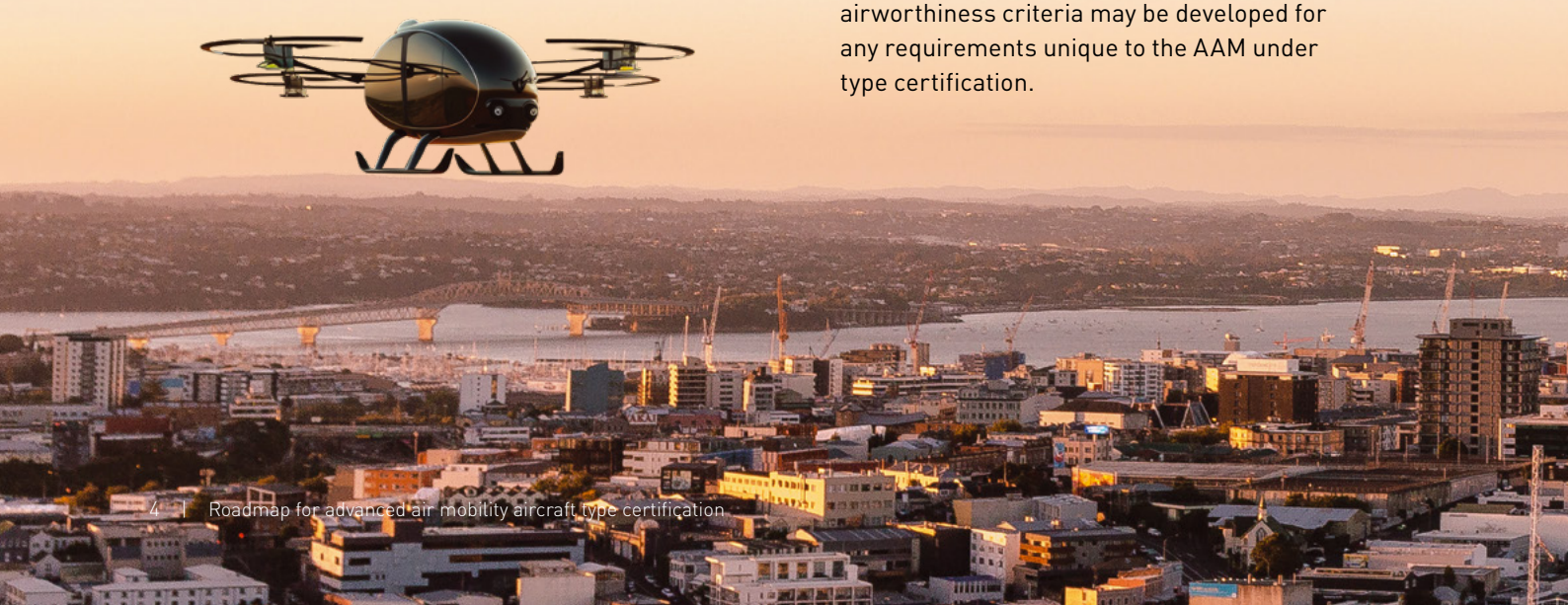


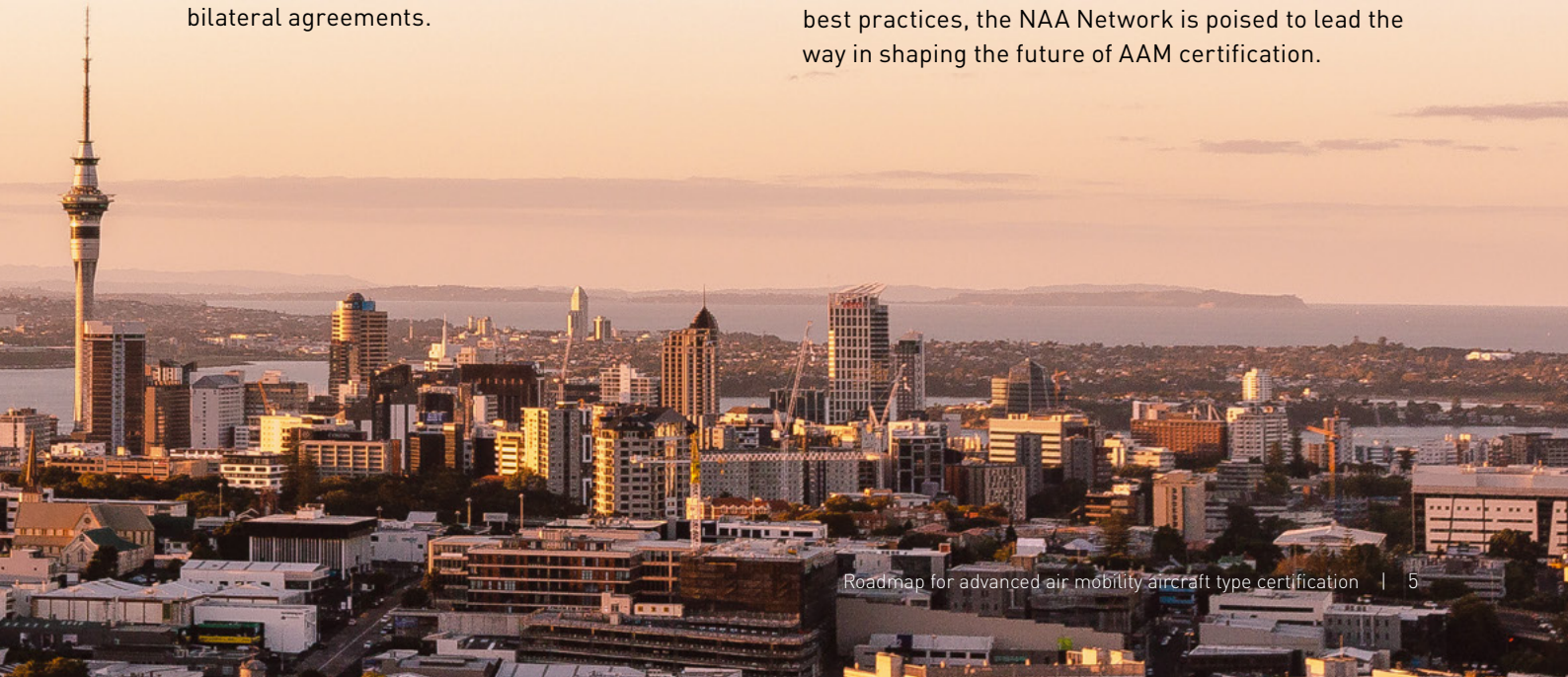
Image: Auckland, New Zealand

- **Civil Aviation Authority of New Zealand (CAA NZ):** CAA NZ will utilize the flexibility within the New Zealand regulatory framework to accept appropriate airworthiness design standards on a case-by-case basis.
- **United Kingdom Civil Aviation Authority (UK CAA):** The UK CAA has adopted the European Union Aviation Safety Agency (EASA) SC-VTOL as the prescribed airworthiness standards for type certifying AAM. NAA Network coordination and alignment with the UK CAA on common airworthiness standards is critical, considering the differences that currently exist between SC-VTOL and the airworthiness criteria prescribed in FAA AC 21.17-4.
- **Streamlined validation:** This Roadmap refers to the principle of streamlined validation. In the context of this Roadmap, streamlined validation is the process that prioritizes validation effort towards the differences in certification standards, accepts the type certifying Authorities findings of compliance where there are no differences, promotes the exchange of Means of Compliance, and leverages efficiencies through multi-validation teams. Streamlined validation does not infer an administrative review of the AAM type design and does not supersede arrangements in NAA Network bilateral agreements.

Challenges and opportunities:

- **Challenge:** Preserving the safety focus inherent in the type certification process whilst maximizing the use of consensus standards and accepted means of compliance to ensure that NAAs have the capacity to meet industry demands to type certify and validate AAM.
- **Challenge:** Enabling innovation while maintaining, or improving upon, current levels of aviation safety, supporting global harmonization, and recognizing updated bilateral agreements.
- **Opportunity:** Fostering collaboration, promoting technological advancement, and streamlining validation processes within the NAA Network.
- **Opportunity:** Meeting industry desire for regulatory harmonization of certification and validation requirements and processes to enable transferability of AAM aircraft across the Network.

The background and context of AAM certification underline the vital need for a strategic and harmonized approach. The NAA Network's Roadmap recognizes the potential of AAM technologies and the complexity of the regulatory landscape, focusing on safety, collaboration, innovation, and AAM inclusive agreements. By understanding the current landscape and working towards aligned global standards and best practices, the NAA Network is poised to lead the way in shaping the future of AAM certification.



SAFETY AND INNOVATION

Safety and innovation are at the core of the NAA Network's approach to AAM certification. This section outlines the strategies to foster a culture of safety while supporting technological advancement.

Principle 1, Safety and Innovation: Balance safety standards with technological advancement and promoting innovation within a safety-first framework.

The safety continuum:

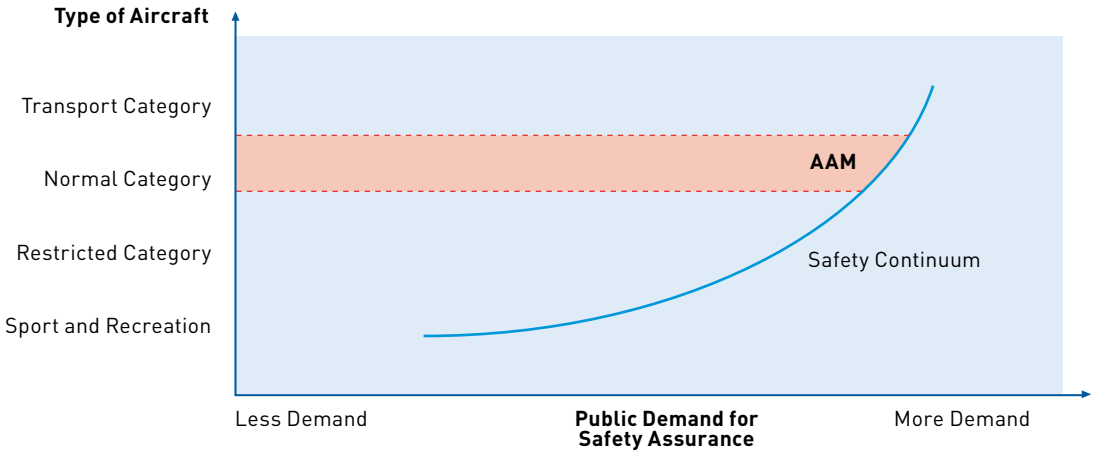
The NAA Network recognizes the safety continuum, as described by the International Civil Aviation Organization (ICAO)[1], in the context of type certifying AAM aircraft and other emerging aviation technologies.

"Society demands greater safety assurance as the products and their operations become more complex, and as the occupants become further removed from understanding and managing the risks.

Society demands a greater safety rigour for a large commercial transport aeroplane than for a small aeroplane" (ICAO).

The NAA Network will apply the principles of the safety continuum when seeking convergence on airworthiness requirements and type certifying AAM aircraft. This is achieved by the proportionate application of airworthiness standards that are based on the AAM maximum gross weight, maximum number of passengers, and the intended type of

Figure 1. Illustrative application of the Safety Continuum to AAM Aircraft



1 ICAO Airworthiness Manual, Document 9760, Fourth Edition, 2020

operations. The combination of existing airworthiness standards, such as 14 CFR Part 23 for normal category aircraft, are the starting point on the safety continuum, supplemented by the additional airworthiness requirements in FAA AC 21.17-4 or UK CAA SC-VTOL.

Both FAA AC 21.17-4 and UK CAA SC VTOL provide a tiered approach to the type certification of AAM aircraft. This tiered approach is aligned to the safety continuum in that it provides a tailored approach to type certification informed by the type of AAM aircraft operation and maximum number of passengers. These principles will continue to be applied by the NAA Network commensurate with industry innovation of AAM aircraft.

Figure 1 is an illustrative example of the application of the safety continuum to the type certification of AAM aircraft.

Collaboration and alignment on airworthiness:

- **Objective:** Achieve convergence across the NAA Network on common airworthiness requirements.
- **Best practices sharing:** Engage in collaboration and information exchange on best practices among NAA Network members.

Safety standards and certification:

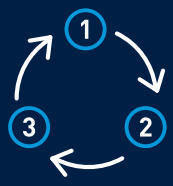
- **Objective:** Uphold high safety standards, reflecting critical considerations for eVTOL and other emerging technologies.
- **Risk management:** Implement comprehensive risk management strategies for safety assurance.
- **Safety Management System:** Identifying the hazards and analyzing, assessing and controlling the risk, and managing the risk within the acceptable safety levels.
- **Development assurance:** Incorporation of development assurance best practices, such as SAE document ARP4754B, *Guidelines for Development of Civil Aircraft and Systems*, and SAE document ARP4761A, *Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment*.
- **Monitoring and compliance:** Develop robust monitoring mechanisms to ensure compliance with safety regulations.

Innovation and technological advancement:

- **Objective:** Promote innovation within a safety-first framework.
- **Industry collaboration:** Collaborate with industry stakeholders to support the development of innovative AAM technologies.
- **Regulatory flexibility:** Provide a supportive regulatory environment that balances innovation with safety considerations.

Safety and innovation are intertwined priorities for the NAA Network, requiring a harmonized and forward-looking approach. By fostering collaboration on airworthiness, applying the safety continuum and emphasizing risk management, and promoting technological advancement, the Network establishes a robust framework for AAM certification that supports development of global standards and industry needs. This approach lays the foundation for subsequent strategies related to expansion and future actions.

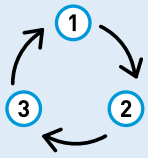
HARMONIZED TYPE CERTIFICATION



In the complex field of AAM type certification, collaboration and alignment across international boundaries are essential. This section outlines the NAA Network's approach to achieving these goals.

Harmonized certification across the network

A principle of the NAA Network and this Roadmap is to seek harmonization and convergence on the airworthiness standards and associated means of compliance used in the type certification of AAM aircraft.



Principle 2, Harmonized Type Certification: Develop a three-phase approach focusing on use of performance-based requirements, seeking convergence on requirements where differences exist, and applying mutually accepted Means of Compliance to achieve the streamlined validation of AAM aircraft across the NAA Network.

The following Three-Phased Approach will be used between the NAA Network Authorities, underpinned by collaboration and exchange of knowledge. These three phases will occur concurrently but quasi-independently with each other.

1. **Performance-based requirements:** Leverage the flexibility inherent in existing regulatory frameworks to utilize performance-based requirements, harmonizing the AAM-specific certification requirements detailed in Appendix A of FAA AC 21.17-4, *Type Certification – Powered-lift*, additional Airworthiness Criteria published by NAA Network Authorities, and the UK CAA's adoption of EASA SC-VTOL.
2. **Convergence on requirements where differences exist:** Exchange of type certification knowledge and compliance information to converge on airworthiness requirements where differences exist in the application of AAM requirements between the Network Authorities.
3. **Mutually accepted means of compliance:** Maximize use of consensus standards and accepted means of compliance and develop common guidelines and procedures for demonstrating compliance, leading to NAA Network Authority acceptance of findings of compliance to enable streamlined validation of AAM within the NAA Network.

Performance-based requirements

The NAA Network Authorities use of the latest amendment to the 14 CFR Part 23 or CS-23 aircraft certification standards replace prescriptive airworthiness requirements with performance-based requirements and considers consensus-based compliance methods for specific AAM designs and technologies.

The 14 CFR Part 23 and CS-23 performance-based airworthiness requirements provide flexibility and encourages innovation by industry. When supplemented with Airworthiness Criteria or Special Conditions, NAA Network Authorities can work with AAM Original Equipment Manufacturers (OEM) to agree on a certification basis for AAM aircraft that provides appropriate safety assurance for the new and novel technologies being type certified.

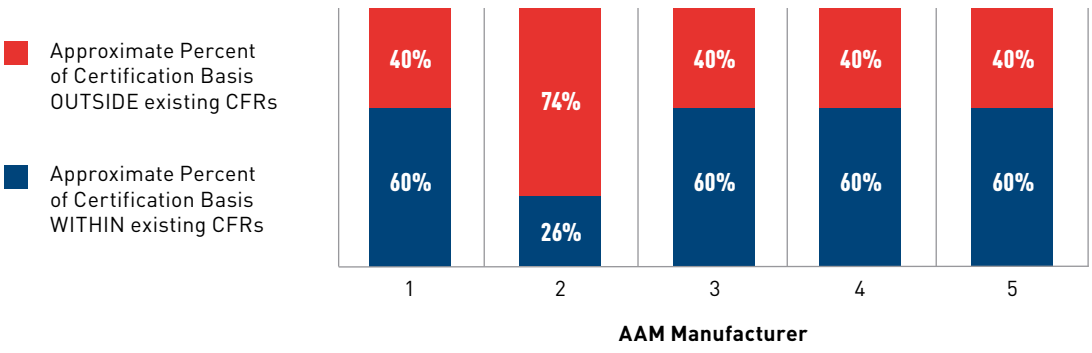
Where differences exist

The NAA Network recognizes that differences do currently exist between the FAA Airworthiness Criteria applied to type certifying AAM aircraft and the UK CAA special condition SC-VTOL applied for the same purpose. However, the core starting point in both cases is 14 CFR Part 23 Amdt 64 or CS-23 Amdt 5 respectively – both of which are performance based and essentially aligned in their airworthiness requirements.

Figure 2[2] is a notional chart that illustrates the approximate percentage of an AAM (airframe) certification basis that is within existing CFRs, including 14 CFR Part 23, for a sample of five active AAM type certification applications underway with the FAA. The remaining percentage of the certification basis is comprised of the FAA Airworthiness Criteria.

The sample data detailed in Figure 2 provides useful context that approximately 60% of certification requirements for AAM are already known and used by the NAA Network when certifying aircraft, with the

Figure 2. Certification basis and existing regulations for U.S based AAM manufacturers



2 U.S. Department of Transportation, Office of Inspector General Report AV2023037, dated June 21, 2023.

remaining 40% of the certification requirements being introduced for AAM. Please note this data is dynamic and these percentages will not hold as FAA makes progress on eVTOL certification basis.

The FAA has published AC 21.17-4, with Appendix A containing the airworthiness criteria for a powered-lift design. Any deviations from this set of criteria would be published in the Federal Register. The UK CAA takes a slightly different approach with their publishing of SC-VTOL, however SC-VTOL itself comprises airworthiness requirements taken directly from CS-23 Amdt 5 and supplements these with AAM specific requirements, essentially achieving the same result as the FAA. The UK CAA also uses Special Condition SC E-19 for electric hybrid propulsion systems, whereas the FAA provide these requirements within the Airworthiness Criteria of the aircraft if the engine is approved as part of the special class aircraft type certificate approval.

The NAA Network will continue to identify differences in airworthiness requirements that currently exist across the NAA Network and actively work to converge and resolve these differences where possible. This work will inform the development of an AAM certification basis by an AAM OEM seeking validation by another NAA Authority. Currently the primary differences are between FAA Airworthiness Criteria published in AC 21.17-4 and UK CAA SC-VTOL. Over time, the NAA Network aspires to progress through convergence to alignment and harmonization of the Airworthiness Requirements applicable to type certifying AAM.

The NAA Network will continue to identify differences in airworthiness requirements that currently exist across the NAA Network and actively work to converge and resolve these differences where possible.

For the NAA Network to realize the benefits of collaboration and alignment, there must be a high degree of alignment between the FAA Airworthiness Criteria and UK SC-VTOL for the specific requirements applied to type certifying AAM. The relatively small percentage in differences between these two sets of requirements is where Network authorities' focus will be applied, firstly when validating, and secondly when seeking to minimize and harmonize these differences across the NAA Network.

Future editions of this Roadmap may include details the differences in airworthiness requirements that exist across the Network. These differences may also include any unique certification airworthiness criteria identified by NAA Network members in addition to those already detailed in FAA AC 21.17-4 and UK CAA SC-VTOL.

Consensus standards

In addition to converging existing differences in airworthiness requirements, the NAA Network Authorities seek to use industry consensus standards as means of compliance for the type certification of AAM. Where the NAA Network are not able to reach convergence on an airworthiness requirement, agreement on the application of consensus standards by the Network will help achieve the aim of streamlined validation. To assist with achieving this outcome, the Network will coordinate their participation in the AAM related work of industry Standards Development Organizations (SDO).

The NAA Network Authorities will coordinate their involvement with SDOs to maximize coverage across the standards being developed, reduce duplication of effort, transfer knowledge and insight between Authorities, and provide coordinated strategic influence into the consensus standards being developed.

Concept of operations

In addition to the differences between Airworthiness Criteria, an AAM OEM's proposed concept of operations (CONOPS) may be used to inform the Airworthiness Criteria applied as part of the type certification process.

One way the CONOPS can be used in the type certification process is to classify the AAM aircraft into type certification sub-categories dependent on the inherent risk of operations. The adoption of such sub-categories could be informed by:

- The maximum number of passengers.
- Aircraft maximum take-off weight.
- Intended aircraft operations, including whether the aircraft operations intend to carry passengers for compensation or hire.

The NAA Network will look for opportunities to incorporate this approach as it will focus type certification effort proportionate to operational risk resulting in a simplification of type certification effort where appropriate.

Additionally, once AAM operations have commenced, lessons learnt from these operations will be an important feedback consideration for successive AAM type certification projects. The feedback of AAM operational information across the NAA Network will be used to inform updates to airworthiness requirements, means of compliance, and will provide opportunities for the NAA Network Authorities to further understand and resolve differences in airworthiness requirements.

COLLABORATION, ALIGNMENT AND REDUCING VALIDATION EFFORT

Given the complexity of AAM aircraft, and industry desire to bring these types of aircraft to market safely and quickly, it is incumbent on the NAA Network members to seek all opportunities to reduce the validation effort associated with introducing a type certified AAM aircraft into operational service. The guiding principle is to reduce the certification burden on not just the validating Authority(s), but also the type certifying Authority, and the applicant (OEM).

Principle 3, Collaboration and Alignment: Foster collaboration within the NAA Network, including parallel alignment with UK CAA, and coordination with other key Authorities that have active domestic AAM certification projects.

The differences between the FAA Airworthiness Criteria and the UK CAA SC-VTOL, along with any additional AAM aircraft type specific Airworthiness Criteria necessary for certifying the aircraft, and any differences in the associated means of compliance for these criteria should serve as a focal point when validating another NAA Network members type certified AAM.

Where there are no differences, then primacy should be given by the validating Authority to the acceptance of the type certifying Authorities findings of compliance.

Similarly, the validating Authority should leverage the acceptance of finding of compliance tests and demonstrations conducted by the type certifying Authority and minimize the duplication of these activities for the purposes of validation.

Reducing validation effort is highly dependent on understanding the acceptable Means of Compliance agreed by a NAA Network member, and which Industry Consensus Standards have been accepted as a Means of Compliance. The exchange of Means of Compliance information between the NAA Network as part of this validation activity is a key initiative to reduce overall validation effort.

The ability and willingness of Network members to agree on Means of Compliance and accepted Industry Consensus Standards, under, or consistent with the principles of existing agreements and arrangements, is the ultimate outcome when seeking to achieve streamlined validation of AAM aircraft.

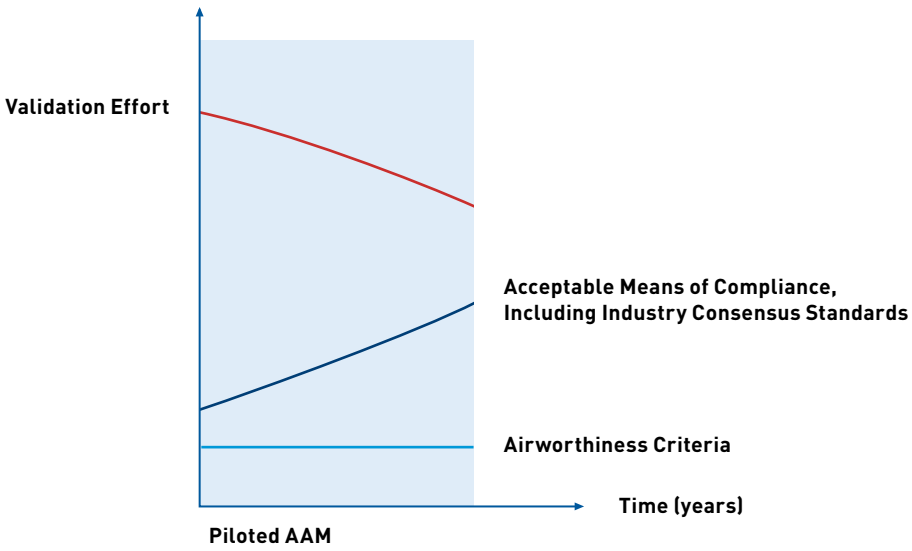
Over time, the exchange of Means of Compliance information between NAA Network members, the increasing acceptance of published Industry Consensus Standards, and the reduction of differences between FAA Airworthiness Criteria and the UK CAA SC-VTOL will result in a decreased validation effort, as measured by redundant resource and time expenditure, and the timely introduction of AAM aircraft into service.

Figure 3 illustrates decreasing validation effort (measured by redundant resource and time expenditure) commensurate with increasing acceptable means of compliance for a piloted AAM aircraft.

Noting the importance of the exchange of Means of Compliance to achieve these outcomes, NAA Network member needs to be sensitive to the fact that some Means of Compliance will be subject to Intellectual Property considerations as they may contain an AAM OEM's propriety information.

In such cases, the type certifying Authority will need to identify this constraint to the validating Authority and agree a workaround. There may be specific provisions in the bilateral agreement for Means of Compliance to address Intellectual Property considerations.

In cases where not all Network members are validating Authorities on a particular certification project, then the NAA Network will ensure that appropriate sharing and learning can occur across the Network, inclusive of any Intellectual Property considerations, to achieve the principle of reducing the certification burden on future type certification projects.**Figure 3.** Decreasing Validation Effort (measured by redundant resource and time expenditure) with Increasing Acceptable Means of Compliance



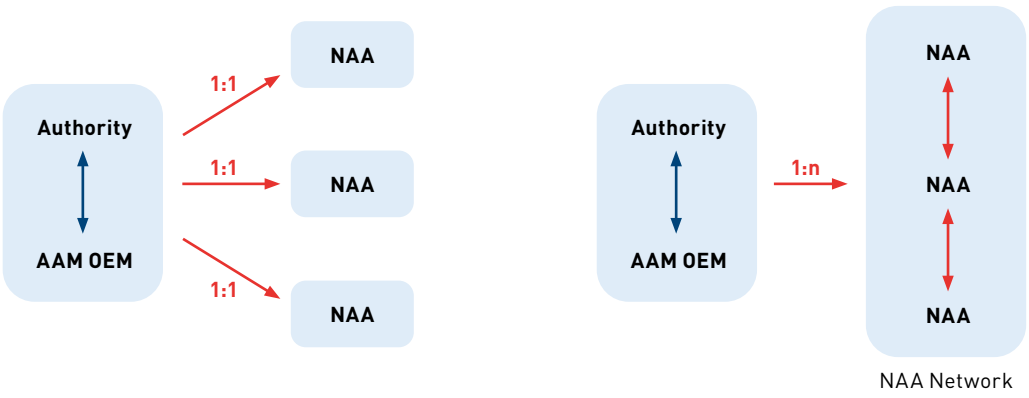
COLLABORATIVE MULTI-AUTHORITY VALIDATIONS

Situations may arise where the AAM OEM seeks validation from multiple NAA Network Authorities. Under this scenario, the guiding principles for validation detailed in this Roadmap need to be implemented across all validating Authorities.

Principle 4, Collaborative Multi-Authority Validation: Leverage opportunities for multi-authority collaborative validation of AAM aircraft undergoing type certification by one of the NAA Network authorities.

The important objective of this approach is the reduction of validation burden for all NAA Network Authorities and the AAM OEM involved in the multi-validation activity. Ideally this would be implemented through a "one-to-many" collaborative program between the type certifying Authority and the validating Authorities, such that the type certifying Authority can communicate and exchange type certification information once to all validating Authorities and that the validating Authorities work together to coordinate requests for validation information and integrate their validation work into the type certification program in an efficient and collective manner.

Figure 4. The case for collaborative multi-authority validation



Whilst multi-authority validation can and will ultimately be underpinned through respective bilateral agreements, the NAA Network Authorities recognize that a collaborative approach to AAM validation can be taken across the Network now without the need to amend existing or enter into new bilateral or multilateral arrangements.

In this collaborative model, the validating authorities collaborate their expertise, considerations, and efforts towards the common goal of validating the AAM, whilst each retains its regulatory independence regarding acceptance of airworthiness requirements, compliance, and any associated conditions and limitations imposed via the validated type certificate.

Figure 4 illustrates the traditional one-to-one approach for validation and the approach for multi-authority validations.

One advantage of the multi-authority validation approach is that Authority efficiencies can be realized in the immediate term whilst bilateral agreements are reviewed and updated to recognize the more formal process of risk-based validation and acceptance.

Another advantage of this approach is to enable the convergence of airworthiness requirements and facilitate alignment in the application of Means of Compliance and Industry Consensus Standards across the Network, through practical validation activities.

Global coherence

The NAA Network sets a global precedent for a unified and strategic pathway in AAM certification. The focus on collaboration and alignment underscores the NAA Network's commitment to creating a harmonized approach to AAM certification. By adopting a three-phase approach to certification requirements centered on performance-based requirements, minimizing differences, and mutually accepted Means of Compliance, the resources and time required to support AAM validation effort will be reduced and the transferability of AAM across the Network will be improved This approach is underpinned by fostering collaboration between the NAA Network members and alignment where possible.

The NAA Network sets a global precedent for a unified and strategic pathway in AAM certification.

The key to achieving this outcome is the exchange and transferability of Airworthiness Criteria and Means of Compliance between the NAA Network member authorities.

This collaborative framework will guide subsequent strategies and actions in safety, innovation, incentivize the development and update of bilateral agreements, and demonstrate NAA Network leadership in reaching global consensus on AAM airworthiness requirements where differences currently exist.

INCREMENTAL APPROACH

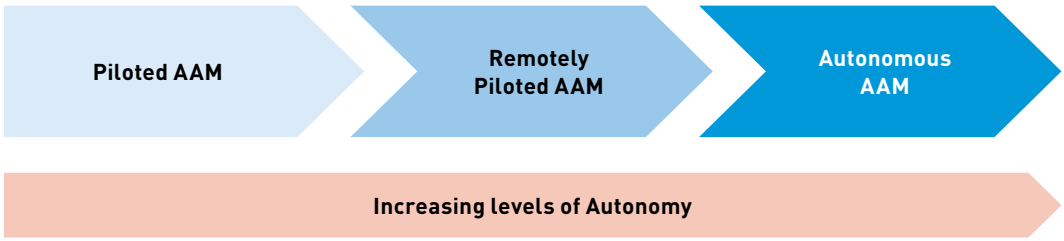
The NAA Network Authorities recognize the challenges with type certifying AAM aircraft given the rapid pace of industry innovation. This Roadmap builds on an incremental crawl-walk-run approach taking advantage of existing opportunities, utilizing existing type certification processes and airworthiness standards, and recognising that NAA Network Authorities will develop supplemental airworthiness criteria and special conditions over time to support type certification of increasingly complex AAM aircraft.

Principle 5, Incremental Approach: Recognize a crawl, walk, run approach for type certifying AAM aircraft, building first on piloted AAM, and then remotely piloted AAM with increasing levels of autonomy.

Figure 5 is an example that illustrates the three primary technology phases associated with AAM aircraft. Airworthiness criteria will be developed for these technology phases, initially informed by individual type certification projects and the application of industry consensus standards where appropriate. The success of one technology phase is dependent on the success of the preceding phase.

The harmonization of AAM certification requirements utilizing the three-phased approach previously described is an important model to apply commensurate with evolving AAM technologies. Applying this model to piloted AAM aircraft and then incrementally to remotely piloted AAM with increasing levels of autonomy provides an efficient framework for type certification and reduces the resources and time required to support the validation effort until such time as certification of these AAM technologies is normalized as a steady state activity.

Figure 5. Incremental approach to type certifying AAM technology phases



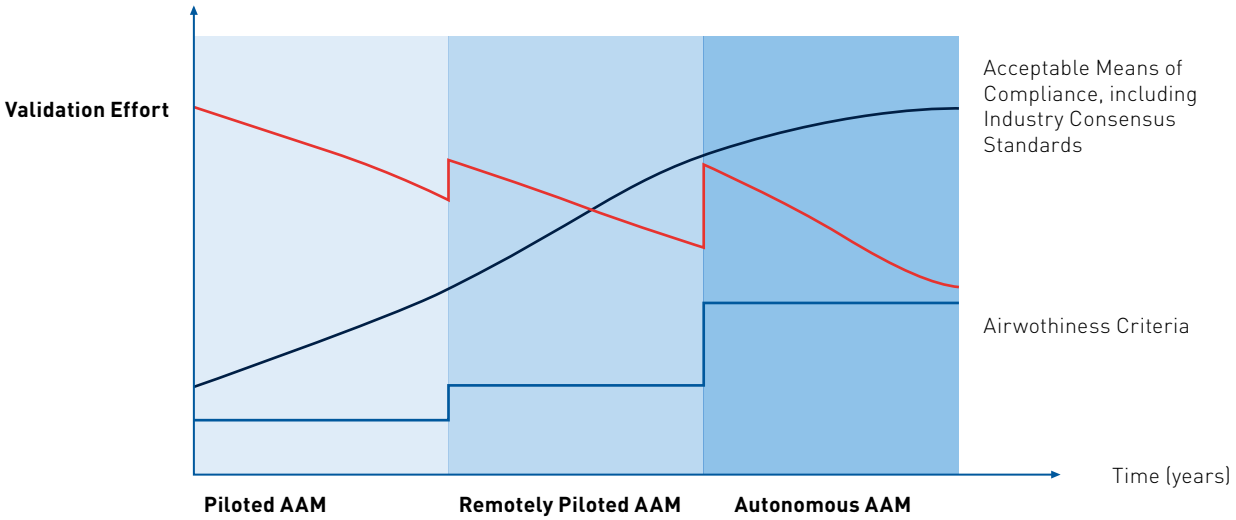
Airworthiness criteria is required for each AAM technology phase, where each set of criteria incrementally builds on the last. When coupled with acceptable means of compliance that leverage industry consensus standards, and collaboration across the NAA Network, the resources and time expenditure required to support certification and validation effort should be expected to decrease over time.

Building on the principles of reducing validation effort discussed in the previous section, Figure 6 illustrates decreasing validation effort commensurate with increasing acceptable means of compliance for each AAM technology phase.

Ultimately, this approach will provide regulatory efficiencies to the NAA Network authorities through reduced need for unique standards development, reduced resources and time expenditure required for validation effort, and therefore, reduced burden on AAM OEM's, resulting in expedited introduction into service of AMM by each NAA Network authority.

An inability to converge on airworthiness criteria and accept means of compliance across the Network will result in an escalation of validation effort as successive AAM technology phases are matured. The NAA Network recognizes this is an undesirable outcome and this Roadmap serves to provide the strategic approach to guide the Network Authorities towards harmonization through these technology phases.

Figure 6. Decreasing Validation Effort (measured by redundant resource and time expenditure) with Increasing Acceptable Means of Compliance



AAM INCLUSIVE BILATERAL AGREEMENTS

The strategic inclusion of AAM aircraft through updated bilateral agreements is a cornerstone of the NAA Network's approach to AAM certification. This section details the processes and strategies required to review and update bilateral agreements where necessary to include powered lift AAM type certification and the associated streamlined validation of these aircraft within the Network.

Principle 6, AAM Inclusive Bilateral Agreements: Establish guiding principles and a comprehensive process for establishing new bilateral agreements and updating existing bilateral agreements, specifically regarding type certification and streamlined validation of AAM aircraft.

Performance-based regulation:

- **Objective:** Embrace performance-based regulations that will support development of future global airworthiness standards, fostering innovation while maintaining safety.
- **Methodology:** Leverage existing regulatory standards, such as 14 CFR Part 23 amendment 64 and CS-23 amendment 5, supplemented with airworthiness criteria and special conditions to address specific airworthiness requirements for AAM and eVTOL aircraft.
- **Transferability among network members:** Coordinate with the UK CAA's adoption of EASA SC-VTOL to create a unified approach within the NAA Network that begins with transferability, progressing through convergence to alignment and harmonization.

Streamlined validation process:

- **Objective:** Create a unified process that prioritizes validation effort towards the differences in certification standards, accepts the type certifying Authorities findings of compliance where there are no differences, promotes the exchange of Means of Compliance, and leverages efficiencies through multi-validation teams.
- **Collaboration:** Facilitate collaboration among NAA Network members (FAA, UK CAA, TCCA, CASA, CAA NZ) to develop common validation protocols and procedures
- **Expansion:** Consider adding new members to the Network, ensuring broader global support for the Network's validation process.

Updating bilateral agreements:

- **Objective:** Review existing NAA Network bilateral agreements, and update them where necessary, to ensure that the six principles of this Roadmap can be realized.
- **Objective:** Recognize updated agreements reflecting AAM's evolving landscape, including the powered lift type certification and the application of the incremental crawl, walk, run principle.
- **Objective:** Apply a risk-based approach to updated agreements that focus validation effort on airworthiness criteria that are specific to new and novel technologies, and that accept findings of compliance where an NAA Network member has a demonstrated competency in that area.
- **Stakeholders and alignment:** Engage with stakeholders and alignment with international partners when updating bilateral agreements, considering technological advancements, regulatory changes, and market needs.
- **Special arrangements:** The use of a special arrangement, subordinate to the bilateral agreement, may be considered as an expedient way to agree the principles of this roadmap between two Authorities whilst the longer-term update to the bilateral agreement is made.
- **Mutual recognition:** Establish mechanisms for recognizing type certifications, standards, and validations among NAA Network members.

Monitoring and oversight

- **Objective:** Implement a robust monitoring and oversight framework to ensure compliance with the agreements and maintain transparency and trust within the network.
- **Ongoing collaboration:** Foster ongoing collaboration, communication, and information sharing among network members to facilitate continuous improvement and responsiveness to industry changes.

The review and update of bilateral agreements to ensure they are inclusive of AAM underscores the NAA Network's commitment to harmonization and collaboration in AAM certification. By focusing on performance-based regulation, streamlined validation, and mutual recognition, the Network lays the groundwork for a cohesive and efficient approach to AAM development and certification. This process sets the stage for the continued emphasis on safety and innovation as the AAM and emerging technologies landscape continues to evolve.

Image: Banff National Park, Canada

IMPLEMENTING THE ROADMAP

The NAA Network Roadmap for AAM Certification represents a collective vision and strategic plan to advance the certification and integration of AAM aircraft and technologies into the global aviation ecosystem. To translate this vision into tangible progress, the following next steps are outlined:

Next steps

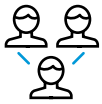
Where required, the NAA Network will develop an implementation plan to ensure the six principles of this Roadmap are effectively implemented across the Network. Roles, responsibilities, and accountabilities to NAA Network members, working groups, and key stakeholders will be assigned with ongoing monitoring to ensure alignment with the Roadmap principles.

The following activities are identified in the immediate term:

Airworthiness requirements: Continue to work constructively across the NAA Network to understand and converge on differences in the current airworthiness requirements applied to the type certification of AAM Aircraft.

Industry consensus standards: Initiate a review of NAA Network Authorities current involvement in SDO AAM related work and seek to coordinate this effort across the NAA Network.

Collaboration: Continue to exchange knowledge across the NAA Network arising from active AAM type certification projects to harmonize on existing and future airworthiness requirements and maximize transferability of type certified AAM across the Network.



Collaborative multi-authority validation: Seek opportunities to initiate collaborative multi-Authority validation projects.

Bilateral agreements: Review existing NAA Network bilateral agreements and initiate updates where necessary to ensure the principles of this Roadmap can be achieved. Initiate bilateral agreements with NAA Network Authorities where none currently exist.

Timeline

Annex A provides an indicative timeline associated with implementing the principles of this Roadmap. These timelines cannot yet be fully quantified given the nascent phase of AAM aircraft certification and operations, coupled with individual NAA Authority specific constraints, priorities, and resourcing required to implement some of the Roadmap principles at the Authority domestic level. Nevertheless, the NAA Network focus is to work together to achieve these milestones as early as practicable.

One important constraint to recognize across the NAA Network Authorities is the time required to establish or update bilateral agreements, which are necessarily bespoke in their nature, reflective of specific regulations, are subject to individual Authority legal and governance requirements, and all of which invoke differing timelines across the Network. Collaborative multi-Authority validation provides a pathway forward whilst individual bilateral agreements are updated.

Future collaboration and expansion

Engage new members: Continue efforts to expand the NAA Network Workgroup 2 with Authorities that can actively contribute to the alignment of airworthiness requirements, means of compliance, and validating criteria and processes.

Strengthen existing partnerships: Enhance collaboration and alignment with current NAA Network members and international partners like ICAO and EASA.

The next steps outlined in this section provide a clear and actionable path forward for the NAA Network's efforts in AAM certification. They reflect a commitment to collaborative action, transparency, engagement, and innovation. By focusing on implementation, expansion, communication, and support for research and development, these next steps set the stage for meaningful progress in the harmonization of regulatory frameworks and advancement of AAM technologies.

Image: London, United Kingdom

CONCLUSION

The NAA Network's Roadmap for AAM Aircraft Type Certification represents a strategic and unified approach to addressing the complex challenges and opportunities presented by the burgeoning field of AAM aircraft and emerging aviation technologies.

The NAA Network Authorities have identified six principles which enhance each individual Authorities readiness to type certify and validate AAM aircraft by leveraging the strategic partnership and collective expertise of the NAA Network. These six principles form the basis of this Roadmap and set the future direction for the NAA Network for certifying AAM.

- Balance safety and innovation.
- Harmonize type certification.
- Collaborate within the Network and seek alignment.
- Leverage streamlined validation and multi-authority validation.
- Take an incremental approach to certifying emerging technologies.
- AAM inclusive bilateral agreements.

By encapsulating these principles, the Roadmap articulates a vision for the NAA Network that is responsive, forward-looking, and aligned with the ever-evolving landscape of emerging aviation technology. The Roadmap sets a precedent for international collaboration and leadership in AAM certification, underlining the Network's role as a driving force in shaping the future of aviation.

The NAA Network's Roadmap serves as a guiding document for all stakeholders, reflecting a collective determination to lead with integrity, innovation, and a shared sense of purpose. The Roadmap is a testament to the NAA Network's resolve to navigate the complexities of AAM certification with clarity, agility, and a commitment to excellence.

GLOSSARY

- **AAM (Advanced Air Mobility):** A sector encompassing new aerial transportation technologies, including eVTOL aircraft.
- **Airworthiness criteria:** Includes the portions of airworthiness standards identified in 14 CFR parts 23, 25, 27, 29, 31, 33, and 35 and other criteria identified by the authority to provide an equivalent level of safety to the existing standards found by the authority to be appropriate and applicable to the specific type design undergoing type certification.
- **Airworthiness requirements:** The comprehensive and detailed set of airworthiness codes established by the Authority, inclusive of applicable airworthiness standards and airworthiness criteria, for the specific type design undergoing type certification.
- **Airworthiness standards:** The requirements detailed in 14 CFR parts 23, 25, 27, 29, 31, 33, and 35, or CS equivalent parts, found by the authority to be appropriate and applicable to the specific type design undergoing type certification.
- **Bilateral agreements:** Agreements between two aviation authorities that allows reciprocal acceptance of specified aeronautical products and of procedures for approving different types of aeronautical products.
- **Consensus standards:** An industry developed standard the authority has accepted for use as a means of compliance to the applicable regulations for aircraft design, production, and airworthiness.
- **eVTOL (Electric Vertical Takeoff and Landing Aircraft):** Aircraft capable of vertical takeoff and landing using electric propulsion.
- **Means of compliance:** A detailed design standard that, if met, accomplishes the safety intent of the regulation. A means of compliance is one method, but not the only method, to show compliance with a regulatory requirement.
- **Naa network:** National Aviation Authorities Network, currently comprising Authority members from the United States (FAA), Australia (CASA), United Kingdom (UK CAA), Canada (TCCA), New Zealand (CAA NZ).
- **Network:** Taken to mean the NAA Network.
- **Powered-lift:** A heavier-than-air aircraft capable of vertical takeoff, vertical landing, and low speed flight that depends principally on engine-driven lift devices or engine thrust for lift during these flight regimes and on nonrotating airfoil(s) for lift during horizontal flight.
- **Special condition – VTOL:** airworthiness requirements accepted by the UK CAA to be appropriate and applicable to the specific type design undergoing type certification.
- **Standards Development Organization:** an industry organization that works with Authorities to develop industry-vetted and endorsed standards that can be accepted by Authorities and used as means of compliance with Authority Airworthiness Regulations.
- **State of design**: The country having regulatory authority over the organization responsible for the design and airworthiness of an aeronautical product or article.
- **Streamlined validation:** In the context of this Roadmap, streamlined validation is the process that prioritizes validation effort towards the differences in certification standards, accepts the type certifying Authorities findings of compliance where there are no differences, promotes the exchange of Means of Compliance, and leverages efficiencies through multi-validation teams. Streamlined validation does not infer an administrative review of the AAM type design and does not supersede arrangements in NAA Network bilateral agreements.
- **Type certificate:** A design approval issued by an authority when the applicant demonstrates that a product complies with the applicable regulations. The type certificate includes the type design, the operating limitations, the type certificate data sheet, the applicable regulations, and other conditions or limitations prescribed by the authority. Validation: The process used by one authority to approve the type certificate issued by another authority. Validation processes and requirements are detailed in authority bilateral agreements.

ANNEX A: Roadmap timeline of activities