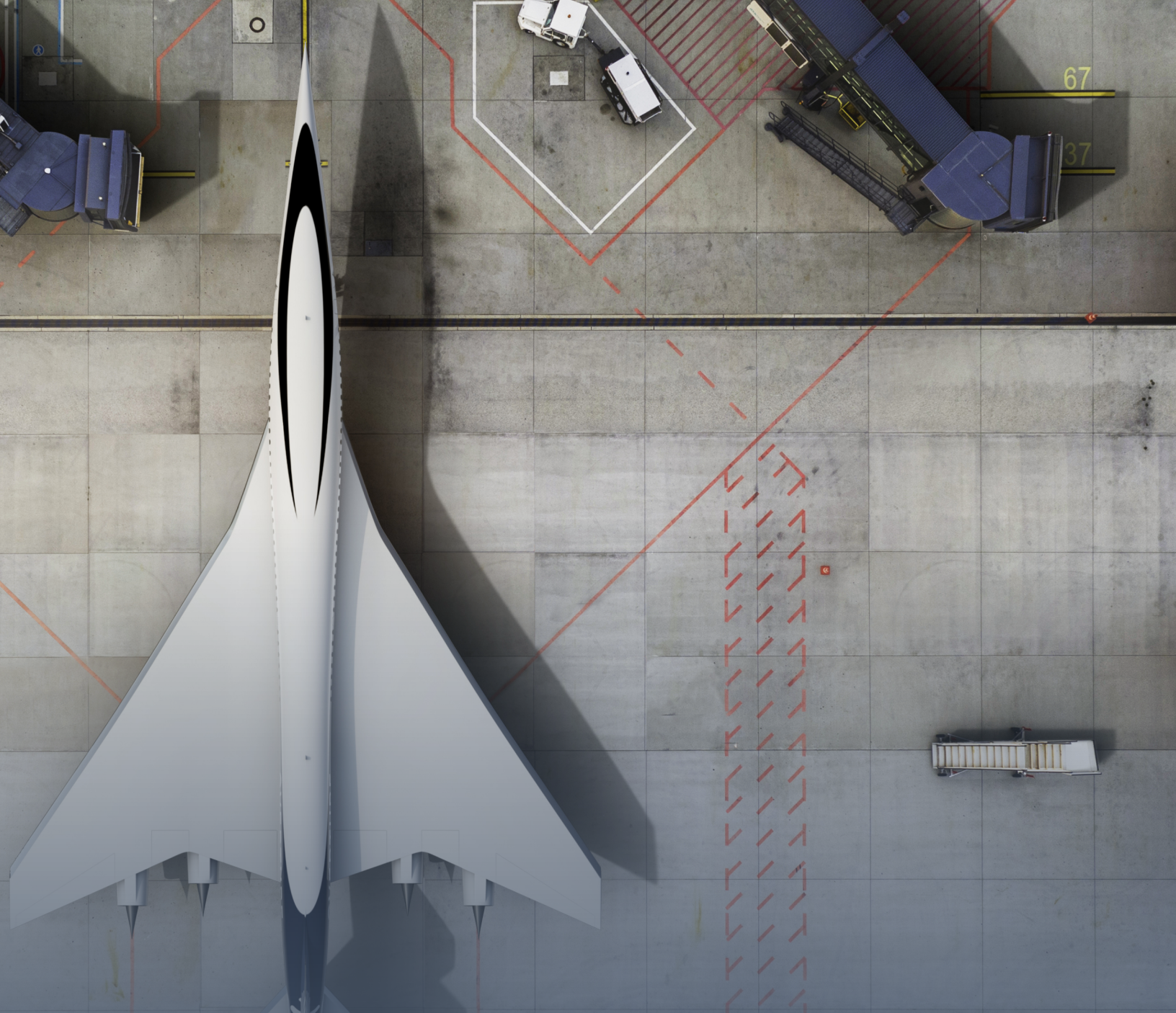

# AIAA High-Speed Flight Policy, Regulations, Operations, and Standards (PROS) Subgroup

**Q4 2025 Final Report**

AIAA

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**Methodology:**

Monthly calls and ad-hoc group member interactions.

Calls as main tool for brainstorming and group inputs entered in PPT as notes and transferred to report and PPT deliverables

**Inputs and Updates:**

Group Calls: 27 Dec 2023; 16 Jan (at AIAA SciTech),

5 Feb, 4 March, 1 April, 8 May, 19 June, 1 July, 15 July, 28–29 July 2024

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PROS' Record of Revisions

| GROUP | REVISION | DATE | CHANGES | NOTES |
|---|---|---|---|---|
| PROS | 1.0 | 040424 | N/A | First Draft |
| | 1.1 | 041924 | Inputs Group. J Page | |
| | 1.2 | 050824 | Inputs Group Call | |
| | 1.3 | 051324 | Vision-Objectives and Goals | Post May HSF All hands call |
| | 1.4 | 07/28-29 | Recommendations-NGRA-Themes and Rankings | 60% Ranking Surveys Completed |
| | 1.5 | 08/30-31<br>09/16<br><br>02/23/25 | Tables into Narratives completed<br>Removed DRAFT Watermark | 75% Ranking Surveys Completed<br><br>Final Changes |

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# Preface

The PROS subgroup recommendations are submitted as a partial deliverable for the AIAA High-Speed Flight Task Force Chairs. In turn, the HSF Task Force full deliverables are meant to inform the AIAA strategic planners, including the CEO, the Executive Committee, the Council of Directors, and the Board of Trustees. The PROS members have been guided by the AIAA's last published Annual Report (2020) and its current strategic goals as shown in Figure 1.


**Figure 1.** *AIAA Strategic Goals guided the development of findings for the PROS Subgroup.*

## High-Speed Flight Task Force Charter and Interests

The Policy, Regulation, Operations and Standards (PROS) group is one of five subgroups (See Figure 2) in the High Speed Flight Task Force (HSFTF). The goal of HSFTF is to determine what industry and the Institute should be doing to support engineers, technologists, policymakers, and leaders active in the high-speed flight industry sector.

### PROS Subgroup Intent

The PROS subgroup deliverables are intended to provide AIAA with insights that are actionable within the scope and reach of the Institute, including:

- White papers and virtual collections
- Educational products and academic publications
- Professional development courses and workshops
- Independent forums and similar gatherings – AIAA as a neutral host for open discussions and debates
- Tutorials and/or mentoring programs to provide startups and growing companies with basic foundations and requirements for regulations, certification, standards, ops and policies advocation, compliance, etc.

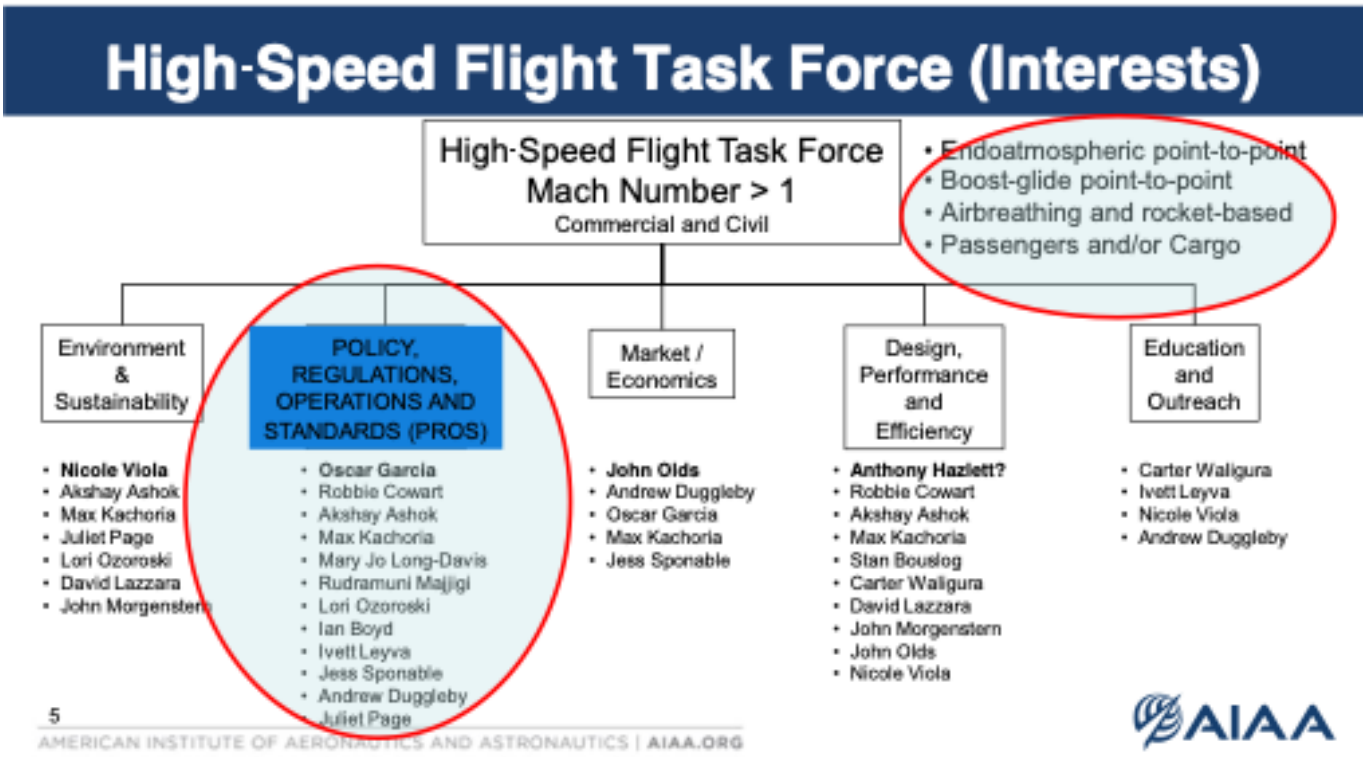


**Figure 2.** *High Speed Flight Task Force Organization Structure.*

# Background

### PROS Subgroup Title Statement

Guidance and Insights for the Regulations, Certification, Standards and Operations of new and innovative High-Speed Air and Space Flight Vehicles capable of flight speeds above Mach 1.

There are currently numerous startup and traditional companies interested in fielding a high speed option. Figure 3 details the existing endo- and exoatmospheric ecosystem of proposed aircraft and spacecraft.


**Figure 3.** *Proposed high-speed aircraft and spacecraft in the current endo- and exo-atmospheric ecosystem (not exhaustive).*

## Scope Statement

The PROS subgroup focuses on areas including policy, regulations, operations, standards, and rules frameworks within which Mach 1+ (high-speed flight) capable vehicles will need to be compliant to operate safely, sustainably, reliably, economically, and seamlessly within the existing National and International Subsonic-flight Air Transportation Systems (NISATS).

The group studies the landscapes, opportunities, and visions for these vehicles, their related programs and applicable legal/regulatory/standards/operational frameworks applicable to their full lifecycle research and development (R&D), test and evaluation (T&E), entry into service (EIS), routine service, environmental impacts, and end of life, etc..

## Rationale Statement

Existing policies, regulations, operations and standards of high-speed air (endoatmospheric) vehicles are limited, prescriptive and outdated (i.e., Concorde centric) and in need of actualization and optimization for the forthcoming ecosystem of high-speed vehicles. Existing PROS for space (exoatmospheric) vehicles intending to provide point-to-point flight for transportation to and from Earth are extremely limited and nonexistent for certain phases of flight (i.e., suborbital transit).

This group will inform AIAA on possible measures to close gaps and overcome existing PROS barriers and issues and the recommended actions to successfully and seamlessly align PROS disciplines and dimensions with incoming new technologies, advanced systems, and innovations required for the vehicles' full lifecycle, from R&D through entry into service and maturity.

## Objectives

The PROS group will deliver findings and recommendations to AIAA and the emerging ecosystem of high-speed flight vehicles to inform, influence, and guide policies, laws, regulations, and standards that are innovative, agile, and performance based, covering design, R&D, T&E, demonstrations, entry into service, and full lifecycles. AIAA's contributions to optimize the PROS frameworks will greatly enhance other industry frameworks such as capital deployment, reduce perceived investment risk, demand from markets, costs, revenues, sociopolitical acceptance, and subsonic aviation and spaceflight ecosystems integration with these future systems.

## Methodology and Deliverables

The PROS subgroup will provide AIAA with a set of observations, findings and recommendations. The recommendations are characterized as NGRAs (Need-Gap-Recommendation-Action; timings and levels of effort, Low, Medium, High) addressing the PROS areas of expertise.

The NGRA format allows for a common recommendation format for all subgroups and for seamless revisions to be made from time to time as the HSF Task Force develops and evolves.

Each recommendation follows the **Needs, Gap, Recommendation and Action Time and Effort format** aligned with other HSF groups.

- The Action Effort element was introduced in June, and it intends to qualify the recommendation's AIAA burden as Low, Medium, and High effort based on the group's consensus in areas including:
  - Alignment with AIAA's current activities, action, and strategic planning
  - Level of commitment and perseverance of volunteers to perform the recommended actions
  - Level of time and financial resources needed to perform the recommendation

## AIAA Assigned Tasks

1. Subgroups will need to conduct a **Landscape Assessment** for their subject area
   - 1.1 What are AIAA, industry, government, and academia currently doing in this area?
   - 1.2 What are the issues, barriers, and concerns?
   - 1.3 What are the gaps in this area?
2. Subgroups need to conduct an **Opportunities Assessment** for their subject area
   - 2.1 Are there obvious actions that would remove barriers to high-speed flight?
   - 2.2 What can AIAA and industry do to advance high-speed flight in this subject area?
3. Subgroups need to develop **AIAA Vision Capabilities** for their subject area
   - 3.1 What is the end state for this subject area in 3, 10, and 15 years?
   - 3.2 What is the AIAA end state over this same interval?
   - 3.3 What are the key actions over this same interval?

## Landscape Assessment

The PROS subgroup has detected, identified, and characterized an overarching need for alignment of the HSF Vectors, and stakeholders' efforts, activities via a super Vector that avoids unnecessary consumption of subject matter experts' bandwith, duplication of efforts, mixed messages to the market, policymakers, regulators, etc. A graphical depiction of this HSF Super-Vector is shown in Figure 4.

AIAA should play a crucial role as a hub, acting as a Secretariat, for example, as it does for ISO TC20 Aircraft and Space Vehicles and its Subcommittees.

This is a guiding principle for all other PROS results and deliverables in this report.


**Figure 4:** *AIAA as an HSF Super-Vector harnessing all relevant stakeholders activities.*

The landscape assessment also includes HSF relevant sections within the FAA Reauthorization Act of 2024. All deliverables in this report have considered these sections and their requirements, impact, and relationships to international entities, civil aviation authorities, etc.

- The FAA Reauthorization Bill of 2024 updates the HSF current landscape, barriers-opportunities from the following bill's sections
  1. Sec. 311. Use of advanced tools and high-risk flight testing in certifying aerospace products.
  2. Sec. 312. Transport airplane and propulsion certification modernization.
  3. Sec. 322. Study on radiation exposure.
  4. Sec. 328. Restricted category aircraft maintenance and operations.
  5. Sec. 346. Study on airworthiness standards compliance.
  6. Sec. 362. Cabin air safety.
  7. Sec. 630. Airspace integration for space launch and reentry.
  8. Sec 1009 High Speed Flight Testing
  9. Sec 1010 High Speed Aircraft Pathway to Integration Study
  10. Sec. 1011. Operating high-speed flights in high altitude Class E airspace.
  11. Sec. 1025. Research plan for commercial supersonic research.
  12. Sec. 1108. Rulemaking related to operating high-speed flights in high altitude Class E airspace.
  13. Sec. 1110. Advancing global leadership on civil supersonic aircraft.
- AIAA Europe approach to HSF: Include EU and UK regulators: CAA, EASA, ESA, and academic, R&D and other relevant institutions (DLR, ONERA, TU Delft, ENAC, INTA, etc.)

# Summary of PROS Need-Gaps-Recommendation-Action (NGRA)

AIAA recommended actions by Strategic Theme (These are highest-level themes framing the identified recommendations NGRAs):

1) Advocacy
   1) Establish a permanent entity, Standing Technical Committee or similar, within AIAA to
      1) Coordinate HSF initiatives, most likely IOC (conference sessions, competitions, workshops & short courses)
      2) Act as a repository intelligence portal or similar for HSF industry efforts, nationally and internationally (i.e., ISO TC20 Secretariat model)
      3) Advocate for creation of one (or more) federal advisory committee(s) to help guide/coordinate among U.S. government agencies on HSF (workshops)
      4) Harness ongoing and previous AIAA efforts, i.e., supersonic IOC, HyTASP events, and others
2) Policy and Regulations Support
   1) Serve as an objective technical leader for developing short- and long-term policy and regulatory roadmaps (workshops, white papers). Serve as facilitator and "obstacle remover" for policy and regulatory strategic hurdles, i.e., GPS ITAR-EAR, Upper Class E (FAA)-Upper Airspace (ICAO) integration recommendations
   2) Engage with FAA and U.S. DOT to deploy subject matter expertise and AIAA membership on tasking from the 2024 FAA Reauthorization (panel sessions, workshops, short courses)

3) Operations and Standards Leadership

    1) Serve as an objective technical leader to facilitate the identification of, but not limited to, challenges, barriers, standards, best practices, and research roadmaps that may enable worldwide, environmentally responsible, civil high-speed aviation (panel sessions, workshops, white papers, short courses)

    2) Integrate and include human factors and aeromedical research and testing for commercial HSF operations

## Recommendations – NGRA's Summaries

The PROS subgroup completed the following 10 prioritized and ranked recommendations and the top four are underlined and recommended for immediate action.

**(Ranking rationale, methodologies, and summaries are provided as an Appendix to this report.)**

1. **Industry Developments Alignment –** There is a marked need to align the HSF multiple policy, regulators, operators, and standard development stakeholders and their efforts to further the HSF flight industry
2. **High-Speed Flight as a Novel Transportation Modality –** The HSF industry's special technologies, systems, and infrastructures are at the intersection of the subsonic aviation and orbital spaceflight industries.
3. **High-Speed Flight Standards and Best Practices Streamlining –** The HSF industry will need streamlined and harmonized national and international standards and best practices development protocols to ensure its proliferation and scaling from technology demonstrations to a viable transportation system that is fully integrated with the subsonic and orbital space transportation industries and modalities.
4. **High-Speed Flight Policy as both National Advocacy and Leadership Imperatives –** The U.S. White House and Congressional policy directives for aeronautical and aerospace advocacy must include high-speed flight in a bipartisan manner and for the long-term (multidecadal horizons) leadership and economic advantage.
5. **Formation of FAA High-Speed Flight Rulemaking Committees (HSF-ARCs) –** The HSF industry aims to grow, proliferate, and scale nationally and internationally after technology is demonstrated in flight and reaches readiness levels to enter the market and the existing subsonic and orbital space flight systems.
6. **High-Speed Flight Industry Standards and Accepted Levels of Safety – New safety frameworks are required –** for instance, analogs such as the helicopter industry levels of safety standards and references to vaults of knowledge, as well as civil (X-59, etc.) and commercial (Concorde, TU-144) flight heritages.
7. **National Security (ITAR) Restrictions for High-Speed Vehicles –** Key priorities include standardizing technology transfer processes, as well as their use and export to maintain the safety and security for commercial applications in the United States. Examples include the timely and safe transferring of HSF vehicles technologies from ITAR to DOC Export in Arms regulations regime as well GPS and related flight guidance systems.
8. **High-Speed Flight Vehicle Certification –** Aligning FAA's evolving air and spacecraft vehicles certification rules and protocols with the HSF emerging new technologies as they reach technology readiness level (TRLs) for flight and manufacturing certification (TC/PC)
9. **High-Speed Flight Technologies Integration into Existing Subsonic and Spaceflight Systems –** Aligning TRLs with manufacturing readiness levels (MRL), integration readiness levels (IRL) and systems readiness levels (SRL) of the adjacent subsonic flight and spaceflight systems. This also includes integration in Upper Class E (FAA) and International Upper Airspace (ICAO).
10. **Human Factors and Aeromedical Standards for High-Speed Flight Vehicles –** Key priorities include developing stakeholder consensus around Fitness for Flight (FFF) with relevant technical committees, standard-making bodies, and regulatory decision-makers as related to crew and passengers.

## Detailed Ranked Recommendations

1. **Industry Development Alignment** – AIAA as Central Facilitator, Repository Center, Portal for HSF Stakeholders

    **A. NEED**

    There is a marked need to align the multitude of HSF policymakers, regulators, operators, and standard development stakeholders and their efforts to further the HSF flight industry. Although well intentioned, the entities surveyed lack a cohesive, concise, and resilient overarching message. Such cohesiveness is essential for PROS stakeholders to make well-informed decisions to enable, grow, and sustain the HSF industry. This brings an opportunity for AIAA to assist in such an alignment of vectors to produce a super effort capable of effecting positive impact for the HSF industry at large. The HSF aerospace segment estimates growth to a multi-trillion dollar (~$1-4T) economic impact by 2050.

**B. GAP**

Policy advisory groups, regulators (including interagency and international groups), operators and standards developers lack a comprehensive repository of "cross-cutting" relevant information and materials to understand the high-speed flight industry in its totality to make decisions and take actions to sustainably grow the industry. For instance, the issues of balancing socioeconomic impacts and environmental sustainability of HSF is a timely example of the existing gap.

**C. RECOMMENDATION**

To help build the new high-speed flight economy, AIAA should become the HSF and industry hub to help policymakers, regulators, operators, and standards developers gather and collaborate to build the new economy. AIAA protocols should be innovative, agile, adaptive, and incremental and provide frameworks for national and international performance-based standards and best practices development. A first recommended step is to make the HSF Task Force a permanent AIAA Technical Committee Group, with growing presence in relevant areas such as Standing Committees, Guiding Coalitions (ASCEND), Program and TC Chairs, etc.

**D. AIAA ACTION DATE AND EFFORT**

- HSF Permanent Technical Committee (PTC) formation and charter Q4 2024.
- HSF PTC full integration into AIAA full charter and activities Q4 2025.
- LOW (AIAA has experience as the hub and Global Secretariat for ISO's TC 20 Aircraft and Space Vehicles)

2. **High-Speed Flight Standards and Best Practices –** Streamlining Development for Regulator Acceptance as a Means of Compliance

**A. NEED**

The HSF industry will need streamlined and harmonized national and international standards and best practices development protocols to ensure their proliferation and scaling from technology demonstrations to a viable transportation system that is fully integrated with the subsonic and orbital space transportation industry and modality. Such standards and best practices, when harmonized, can be used as a means of compliance with regulatory agencies, as stated in the references in the recommendations section below. As HSF operational theaters are global by nature, it is a key imperative for industry viability that standards are harmonized from the beginning.

**B. GAP**

The majority of the HSF economic and supply chain stakeholders at all levels nationally and internationally lack a central forum to guide standards and best practices development protocols. Uncertainties introduced by lack of harmonization create a direct impact in the industry credibility, scalability, and interoperability, which in turn hinders interest from policy makers, regulatory agencies, capital and financial enablers, and ironically, standards development organizations (i.e., ASTM, AIAA, ISO, etc.)

**C. RECOMMENDATION**

AIAA should consider enacting a Commercial High-Speed Flight Standards Committee, supported by the existing AIAA Committee on Standards following the guiding principles of the American Standards National Institute (ANSI), and abiding by the protocols of the Office of Management and Budget (OMB A-119 circular, and the National Technology transfer Advance Act of 1995 (NTTAA). Internationally, AIAA, as the secretary of the International Standards Organization (ISO) Technical Committee 20, Aircraft and Space Vehicles, should consider the enacting of Subcommittee (SC 18) High Speed Flight Vehicles to promote U.S. HSF standards and their development protocols internationally.

**D. AIAA ACTION DATE AND EFFORT**

- Enacting an AIAA National Commercial High Speed Flight Standards Committee, Q4 2025.
- Enacting an ISO TC 20, Subcommittee 19 High Speed Flight Vehicles by Q2 2026.
- MEDIUM

3. **Formation of an FAA High-Speed Flight Rulemaking Committee (HSF-ARC) –** Regulatory Agencies Alignment as with Other Novel Industries (AAM, Spaceflight)

**A. NEED**

The HSF industry aims to grow, proliferate and scale nationally and internationally after technology is demonstrated in flight and reaches readiness levels to enter the market and the existing subsonic and orbital space flight systems. Effective policies and low burden regulations that enable innovation will be necessary to integrate HSF into the existing air and space highly standardized and safe frameworks. To effect both, government agencies like the DOT-FAA and FAA AST, and DOC-OSC seek advice and recommendations from industry, public, academia, operators, and other relevant stakeholders using

Federal Advisory and Rulemaking Committees guided by the Federal Advisory Committees Act. The emerging and growing HSF industry needs to provide advice and recommendations to Congress and government agencies on issues that may lead to policy and regulatory changes.

**B. GAP**

There are no relevant advisory and rulemaking committees in place where the HSF industry has the opportunity to provide advice and recommendations to the federal government and Congress. A review of FAA's ARCs shows no meaningful presence of the HSF industry. There are no industry associations, trade groups, or similar that lead the HSF industry into designing, forming or participating in such ARCs.

**C. RECOMMENDATION**

AIAA could lead the HSF industry efforts to form federal agencies' ARCs starting with the FAA's existing platforms that include: advisory committees, aviation rulemaking advisory committees, working groups, aviation rulemaking committees, and aerospace advisory rulemaking committees.

**D. AIAA ACTION DATE AND EFFORT**

- AIAA to complete a review and mapping of Federal ARC's where the HSF industry could participate by Q4 2025.
- AIAA to foster, collaborate with the HSF industry and the DOT-FAA, FAA AST and the DOC-OSC to design, set up and implement relevant ARCs to be in place by Q4 2026 and onward.
- MEDIUM

4. **High Speed Flight as a Novel Transportation Modality –** Fostering Congressional and Regulatory Support

**A. NEED**

The HSF industry's special technologies, systems, and infrastructures are at the intersection of the subsonic aviation and orbital spaceflight industries. Operating in such convergence could deem the HSF industry a novel transportation modality, requiring equally innovative PROS frameworks at all levels. Creating a novel transportation modality, or even a subset of the existing air and space transportation modes requires an all of nation buy in at multiple levels including social, financial, and political from main street and Wall Street to Congress.

**B. GAP**

There are very limited and sometimes nonexistent guiding principles for integrating existing subsonic and orbital flight policies, regulations, operations, and standards into the emerging HSF regimes.

The industry needs to have sufficient and well-informed policymakers, well-trained HSF experts in regulatory agencies and standard development entities and many other relevant stakeholders (risk managers, certifiers, assets managers, etc.). For instance, hypersonic flight cruising altitudes could be qualified as aerospace flight, squarely in between aviation and spaceflight.

**C. RECOMMENDATION**

AIAA could foster the designation of HSF as a novel transportation modality and assist policymakers, regulators, operators, and standards developers as a guide, leader, and integrator of technical and scientific capabilities, activities, and intellectual property (IP) given its massive membership bandwidth.

**D. AIAA ACTION DATE AND EFFORT**

- AIAA should adopt a position regarding HSF as a transportation modality by Q4 2025.
- Implementation of AIAA activities to foster, enable, empower and facilitate the HSF modality starting Q4 2026 and onward.
- HIGH.

5. **High-Speed Flight Policy as National Advocacy and Leadership Imperatives –** All of Nation's Effort, Policy, and Regulation Support

**A. NEED**

The U.S. White House and Congressional policy directives for commercial and civil aeronautical and aerospace leadership must include high-speed flight in a bipartisan manner and for the long term (multidecadal horizons). For instance, there is no commercial or civil HSF Congress Caucus at the House or Senate levels. HSF Caucuses are needed to align bipartisan long-term national HSF policy and legislation. In turn, such caucuses will also affect international and global policies benefitting the U.S. commercial and civil HSF industry.

**B. GAP**

Historical efforts in high-speed flight by the White House, Congress, and agencies (DOT, DOC, DOD, etc.) have been fragmented in terms of time and funding. These initiatives are often perceived as partisan, geopolitical, or company-specific in the short to medium term.

There has been no clear leader for HSF industry policy, legislation, or regulatory promotion. AIAA could fill this gap by centralizing the efforts of less technical and scientific groups, such as NBAA, GAMA, AIA, AOPA, A4A, IATA, ALPA, and NATCA, which are

currently ununited, lack long-term focus (i.e., decadal milestones), and are inconsistent in engaging the White House, Congress, and other regulatory and policymaking agencies.

**C. RECOMMENDATION**

As there is sporadic White House involvement for the HSF industry, AIAA could lead the formation of a National HSF-Council (NHC) that would enable a consistent White House push via HSF-Policy Directives (HPDs) informed by an HSF Users Advisory Group. The NHSFC would lead the long-term thinking, trickling down to Congress, regulatory agencies, academia, standards developments organizations, and industry. The National Space Council (NSC) and its Users' Advisory Group (UAG) could be a relevant analog for the effort.

**D. AIAA ACTION DATE AND EFFORT**

- AIAA led House and Sente HSF Caucus in place by Q4 2025.
- National High-Speed Flight Council and User's Advisory Group established by Q4 2026.
- MEDIUM

6. **National Security and ITAR Restrictions to Technology Transfer, Use, and Export of Commercial High-Speed Vehicles**

**A. NEED**

Unless some critical dual-use technologies included in restrictive policy frameworks such as ITAR (for instance GNSS receivers) are moved from ITAR to EAR or other regulations allowing high-speed flight operations and commercialization to be exported globally, program launch and capital investment and formation will be insufficient for supersonic and hypersonic high-speed flight.

For instance, for Guided Supersonic Projectiles (GSP) capable of greater than Mach 1.8 speeds, global geopolitical volatility precludes a change of the GNSS receiver export and export in arms regulations regime for the near future. This limits investment and capital formation to experimental demonstrations of supersonic and hypersonic vehicles.

**B. GAP**

State Department Directorates of Trade Controls and Department of Commerce lack background or assurances in the uses of unrestricted GNSS for commercial and civil flight operations (ITAR restriction of sales of GNSS receivers per 22CFR Part 121 (US Munitions List)). Limiting navigation signals to approximately Mach 1.8 (over 600 m/s) for supersonic and hypersonic flight hinders investment, capital formation, and program launch decisions.

**C. RECOMMENDATION**

By collaborating with DOD and DOS operational firewalls can be created to ensure safe and secure high-speed commercial and civil operations. Also, there should be an effort to involve Federally Funded Research and Development Centers (FFRDCs), to educate legislators and public administrators, and to lobby and influence trade and policymakers to transfer GNSS receivers' exports from ITAR to the EAR Commerce Control List (CCL).

**D. AIAA ACTION DATE AND EFFORT**

- Lobby group to establish protocols to assist industry in transferring ITAR Technologies to U.S. DOS EAR Regime by Q4 2027
- Unrestricted –U.S. DOC by Q4 2030
- HIGH

7. **High-Speed Flight Industry Standards and Accepted Levels of Safety –** New Paradigms Specifically for High-Speed Flight (HSF) Commercial Vehicles

**A. NEED**

Commercial HSF requires a new paradigm to establish acceptable levels of safety for passenger and cargo transportation. HSF vehicles entry into service could use safety, hazard, and levels of safety analysis aligned with other-than-transport category aircraft (i.e., the UAS/AAM industry and the commercial helicopters' industry).

**B. GAP**

Safety frameworks, standards, and regulations for HSF commercial vehicles with novel TRL ready technologies do not exist and/or cannot be easily transferred from any subsonic aviation or orbital commercial transportation regimes and existing frameworks.

**C. RECOMMENDATION**

AIAA can stand up TCs, working groups, meetings, or workshops to produce white papers, safety reports, and thought leadership guidance to address the HSF required levels of safety for commercial service at the speed of TRL and industry demonstrations and entry into service realities (Boom, Hermeus, Stratolaunch, SpaceX, NFA, etc.).

**D. AIAA ACTION DATE AND EFFORT**

- Working groups, TCs or similar by Q4 2025
- Industry guidance for commercial HSF levels of safety; first documents set by Q4 2026
- HIGH

8. **High-Speed Flight Technologies Integration in Existing Subsonic and Spaceflight Systems**

**A. NEED**

There is a need to integrate technologies and operations (i.e., TRLs and Upper Class E airspace operations). The Technology Readiness Level (TRL) progress must be dynamically aligned with Manufacturing Readiness Levels (MRL) and Integration Readiness Level (IRL) to yield System Readiness Level (SRL). SRLs provide complete representations of the integration of supersonic and hypersonic vehicle technologies into the full operational ecosystem of systems, ATC, airports, supply chain-OEM', finance-insurance-policy, etc. TRL development alignment with MRL, IRL, and SRL is a condition for program financing and launch decisions.

**B. GAP**

Tools, protocols, and processes to align TRL with MRL, IRL and SRL, and Upper Class E Traffic -airspace operation integration are developing but are not yet commonplace. TRLs can be certifiable but not have protocols for ensuring their manufacturability and integration in a production-industrialized commercial program setting. Vehicles can be capable of operating in Upper Class-E (above 60,000 feet) airspace, although regulations and operational guidance are not ready yet.

**C. RECOMMENDATION**

AIAA TCs and members can engage in delivering tools, protocols, and processes to align TRL with developing MRL, IRL and SRL. The MRL for the vehicle's technology must be checked against the TRL development at all times to assure certification, production, and program scalability. Funding for TRL advancement and demonstrations of preproduction prototypes, proof of concept and low-rate initial production vehicles should be in lockstep with funding for MRL, IRL, and SRLs required to fund and launch commercial vehicle programs.

**D. AIAA ACTION DATE AND EFFORT**

- SHORT COURSES AND WORKSHOPS ON TRL ALIGNMENT WITH MRL-IRL-SRL, and Upper Class E Airspace IN PLACE BY Q4 2025
- LOW

9. **High Speed Flight Vehicle Certification –** Aligning FAA's Evolving Air and Spacecraft Vehicle Certification Rules and Protocols with the HSF Industry

**A. NEED**

Current FAA regulations for the certification of supersonic and hypersonic airframe, powerplant and vehicle systems requires subject matter expert (SME) panels with relevant experience as safety experts boards under the U.S. Congress' 2020 Certification and Accountability Safety Act. Currently, such SMEs are extremely scarce or nonexistent for HSF vehicles. Concorde and DOD SMEs and newly trained SMEs are required. Legislative and congressional approvals to amend or waive certification regulations is a major challenge to enable entry into commercial service.

OEMs need innovative digital twin technologies applied to the FAA Certification protocols and procedures to move from TRL readiness to entry into commercial service and maturation.

Certification SMEs are needed to populate the Certification Safety Expert Boards.

**B. GAP**

The HSF industry needs FAA-aviation safety (AVS) SMEs, digital twin certification technologies, waivers, and relaxation protocols of existing FAR 25 – ($10^{-9}$ risk) levels of safety standards requirements for supersonic and hypersonic commercial operations (FAR 135/125/121) and (FAR 33, 25) – certification rules of airframe and power plant and integrated vehicle systems.

**C. RECOMMENDATION**

AIAA should set up a technical committee on HSF vehicle certification, write and research white papers, enable short courses, and lead workshops on FAA's HSF digital twin technologies for certification.

**D. AIAA ACTION DATE AND EFFORT**

- TC ON HSF VEHICLES CERTIFICATION IN PLACE Q4 2025
- DIGITAL TWIN TECHNOLOGY FOR CERTIFICTION AND TRL MATURATION ACTIVE BY Q4 2030
- HIGH

10. **Human Factors and Aeromedical Standards for Passengers and Crew –** Research and Applied Technologies for Commercial HSF

**A. NEED**

There is a need for standards and best practices to inform regulation, which can be done through published research, adding conclusive human factors and health studies related to the effects of commercial high-speed and altitude flight on human health.

**B. GAP**

There are limited understanding and data about the health effects of exposing crew and passengers to high-altitude radiation that could present liability risks to policymakers, regulators, capital sources, and program launch decision makers. If flight crew productivity metrics, such as flight time, duty periods, and rest rules, are restricted due to radiation exposure, then program launches could be halted.

**C. RECOMMENDATION**

AIAA could be the hub for industry, government, academia, and private sector partnerships to lead studies, white papers and educational sessions, workshops, etc., that focus on the effect of high-speed flight on human health. NASA and DOD's high altitude and speed declassified human factors and health data from relevant aircraft and spacecraft (i.e., SR-71, U-2, Space Shuttle, ISS<) could be used.

**D. AIAA ACTION DATE AND EFFORT**

- AIAA TC AND STANDARDS DEVELOPMENT COMMITTEE ON HUMAN FACTORS AND AERO MEDICAL RESEARCH FOR HSF ENABLED BY Q4 2025
- LOW

# AIAA Vision Capabilities Charts

The following tables will look at near-term (1, 3, 5 years) goals and objectives, as well as the long-term (5, 15, 25 years) vision.

## D.1. By Flight Regime – Supersonic, Hypersonic, and Suborbital

Table 1 provides a breakdown of industry milestones by flight regime for the next three decades, narratives follow.

| | 2024-2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|
| **INDUSTRY MILESTONES** | **PROGRESS** | **END STATE** | **PROGRESS** | **END STATE** | **PROGRESS** | **END STATE** |
| SUPERSONIC | SONIC BOOM X-59 NASA QUESST FLIGHTS | SUPERSONIC OVE R LAND STANDARD IN PLACE | OVER WATER BOOM, SPIKE ENTRY INTO COMMERCIAL SERVICE | QUIET SUPERSONIC COMMON CARRIAGE ENTRY INTO SERVICE-SPECIALIZED AND VIP | SUPERSONIC MASS COMMON CARRIAGE WORLDWIDE MULTIPLE OPERATORS AND OEM'S | SUPERSONIC MASS COMMON CARRIAGE WORLDWIDE |
| HYPERSONIC | HERMEUS QUARTERBACK TESTS | HERMEUS ENTRY INOT MILITARY SERVICE | DARKHORSE TESTS- | DARKHORSE ENTRY INTO SERVICE HALCYON TESTS | HALCYON PASSENGER ENTRY INTO SERVICE | HYPERSONIC COMMON CARRIAGE |
| SUBORBITAL | STARSHIP INTEGRATED TESTS 10-20 | STARSHIP ENTERS MILITARY AND SPECIAL MISSION SERVICES | STARSHIP-RADIAN-SIERRA-DAWN ENTER LIMITED SERVICE | SPECIALIZED CARRIAGE STARSHIP | COMMON CARRIAGE STARSHIP | COMMON CARRIAGE SIERRA, RADIAN, ET AL |
| | | SONIC STANDARDS IN PLACE FAA-ICAO | | | | |

**Table 1.** *Industry milestones by flight regime, 2024–2050*

### Supersonic

The near-term goal for supersonic flight is focused on X-59 NASA Quesst flights, with an end-state vision of a supersonic flight overland standard in place by 2030. Progressing into 2035, the goal is an overwater Boom and Spike aircraft entry into commercial service, with an end-state vision of quiet supersonic common carriage entry into service, both specialized and VIP, by 2040. The final industry goal for supersonic flight is mass common carriage with multiple worldwide operators and OEMs. The end-state vision is to have mass common carriage available globally by 2050.

### Hypersonic

The near-term goal for hypersonic flight is focused on the Hermeus Quarterback supersonic flight tests to validate

the Chimera engine and airframe integration. In 2035, the goal is to perform and complete the Darkhorse tests and have the Darkhorse enter into service and start progressing with Halcyon tests by 2040. The end-state goal is for the Halcyon passenger jet to enter service in 2045, with the completion of hypersonic common carriage planned for 2050.

### Suborbital

For suborbital flights, the objective is to complete the Starship Integrated tests 10-20 by 2025. By 2030, the vision is for Starship to enter civil and special mission services, with sonic boom standards established for the FAA and ICAO. In 2035, the goal is for the Starship-Radian-Sierra-Dawn to enter limited service, and a specialized carriage Starship to be available by 2040. Long-term goals for 2045 include a common carriage Starship, and by 2050, the completion of the common carriage Sierra-Radian.

## D.2 By Policy, Regulations, Operations, and Standards

Table 2 provides a breakdown of industry milestones for the next three decades by policy, regulations, operations, and standards.

| | 2024-2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|
| **AIAA VISION AND CAPABILITIES** | **PROGRESS** | **END STATE** | **PROGRESS** | **END STATE** | **PROGRESS** | **END STATE** |
| LANDSCAPE | AIAA SETS UP CROSS-CUTTING HSF PERMANENT TC'S | HSF FULLY INTEGRATED IN AIAA STRATEGIC PLANS | | HSF INDUSTRY, ACADEMIA, POLICY REGULATION AND STANDARDS-VECTORS ALIGNED GLOBALLY | | |
| POLICY | AIAA LEADS HSF AS A NATIONAL IMPERATIVE ACTIVITY-NATIONAL HSF COUNCIL AND RELATED INDUSTRY ADVISORY GORUPS<br><br>AIAA LEADS THE PROJECT: HSF AS A MODALITY OF AWEROSPACE TRANSPORTATIO N | AIAA LEADS THE NATIONAL HSF EFFORTS<br><br>HSF SENATE AND HOUSE CAUCUSES IN PLACE<br><br>AIAA LEADS HSF INTER AGENCY WORKING GROUPS | HSF SETS UP AN INTEGRATED IN AIAA AND US DOT, ET AL AS A SPECIALIZED TRANSPORTATION MODALITY<br><br>AIAA ESTABLISHES ISO HSF TECHNICAL COMITTE SECRETARIAT | HSF IS A TRANSPORTATION MODALITY MATURED INTO COMMON CARRIAGE | | GLOBAL HSF INTEGRATED ENDO AND EXO ATMOSPHERIC |

*Continued on next page*

*Continued*

| | 2024-2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|
| REGULATIONS | AIAA PARTICIPATES IN FAA AVIATION AND SPACE RULEMAKING COMMITTEES (ARC'S AND SPARC'S)TO SUPPORT HSF EFFORTS | AIAA LEADS THE FORMATION OF STAND-ALONE HSF FAA AVIATION AND SPACE RULEMAKING COMMITTEES (ARC'S AND SPARC'S) | AIAA FACILITATTES THAT HSF VEHICLES HYPERSONIC AND SUBORBITAL ARE IN THE COMMERCE DEPARTMENT EAR REGIME | CERTIFICATION OF HSF VEHICLES HAS INDUSTRY CONSENSUS STANDARD BASIS-EQUIVALENT TO FAR PART 25/33 | | GLOBAL HSF REGULATIONS AS A STANDALONE UN-SPECIALIZED AGENCY<br><br>HSF IS A MATURE AEROSPACE COMMERCIAL SYSTEM |
| OPERATIONS | AIAA SUPPORTS SUPERSONIC FLIGHT OVERLAND R&D , T&E TO ENSURE FAA RULES ARE APPLIED DYNAMICALLY | AIAA GUIDES THE IMPLEMENTATIO N OF SUPERSONIC FLIGHT OVER LAND POST NASA X-59 QUESST MISSION | AIAA FACILITATES INTEGRATION OF HSF TECHNOLOGY ENABLING SYSTEMS READINESS LEVELS (SRL) | HARMONIZED SUPERSONIC FLIGHT OVER LAND GLOBALLY-AIAA LEADS GUIDANCE AND EVOLUTION OF OPERATIONAL IMPLEMENTATION | | HSF ENDO AND EXO ATMOSPHERICHA VE ACHIEVE COMMON CARRIAGE (FAA 121 ) EQUIVALENT LEVELS OF SAFETY |
| STANDARDS | AIAA SETS UP A HSF STANDARDS DEVELOPMENT COMMITTEE | AIAA- HSF STANDARDS DEVELOPMENT COMMITTEE LEADS EMISSIONS AND NOISE STANDARDS HARMONIZED CAMPAIGNS | EMISSIONS AND NOISE STANDARDS ADOPTED-SPECIALIZED USE | EMISSIONS AND NOISE STANDARDS-COMMON CARRIAGE IN PLACE | UN-ICAO AND MULTI LATERAL TREATIES ENABLE HSF AT ALL REGIMES | CLEAN TECHNOLOGIES MEET ALL STANDARDS |

**Table 2.** *Industry milestones by policy, regulations, operations, and standards, 2024–2050*

The progress goal by 2025 is for AIAA to set up permanent cross-cutting HSF TCs. This will prepare for the 2030 object of HSF being fully integrated in AIAA strategic plans by 2030. The final objective for this category is for the HSF industry, academic, policy regulation, and standards to be vector aligned globally by 2040.

## Policy

In 2024 and 2025, progress is working toward AIAA leading HSF as a national imperative activity through a national HSF council and related industry advisory groups. AIAA also will lead the project of HSF as a modality of aerospace transportation. In 2030, the goals include AIAA leading the national HSF efforts, the HSF Senate and House caucuses are in place, and AIAA leading HSF interagency working groups. In 2035, the goal is for an integrated AIAA and U.S. DOT as a specialized transportation modality. Additionally, AIAA will establish an ISO HSF technical committee secretariat. The 2040 objective is for HSF to be a transportation modality as common knowledge. Finally, by 2050, the goal is for global HSF to be integrated into endoatmospheric and exoatmospheric airspace system.

## Regulations

In 2024 and 2025, progress should be made toward AIAA participating in FAA aviation and space rulemaking committees such as ARCs and SPARCs to support HSF efforts. In 2030, the goal is for AIAA to lead the formation of standalone HSF FAA aviation and space rulemaking committees like ARCs and SPARCs. In 2035, progress includes AIAA facilitating that HSF vehicles, hypersonic, and suborbital are in the commerce department EAR regime. The objective by 2040 is that certification of HSF vehicles has an industry-consensus standard basis, equivalent to FAR part 25/33. "In 2050, global HSF regulations should be promulgated by an FAA standalone specialized agency. For instance, the envisioned entity could be called the FAA Office of High Speed Aerospace Transportation (FAA-HSAT), like the FAA Office of Commercial Space Transportation (FAA-AST) is today for regulation of the commercial spaceflight industry. By 2050, the HSF industry will be a mature aerospace commercial industry involved in the common carriage of goods and people."

### Operations

In 2024 and 2025, AIAA supports supersonic flight over land research and development. T&E to ensure the FAA rules are applied dynamically. In 2030, the goal is that AIAA guides the implementation of supersonic flight over land after the NASA X-59 Quesst mission. Progress in 2035 will focus on AIAA facilitating the integration of HSF technology, enabling systems readiness levels (SRLs). This supports the 2040 goal of harmonized supersonic flight over land globally, and AIAA leads the guidance and evolution of operational implementation. In 2050, the objective is for HSF endoatmospheric and exoatmospheric to have achieved common carriage (FAA 121) equivalent levels of safety.

### Standards

The near-term goal for standards is for AIAA to establish an HSF standards development committee by 2025. By 2030, this committee will lead emissions and noise standards harmonized campaigns. The long-term goal by 2035 is to implement specialized emissions and noise standards, supporting the establishment of common carriage standards by 2040. By 2045, UN-ICAO and multilateral treaties will facilitate HSF across all regimes, and by 2050, clean technologies will comply with all standards..

# Products and Insights

## Landscape Assessment

AIAA HSF activities are centered in the United States and internationally in Australia (Adelaide, Melbourne, and Sydney). Table 3 depicts an initial web review survey of AIAA technical committees with involvement in HSF PROS areas. Future drafts of this document will survey, in collaboration with AIAA, HSF PROS activities in all other disciplines such as events, webinars, courses, workshops, podcasts, publications, standards, policy, testimony, speeches, etc.

The Supersonics Integration and Outreach Committee, including David Lazzara from Boom Supersonic and Kaitlin Spak from RTX, have been involved in Environmental Impact Workshops and the Supersonics Operations sessions at recent AIAA SciTech Forums (between 2022-2025). The HyTASP Technical Committee is focusing on flight and ground testing operations. The Space Transportation Technical Committee's policy activities include education of legislators and administrators. There is no activity related to the topic of High-Speed Air Breathing Propulsion .

| AIAA TC ACTIVITY AREA | POLICY | REGULATION | OPERATIONS | STANDARDS |
|---|---|---|---|---|
| Supersonics Integration and Outreach (IOC) Committee David Lazzara, Kaitlin Spak | Environmental Impact Workshop at AIAA SciTech Forum | N/A | Supersonics Operations sessions at AIAA SciTech Forum | N/A |
| HyTASP Technical Committee | N/A | N/A | Flight and Ground Testing | N/A |
| Space Transportation Technical Committee | Education of legislators and administrators | N/A | N/A | N/A |
| High-Speed Air Breathing Propulsion | N/A | N/A | N/A | N/A |

**Table 3.** *Web Review Survey Results*

## PROS Observations and Findings

The PROS group will deliver Findings and Recommendations to HSFTF, AIAA and the emerging ecosystem of HSF vehicle providers to influence and guide the policies, laws, regulations, and standards that are innovative, adaptive, incremental, agile, and performance based, covering design, R&D, T&E, demonstrations, entry into service and full lifecycles.

AIAA's contributions to optimize PROS's frameworks will greatly enhance other industry frameworks such as capital deployment, reduced investment risk, demand from markets, costs, revenues, sociopolitical acceptance, and subsonic aviation and spaceflight ecosystems integration with these future systems.

The landscape assessment finds that the multiple efforts and entities (Table 4) lack a cohesive and concise collective voice, messaging, and delivery alignment of their individual efforts. This brings an opportunity for AIAA to assist in such an alignment of vectors to produce a super effort capable of effecting positive impact for the HSF industry at large.

On the national level, the industry standards and operations trades groups include SAE Super-Hypersonic Aircraft Steering Committee, AIAA RLV-HSF Task Groups, AIA Advanced Concepts, and IFG HSAT Workshops. International groups include ASTM Spaceflight Committee F47, ASTM Xcellerate, NBAA Advanced Technologies, and Boom Supersonic Sustainability Forums. Globally, there are three entities: IATA Supersonic Task Group, ACI Airports New Technology, and UN ISO TC20-US TAG.

National government policies include groups from the Senate and House, specifically focused in the areas of Technology, Commerce, Space, and Transportation. There is one international group: the DOC Office of Space Commerce. Additionally, there are two global groups: UN-ICAO and UN-COPUOS-OOSA.

There are two national government regulations groups: FAA Certification expert panels and FAA-ASCENT R&D. The international entity consists of the FAA-AST International Liaison. Groups leading the multinational and diplomatic efforts include UN-ICAO, UN-ICAO-CAEP, and the ICAO-Space Learning Group.

Within the academia/research/federal- and state-funded think tanks, there are four national groups: NASA High Speed Commercial Vehicles Workshops, JHTO-UCAH-Hypersonics Industry Board, MITRE-Advanced Transportation, and Aerospace Corp P2P. Internationally, there is only one group: ICCT-Environmental. Finally, on a global scale, the involved groups include Deloitte, PWC, Kearney, UBS, Merrill Lynch, BofA, Credit Suisse, and others.

| | NATIONAL | INTERNATIONAL | GLOBAL |
|---|---|---|---|
| Industry-Standards, Operations-Trade Groups | SAE-Super-Hypersonic Aircraft Steering Committee<br>AIAA- RLV-HSF Task Force<br>AIA –Advanced Concepts<br>IFG-HSAT Workshops | ASTM Spaceflight Committee F47<br>ASTM-Xcellerate<br>NBAA-Advanced Technologies<br>BOOM-Sustainability Forums | IATA-Supersonic Task Group<br>ACI-Airports New Technology<br>UN- ISO TC20-US TAG |
| Government-Policy | Senate and House-Technology, Commerce, Space, Transportation | DOC-Office of Space Commerce | UN-ICAO<br>UN-COPUOS-OOSA |
| Government-Regulations | FAA Certification expert panels<br>FAA-ASCENT R&D | FAA-AST- International Liaison | UN-ICAO<br>UN-ICAO-CAEP<br>ICAO-Space Learning Group<br>ng Group |
| Academia, Research, Federal- and State- Funded Think Tanks – Consulting | NASA High Speed Commercial Vehicles (HSCV) Workshops<br>JHTO-UCAH-Hypersonics-Industry Board<br>MITRE-Advanced Transportation<br>Aerospace Corp-P2P | ICCT-Environmental | Deloitte, PWC, Kearney, et al.<br>UBS, Merrill Lynch, BofA, Credit Suisse, et al. |

**Table 4.** *Landscape Assessment: Grouped by scope: nationally, internationally, and globally*

## Issues, Barriers, and Concerns

1. **Emissions, noise, and infrastructure access and needs (ground and airspace)**
2. **Certification and operations of the full vehicle lifecycle including R&D, T&E, and entry into service stages**
3. **FAA 2020 Certification Safety and Accountability Act -- new rules and technical advisory boards aligning HSF experts with new technologies**

Policy issues include Congress's education and understanding of HSF, the stigma surrounding private fast flying, and environmentalists' opposition, as well as policies for sharing entry into service risks (maximum probable loss). Regulatory issues involve aircraft and powerplant production and airworthiness certification, which require experienced FAA subject matter experts due to new rules following the Boeing MAX certification overhaul.

Operational issues consist of routine versus segregated operations and their impact on other vehicles, along with HSF safety management systems and flight quality assurance protocols. Standards issues arise from Standards Development Organizations (SDOs) relying on volunteers due to limited bandwidth and a shortage of subject matter experts, as well as low collaboration among SDOs..

Barriers to policy include the White House and Congress's legislative push to enable HSF R&D and prioritize Airspace Upper Class E, as well as budget constraints for DOT, DOC, DOE, and HSF technology certification and operations expertise at the FAA. Additionally, funding for HSF R&D is a concern.

Regulatory barriers involve achieving safety levels equivalent to commercial vehicles through statistical flight data, utilizing DoD supersonic flight data and experience, and addressing noise and vibration levels for supersonic and hypersonic flight.

Operational barriers include the DOT/DOC FAA and OSC budget for subject matter experts to develop operational specifications, as well as informed consent safety regulations for HSF commercial operations.

In terms of standards, barriers consist of the need for statistical data from costly and extensive flight tests and initial operations, along with the lack of proven digital twin technology for novel flight operations like HSF.

Policy concerns include the balance between sustainable flight metrics (fuel per person or mile) and the value of speed, as well as the influence of social and public engagement on policymakers. Regulatory concerns involve manufacturing certifications, operational and systems maturity levels (beyond TRL), and manufacturing readiness level (MRL). Operational concerns focus on new entrants' understanding of established subsonic ecosystems. Finally, standards-related concerns include HSF new entrants not sharing safety information, lessons learned, and technical data.

Table 5 depicts issues, barriers, and concerns for both HSF industry realms, endo (air) and exo (space) atmospheric.

| | POLICY | REGULATIONS | OPERATIONS | STANDARDS |
|---|---|---|---|---|
| Issues | Congress/Policymakers education understanding of HSF<br><br>Private-Fast-Flying stigma and environmentalists' opposition<br><br>Policy for sharing entry into service risks-maximum probable loss (MPL) | Aircraft, powerplant, production, airworthiness certification – Needs experienced FAA subject matter experts | Routine vs. segregated Ops-impact on other vehicles<br><br>HSF Safety management systems, flight quality assurance protocols | SDO's now rely on volunteers – Bandwidth and SME's scarcity<br><br>SDO's low collaboration-normative-referencing to optimize bandwidth |
| Barriers | White House, Congress legislative push to enable HSF R&D, Airspace Upper Class E prioritization<br><br>Budget for DOT, DOC, DOE, for HSF technology certification and operations expertise at FAA<br>Budget for R&D for HSF | Reaching commercial vehicles' equivalent levels of safety-statistical flight data (actual flight (expensive) vs. digital twins) (Chap)<br><br>Harvesting DOD supersonic flight data and experience<br>Noise/vibration (supersonic-hypersonic) | DOT/DOC FAA, OSC budget for subject matter experts to develop operation specifications (Ops Specs)<br><br>Informed Consent safety regulations for HSF commercial operations (135/121). It exists for spaceflight | Standards require statistical data from costly extensive flight-test and initial operations<br><br>Digital twin technology is not proven for novel flight operations like HSF |
| Concerns | Sustainable flight metrics (fuel per person-mile) vs. value of speed leads policy<br>Social-Public engagement-influence in policymakers | Manufacturing, certifications, operational and systems maturity levels (beyond Technology-TRL, Manufacturing-MRL, and Systems - SRL) | New entrants understanding of established subsonic ecosystem-sensitives | HSF new entrants not sharing safety, lessons learned and tech data |

**Table 5.** *Key Issues, Barriers, and Concerns for High-Speed Flight*

# What are the gaps?

## Policy

Efforts to effect consistent legislative push, solutions and initiatives are fragmented and perceived to be company specific.

**There is no clear HSF Industry Promotional Leader. AIAA could fill this gap**

Groups like NBAA, GAMA, AIA, AOPA, A4A, IATA, ALPA, and NATCA are not united or consistent in enrolling policymakers in HSF.

There is sporadic White House involvement for HSF. A National HSF Council would enable a consistent White House push via a set of HSF Policy Directives trickling down to Congress, agencies, and industry. If necessary, AIAA could be the conduit (see Space NSC-SPD's 1-6 as analogs).

**PROS Finding: There is no commercial HSF Congress Caucus. This is needed to align all national HSF policymaking, resulting in needed international and global policies. AIAA could assist in closing the gap.**

## Regulations

There is no series of aviation regulatory committees for HSF. HSF requires acceleration of all aspects of regulation in all areas. AIAA could be the convenor.

The HSF industry aims to scale nationally and internationally after technology is demonstrated in flight and reaches readiness levels to enter the market and the existing subsonic and orbital spaceflight systems. Effective policies and low burden regulations that enable innovation will be necessary to integrate HSF into the existing highly standardized and safe air and space frameworks. To effect both policy and regulation, government agencies like the DOT-FAA and FAA AST and DOC-OSC seek advice and recommendations from industry, public, academia, operators, and other relevant stakeholders using Federal Advisory and Rulemaking Committees guided by the Federal Advisory Committees Act. The emerging and growing HSF industry needs to provide advice and recommendations to Congress and government agencies on issues that may lead to policy and regulatory changes.

There are no relevant advisory and rulemaking committees in place where the HSF industry has the opportunity to provide advice and recommendations to the federal government and Congress. A review of the FAA's committees shows no meaningful presence of the HSF industry. There are no industry associations, trade groups, or similar that lead the HSF industry into designing, forming, or participating in such advisory and rulemaking committees.

AIAA could lead the HSF industry efforts to form federal agencies' advisory and rulemaking committees starting with the FAA's existing platforms that include: advisory committees, aviation rulemaking advisory committees, working groups, aviation rulemaking committees, and aerospace advisory rulemaking committees.

## AIAA Action Date

AIAA to complete a review and mapping of federal advisory and rulemaking committees where the HSF industry could participate.

AIAA to foster and collaborate with the HSF industry and the DOT-FAA, FAA AST, and the DOC-OSC to design, set up, and implement relevant committees to be in place by Q4 2025 and onward.

## Operations

Concorde operational data is the only existing data that the HSF industry can leverage. There is much more data from HSF unclassified government-owned flight data, statistics, SMSs, and flight quality assurance, etc., that could be used to accelerate entry into service. Maturation into routine HSF ops is critical to reduce costs and time. AIAA could help close that gap by acting as a safe, trusted data clearinghouse.

Commercial HSF flight operations might require a relaxation of risk accepted by travelers as the industry matures, similar to helicopter industry levels of safety. Suborbital commercial spaceflight uses an informed consent, and a licensed or permitted but noncertified[1]

1 https://www.ecfr.gov/current/title-14/chapter-III/subchapter-A/part-400

vehicle safety rule set in place. A level of risk assurance in between helicopters and spaceflight could potentially be suitable for HSF.

HSF is currently entering the demonstration phase. A standardized operations safety framework to share lessons learned safety events does not exist. AIAA could provide a safe, secure, and de-identified-non-punitive clearinghouse for such critical data.

**Immediate Focus:** AIAA should lead, promote, support, and augment success measures for the overland FAA supersonic[2] test flight waiver for commercial operators and authorizations of R&D vehicles such as NASA QueSst X-59 program and other privately-backed supersonic/Quesst hypersonic flight demonstrations, facilitating entry into service, and maturation of vehicles.

### Standards

Standards development organizations and technology research center readiness requires an understanding of high-speed flight performance standards as means of compliance for policy, regulation, and risk management.

PROS Focus should be on the creation of high-speed flight steering committees and voluntary consensus standards committees to facilitate standards development protocols in the United States (OMB A- 119, NTTAA Act of 1995) and transferability to international civilian high-speed flight. Although digital twin technology exists to simulate systems, manufacturing, and flight operation simulations, there is no path from digital data to real-life standards development. This gap poses a time and cost problem for the development of standards that rely mostly on actual flight data. AIAA could lead the creation of protocols for using simulated data in standards development.

## PROS Opportunities Assessment

### What are the actions that could remove barriers to HSF

### What can AIAA and industry do to advance HSF

The projected end state within three years for policy is for all government entities to understand HSF integration into the national economy, leadership, and security. At 10 years, a national HSF council is in place and producing White House HSF policy directives that transcend administrations. In 15 years, national HSF council and policy best practices are shared and applied bi-laterally within HSF countries. Long term, the goal is for HSF to be fully integrated in the United States and other global policy bodies at all levels.

The three-year end-state goal for regulation is to roadmap the HSF regulatory annexes to the CFR and the 14 aviation and spaceflight chapters. In 10 years, HSF demonstrations capture all data needed to implement an HSF regulatory roadmap. Within 15 years, the goal is for HSF entry into service safety, efficiency, and sustainability information sharing programs in place. Long term, regulatory end state is projected for all HSF regulations to be developed with industry consensus standards.

The three-year end state for operations includes roadmaps and strategies to integrate HSF with subsonic ecosystems and acceptance of HSF with optimal levels of safety (such as for helicopters and AAM). The 10-year goal is for digital twin simulations for all HSF operations to be maximized and applied to regulations, operations, and standards. Additionally, operational specifications for ad-hoc operations are in place for demos and limited time-critical operations, such as humanitarian or civil. Within 15 years, the goal is for operational specifications for schedules commercial HSF operations to be in place, with all legal, policy, and commercial dimensions aligned. The long-term end-state goal for operations is to implement HSF routine operations while ensuring safety, quality, and lessons learned for HSF in space.

The projected three-year goal for standards is to establish a roadmap for performance standards to ensure HSF compliance. This will help all stakeholders understand the protocols for producing Voluntary Industry Consensus Standards (VICS) in accordance with OMB A-119 and NTTAA 1995, which will be used for regulatory compliance in the United States and abroad. The 10-year goal is to quickly derive standards and practices from HSF demonstrations and TRL advancements, while also promoting international standards, including ISO-TC 20 (with AIAA as the secretary), to facilitate compliance globally.

2 https://www.faa.gov/sites/faa.gov/files/2021-08/SFA_Supersonic_Final_Rule.pdf

The 15-year goal is to have these performance standards in use for HSF entry into service, transitioning from performance standards to prescriptive standards as service maturity develops. The long-term goal is to ensure that HSF standards align with industry growth. Projected end-states for Regulation, Operations, Specifications and Standards are summarized in Table 6

| | POLICY | REGULATIONS | OPERATIONS | STANDARDS |
|---|---|---|---|---|
| **REGULATORY** | HSF regulatory annexes to CFR 14 Aviation and Spaceflight Chapters road mapped | HSF demonstrations capture all data needed to implement HSF regulatory roadmap | HSF entry into service safety, efficiency and sustainability voluntary information sharing programs in place | All HSF regulations are developed with industry consensus standards |
| **OPERATIONS** | Roadmaps and strategies to integrate HSF with subsonic ecosystems in place<br><br>Acceptance of HSF with optimal levels of safety (like helicopters and AAM) | Digital twin simulations for all HSF operations maximized and applied to regulations, operations and standards<br><br>Operational Specifications for ad-hoc operations in place for demos and limited time-critical operations (Humanitarian, civil, etc.) | Operational specifications for scheduled commercial HSF operations in place, with all legal, policy, commercial dimensions aligned | Apply HSF routine operations in the long term, safety, quality, lessons learned, etc, for HSF to and from Earth to space |
| **OPERATIONAL SPECIFICATIONS FOR AD-HOC OPERATIONS IN PLACE FOR DEMOS AND LIMITED TIME-CRITICAL OPERATIONS (HUMANITARIAN, CIVIL, ETC.)** | Operational specifications for scheduled commercial HSF operations in place, with all legal, policy, commercial dimensions aligned | Apply HSF routine operations in the long term, safety, quality, lessons learned, etc, for HSF to and from Earth to space | | |
| **STANDARDS** | Roadmap to performance standard as means for HSF compliance in place<br><br>Ensure all stakeholders understand the protocols to produce Voluntary Industry Consensus Standards (VICS) as per OMB A-119, NTTAA 1995 to be used as Means of Compliance (MOC) for regulation in the USA and abroad (i.e., ICAO SARPS) | Standards and practices quickly derived from HSF demos and TRL advancement<br><br>International Standards, including ISO-TC 20 (AIAA is the Secretary) USA standards proliferate as means of compliance internationally | Performance standards in use for HSF entry into service<br><br>Transition from performance standards to prescriptive standards as in service maturity develops | HSF standards aligned with industry growth |

**Table 6.** *Projected End States*

## AIAA Key Actions

Key actions for the AIAA in three years include AIAA investing in the hub to lead, promote, and represent HSF (including endo- and exoatmospheric) in the United States to facilitate experimental demonstrations. To accomplish this, actions include aligning the federal government with Congress, enabling the FAA pipeline of SMEs for HSF regulators, enabling the HSF interfaces with the subsonic industry, and becoming the hub of standards development organizations.

In ten years, the goal is to make sure the AIAA-led HSF hub has a global presence to facilitate HSF entry into service. Actions include focusing on value of speed with environmental metrics aligned: more fuel-per-mile, but a positive quick-total impact. Additionally, ensuring FAA (aviation and space) are seamlessly aligned for HSF.

The 15-year goal for AIAA is to fully align with air and space transportation trade organizations as HSF industrial manufacturing and commercial operations begin. To accomplish this, roadmaps are required for HSF SMEs, workforce, safety, efficiency, and sustainability after entry into service. Another action is ensuring safe, reliable, and economic growth of the HSF industry.

A long-term goal is that AIAA supports HSF industry point-to-point on Earth and into deep space HSF. The key action is once HSF is routing P2P on Earth to transition to HSF from Earth to other points in space.

A summary of AIAA Key actions is contained in Table 7.

| END ESTATE YEARS | 3 | 10 | 15 | LONGER TERM |
|---|---|---|---|---|
| AIAA | AIAA invests in the hub to lead, promote and represent HSF (endo and exo) in the U.S. to facilitate experimental demonstrations (TRL ~6-7) | AIAA-led HSF Hub has global presence to facilitate HSF entry into service (TRL 8-9) | AIAA is fully aligned with air and space transportation trade organizations as HSF industrial manufacturing and commercial operations begin | AIAA supports HSF industry point to point on Earth and into deep space HSF |
| Key Actions | Align federal government WH-Congress caucus-states<br><br>Enable FAA pipeline of subject matter experts's HSF regulators<br><br>Enable HSF interfaces with subsonic industry<br><br>Become hub of standards development organizations | Focus on value of speed with environmental metrics aligned- more fuel per mile, but quick-total impact positive<br><br>Ensure FAA aviation and space are seamlessly aligned for HSF | Roadmap HSF subject matter experts, workforce, and roadmaps to safety, efficiency, and sustainability post-entry into service<br><br>Ensure safe, reliable, and economic growth of HSF industry | Once HSF is routine P2P on Earth, transition to HSF from Earth to other points in space |

**Table 7.** *Summary of AIAA Key Actionss*

# Appendix

PROS Need-Gaps-Recommendation-Action (NGRA)

| ID | RECOMMENDATION-TITLE | PROS AREA | DEFINED NEED | SUGGESTED AIAA ACTION | AIAA OUTPUT |
|---|---|---|---|---|---|
| 1 | Industry Development Alignment- AIAA as Central Facilitator, Repository Center, Portal for HSF Stakeholders | STANDARDS AND BEST PRACTICES | Need to align HSF national and international stakeholders' efforts | AIAA should become the HSF and industry "hub" to help policy makers, regulators, operators and standards developers gather and collaborate to build the new economy. AIAA protocols should be innovative, agile, adaptive, incremental and provide frameworks for national and international performance-based standards and best practices development. A first recommended step is to make the HSF Task Force an AIAA permanent Technical Committee Group, with growing presence in relevant areas such as Standing Committee (SC), Guiding Coalitions (ASCEND), Program and TC Chairs, etc. | HSF WORKSHOPS, EVENTS AND SHORT COURSES-WHITE PAPERS |
| 2 | High Speed Flight as a Novel Transportation Modality-Fostering Congressional and Regulatory Support | POLICY | The commercial High Speed Flight (HSF) transportation novel modality stands alone in terms of technologies, systems, and infrastructures at the intersection of the subsonic aviation and orbital spaceflight industries requiring new policy and regulatory frameworks at all levels. | AIAA could foster the creation HSF as a novel Transportation modality and assist policy makers, regulators, operators and standards developers as a guide, leader and integrator of technical and scientific capabilities, activities and intellectual (IP) given its massive membership bandwidth. | AIAA TO PRODUCE HSF WHITE PAPERS AND WORKSHOP-DAYS FOR MEMBERS OF CONGRESS AND, OR RELEVANT FEDERAL AGENCIES |

| ID | RECOMMENDATION-TITLE | PROS AREA | DEFINED NEED | SUGGESTED AIAA ACTION | AIAA OUTPUT |
|---|---|---|---|---|---|
| 3 | High Speed Flight Standards and Best Practices-Streamlining development for regulatory acceptance as means of compliance | REGULATIONS AND STANDARDS | The HSF industry needs streamlined and harmonized national and international standards and best practices development protocols to ensure their proliferation and scaling from technology demonstrations to a viable transportation system fully integrated with existing subsonic and orbital space transportation industry and modality. Such standards and best practices, when harmonized, can be used as a means of compliance with regulatory agencies, | AIAA should consider enacting a Commercial High Speed Flight Standards Committee, supported by the existing AIAA Committee on Standards following the guiding principles of the American Standards National Institute (ANSI), and abiding by the protocols of the Office of Management and Budget (OMB A-119 circular, and the National Technology transfer Advance Act of 1995 (NTTAA). Internationally, AIAA, as the secretary of the International Standards Organization (ISO) Technical Committee 20, Aircraft and Space Vehicles, should consider the enacting of Subcommittee (SC 18) High Speed Flight Vehicles to promote US HSF standards and their development protocols internationally. | SET UP OF A COMMERCIAL HIGH SPEED FLIGHT STANDARDS COMMITTEE |

| ID | RECOMMENDATION-TITLE | PROS AREA | DEFINED NEED | SUGGESTED AIAA ACTION | AIAA OUTPUT |
|---|---|---|---|---|---|
| 4 | High Speed Flight Policy as a National Leadership Imperative-All of Nation's Effort, Policy and Regulation Support | POLICY | The United States' White House and Congressional policy directives for aeronautical and aerospace leadership must include high speed flight in a bi-partisan manner and for the long term (multi decadal horizons). For instance, there is no commercial HSF Congress Caucus at the House or Senate levels. Such HSF Caucuses are needed to align a bi-partisan long term National HSF policy making. In turn, such Caucuses will also affect international and global policies benefitting the USA HSF industry. | AIAA could lead the formation of a National HSF-Council (NHC) which would enable a consistent White House push via HSF-Policy Directives (HPD's) informed by an HSF Users Advisory Group. The NHSFC would lead the long-term thinking, trickling down to Congress, regulatory agencies, academia, standards developments organizations, and industry. The National Space Council (NSC) and its Users' Advisory Group (UAG) could be a relevant analog for the effort. | SET UP A TASK GROUP TO PRODUCE A WHITE PAPER AND ROADMPAP FOR A NHSFC |

| ID | RECOMMENDATION-TITLE | PROS AREA | DEFINED NEED | SUGGESTED AIAA ACTION | AIAA OUTPUT |
|---|---|---|---|---|---|
| 5 | Formation of an FAA High Speed Flight Rulemaking Committee (HSF-ARC)- Regulatory agencies alignment as with other novel industries (AAM, Spaceflight) | REGULATIONS AND STANDARDS | The HSF industry aims to grow, proliferate and scale nationally and internationally after technology is demonstrated in flight and reaches readiness levels to enter the market and the existing subsonic and orbital space flight systems. Effective policies and low burden regulations that enable innovation will be necessary to integrate HSF into the existing air and space highly standardized and safe frameworks To effect both, government agencies like the DOT-FAA and FAA AST and DOC-OSC seek advice and recommendations from industry, public, academia, operators and other relevant stakeholders using Federal Advisory and Rulemaking Committees (ARC's) guided by the Federal Advisory Committees Act (FACA). | AIAA could advocate for the formation of Federal Agencies' ARC's starting with the FAA's existing platforms that include; Advisory Committees (AC's), Aviation Rulemaking Advisory Committees (ARAC's), Working Groups (WG's), Aviation Rulemaking Committees (ARC), Aerospace Advisory rulemaking Committees (SPARC). | AIAA TO DEVELOP WORKSHOPS WITH THE FAA TO DEFINE HSF ARC'S |
| 6 | High Speed Flight Industry Standards and Accepted Levels of Safety- New Paradigms specifically for High-Speed Flight (HSF) Commercial Vehicles | STANDARDS AND OPERATIONS | Commercial High Speed Flight (HSF) requires a new paradigm to establish acceptable levels of safety for passenger and cargo transportation. HSF vehicles entry into service could use safety, hazard and levels of safety analysis aligned with other than transport category aircraft. For instance, the UAS/AAM industry and the commercial helicopters' industry | Promote High Speed Flight Industry Standards and Accepted Levels of Safety - New safety frameworks are required-helicopter industry levels of safety-standards vaults of knowledge from military, NASA (X-59 et al), and Concorde heritages | AIAA Workshops, roadmaps and white papers in collaboration with the FAA, UAS/AAM and Helicopter industries |

| ID | RECOMMENDATION-TITLE | PROS AREA | DEFINED NEED | SUGGESTED AIAA ACTION | AIAA OUTPUT |
|---|---|---|---|---|---|
| 7 | ITAR Restrictions to technology transfer and export of Commercial High-Speed Vehicles-HSF GPS ITAR Restrictions must be Fully Lifted or Placed in the US DOS EAR regime ASAP | POLICY, REGULATION AND OPERATIONS | Unless GNSS receivers are moved from ITAR to EAR or other regulations allowing high speed flight operations above Mach 1.8 , program launch and capital investment and formation will be insufficient for supersonic and hypersonic high-speed flight. Global geo-political volatility precludes a change of the GNSS receiver export and export in Arms Regulations (EAR) regime, for the near future. Limiting investment and capital formation to experimental demonstrations of supersonic and hypersonic vehicles | Modernize ITAR Restrictions to technology transfer and export of High-Speed Vehicles - Transferring HSF vehicles from ITAR to DOC Export in Arms (EAR ) regulations regime. | AIAA TO FORM A TASK GROUP AND FOCUSED WORKSHOP ON ITAR BARRIERS AND CHALLENGES TO HSF-INITIAL WHITE PAPER ON GPS ISSUES |

| ID | RECOMMENDATION-TITLE | PROS AREA | DEFINED NEED | SUGGESTED AIAA ACTION | AIAA OUTPUT |
|---|---|---|---|---|---|
| 8 | High Speed Flight Vehicles Certification-Aligning FAA's evolving air and spacecraft vehicles certification rules and protocols with the HSF industry | CERTIFICATION AND STANDARDS | Current FAA regulations for the certification of supersonic and hypersonic airframe, powerplant and vehicle systems requires SME's panels with relevant experience, as Safety Experts Boards. Currently, such SME's are extremely scarce and, or nonexistent for HSF vehicles. Concorde and DOD SME's and newly trained SME's are required. Legislative and Congressional approvals to amend or waive certification regulations is a major challenge to enable entry into commercial service. | Align High Speed Flight Vehicles Certification - Aligning FAA's evolving air and spacecraft vehicles certification rules and protocols with the HSF emerging new technologies as they reach TRL's for flight and manufacturing certification (TC/PC). Transfer SME's experience from DOD-Military SME's, supersonic and hypersonic (as ITAR, EAR regulations permit) SME's DOD-Military. AIAA to influence FAA-Aviation Safety (AVS) waivers and relaxation protocols of existing FAR 25 – (10 ^-9 risk) levels of Safety standards requirements for supersonic and hypersonic commercial operations (FAR 135/125/121) and FAR 33, 25) certification rules of airframe and power plant and integrated vehicle systems. Contribute to future FAA post 2023 Safety and Accountability for Certification Acts and other Congressional guidance. | TECHNICAL COMMITTEE ON HSF VEHICLE CERTIFICATION, WHITE PAPERS , SHORT COURSES AND WORKSHOPS ON FAA HSF "DIGITAL TWIN" TECHNOLOGIES FOR CERTIFICATION |

| ID | RECOMMENDATION-TITLE | PROS AREA | DEFINED NEED | SUGGESTED AIAA ACTION | AIAA OUTPUT |
|---|---|---|---|---|---|
| 9 | High Speed Flight Technologies Integration in Existing Subsonic and Spaceflight Systems- Align TRL's with Manufacturing System and Integration Readiness Levels (MRL-SRL-IRL) | OPERATIONS AND STANDARDS | Technology Readiness Level (TRL's) progress must be dynamically aligned with Manufacturing Readiness Levels (MRL) and Integration Readiness Level (IRL) to yield System Readiness Level (SRL). SRL's provide complete representations of the integration of supersonic and hypersonic vehicle technologies into the full operational eco system of systems, ATC, airports, supply chain-OEM's, finance-insurance-policy et at. Technology Readiness Levels (TRL) development alignment with Manufacturing Readiness Levels (MRL), Integration Readiness Levels(IRL) and Systems Readiness Levels (SRL) is a condition for program financing and launch decisions. | High Speed Flight Technologies Integration into Existing Subsonic and Spaceflight Systems - Aligning TRL's with Manufacturing Readiness Levels (MRL), Integration Readiness Levels (IRL) and Systems Readiness Levels (SRL) of the adjacent subsonic and spaceflight flight systems. AIAA to add valuable inputs to ensure that technology can be industrialized and scales for favorable commercial program funding and launch decisions. AIAA's TC to assist with TRL's guidance to be certifiable with protocols for ensuring their manufacturability, integration in a production-industrialized commercial program setting. | AIAA to lead short courses and workshops to research and publish documents about Enterprise Resources Programs (ERP's) that include technology, commercial, funding, regulatory and policy decision makers |
| 10 | Human Factors and Aeromedical Standards for Passengers and Crew-Research and Applied Technologies for Commercial HSF | REGULATIONS AND STANDARDS | There is a patent need for standards, best practices to inform regulation, through published research adding conclusive human factors and health studies related to the effects of commercial high speed and altitude flight on human health. | AIAA could be the hub for Industry, government, academia and private sector partnerships to lead studies, white papers and educational sessions, workshops, etc, that focus on the effect of high-speed flight on human health. Use NASA and DOD high altitude and speed declassified human factors and health data from relevant aircraft and spacecraft (i.e. SR-71, U-2, Space Shuttle, ISS< etc.) | AIAA Joint workshops with FAA-CAMI and NASA Human Factors and Aero Medical research. Short courses and standards development committees. |