Aerospace Supply Chain Resiliency Task Force Report to Congress

Delivered November 4, 2024

(A) Executive Summary

The aerospace sector provides critical economic, security, humanitarian, and diplomatic services. Supporting the safest, most effective form of transportation necessitates a complex spider web of worldwide suppliers for goods and services. Aerospace activities are a key driver of nearly every other industry in the United States and worldwide.

The Aerospace Supply Chain Resiliency Appendix 1 – Task Force Membership was purposefully organized to represent the broadest range of disciplines and stakeholders directly impacted by risks to the aerospace supply chain and most vulnerable to disruptions in the National Air Space (NAS) system.[1]

Over the course of this effort, the Task Force has concluded the following:

- Our aerospace supply chain is vulnerable to labor shortages, obstacles in critical materials, and the health of supporting infrastructure. Investment in these three areas, well beyond today's current levels, will be needed to ensure that the aerospace supply chain is able to operate in the presence of supply chain disruptions.
- Unlike other parts of the economy in the U.S., the aerospace supply chain is uniquely dependent on the smooth operation of, and collaboration across regulatory entities, especially the Federal Aviation Administration (FAA). In many cases, key work can only be done by people who have required credentials, repairs and maintenance often require additional government oversight, and the personnel responsible for oversight are subject to Congressional authorization and appropriation timelines.
- Because the aerospace supply chain is tied to global operations, global interoperability requirements, and bilateral or multi-lateral agreements, actions taken in the U.S. cannot be seen as independent of the broader global environment.

The assessment of the Task Force's review of the aerospace supply chain resiliency factors and risks are summarized below.

The U.S. aerospace supply chain begins with sourcing raw materials; progresses through production, installation, operations, alterations and maintenance; and ends with the last use of recycled materials. Numerous variables including geopolitical forces, legislative activities, regulatory application, workforce training, recruitment, and retention, and aerospace infrastructure disturbances can significantly disturb and influence supply chain resiliency.[2]

[1] Created under the authority of FAA to fulfill Title 49 U.S. Code § 40103. *See*, National Airspace System (NAS), Federal Aviation Administration, April 20, 2023 (https://www.faa.gov/air_traffic/nas) ("The NAS is a network of both controlled and uncontrolled airspace, both domestic and oceanic. It also includes air navigation facilities, equipment and services; airports and landing areas; aeronautical charts, information and services; rules and regulations; procedures and technical information; and manpower and material.").

[2] *See, Aviation Technician Education Council, 2024 (https://www.atec-amt.org/pipeline-report); and "Ancient computers, too few pilots and air traffic controller shortages. US air travel could be a rough ride this summer", CNN, June 13, 2023 (https://www.cnn.com/travel/us-aerospace-meltdown-fixes-travel/index.html). See also, "What's the reason for air traffic controller shortages?", Airport Industry Review, May 2024*

The U.S. aerospace industry must obtain resources from outside of the country to maintain the most capable, safe, and efficient aerospace system, including its major end items.[3] The aerospace industry includes state, local, and federal government infrastructure and operations, business, private, and commercial, military, and space operations. All sectors rely on the same sources of raw materials, minerals, and services. Many vital raw materials, *e.g.*, cobalt, titanium sponge, and gallium, are 100 percent import dependent.[4] Production facilities and methods that impinge on the environment, *e.g.*, those that create plastics, composites, and alloys, require high capital investment, specialized workforces, coordination among international business partners, and approval from government entities. Every supply and supplier in the complex supply chain web faces the same workforce and resource challenges.[5]

Global workforce shortages have been on the horizon for decades; however, the COVID-19 pandemic, the "great resignation", a constantly expanding industry, economic cycles that encourage early retirement, and retention challenges have exacerbated workforce issues. Waves of retirements and resignations from the 9/11 tragedy, the COVID pandemic, and changes in demographics and lifestyle expectations have increased hiring and retention pressure throughout the supply chain.

Aerospace workforce losses cannot be measured by mere head count, as the loss of institutional knowledge and skills continues to directly impact productivity.[6] The need for highly skilled individuals to support critical air traffic control and infrastructure that preserve the safety record for the industry is at a tipping point.[7]

In recent years, the civil and military aerospace supply chains have grown increasingly interwoven, creating security and other work requirements to protect the sensitive nature of technology. While the goals of these requirements may be valid, they can exacerbate bottlenecks, stifle innovation, and restrain progress in maintaining resilience in the fragile supply chain.

The Task Force identified and addressed four major risk categories that threaten all contributors to the aerospace supply chain—

(1) Workforce.

Workforce issues are shared by all industries, but the ability to obtain and retain sufficient qualified individuals in the aerospace sector is difficult due to the special technical training, knowledge, certification, and other requirements of aviation safety authorities and the industry. There is a

[3] An aircraft, aircraft engine or propulsion system, communications, navigation, or surveillance equipment used in the provision of air traffic services, and any other end item the manufacture and operation of which has a significant effect on air commerce, as determined by the Secretary.

[4] In addition, Uncrewed Aircraft Systems (UAS), Advanced Air Mobility (AAM) aircraft, spacecraft and launch facilities, and certain Department of Defense (DOD) aircraft use rare earth elements such as yttrium, terbium, dysprosium, samarium, and neodymium, ninety to ninety-five percent of which comes from China.

[5] *See, e.g.*, "Commercial Sector Unable to Reach Airframer Ramp-Ups, Survey Suggests", Aerospace Week, July 24, 2024 (https://aerospaceweek.com/shownews/farnborough-airshow/commercial-sector-unable-reach-airframer-ramp-ups-survey-suggests).

[6] *See*, "Transportation Productivity: Labor Productivity", Bureau of Transportation Statistics (https://data.bts.gov/stories/s/Transportation-Economic-Trends-Productivity-Labor/cksf-e5wx/#:~:text=Air%20transportation%20labor%20productivity%20increased,with%20records%20beginning%20in%201990),
CNN, June 13, 2023 (https://www.cnn.com/travel/us-aerospace-meltdown-fixes-travel/index.html). *See also*, "What's the reason for air traffic controller shortages?", Airport Industry Review, May 2024 (https://airport.nridigital.com/air_may24/reason_for_air_traffic_controller_shortages).

highly competitive environment for skilled pilots, engineers, and technicians within the aerospace sector and from other industries with a need for the same special talents.

Products, manufacturers, operators, maintainers, individual engineers, pilots, and technicians all require FAA certification. In recent years, inadequate personnel resources have undermined the effectiveness of the agency. Consequently, companies are experiencing significant delays in obtaining and shipping raw materials, assemblies, and parts, the certification and licensing processes that allow entry for new products to the market, maintaining the efficiency and safety of older products, and issuing of new and amended certificates and licenses for new and existing operators and individuals.

For the aerospace sector to operate efficiently, the FAA must improve the training and professionalism of its workforce.

(2) Critical Resources.

Critical resources include essential materials as well as the infrastructure and personnel that support the air traffic control system, commercial and private operators, legacy aircraft performing special purpose operations, and supporting local, state, county, and federal government operations, disaster relief, search and rescue, among other public activities.

The infrastructure of the NAS and government processes that support its operations are critical to ensuring the safe and efficient transportation of products, people, and services. This includes not only commercial passenger and cargo transport, but also operations supporting military, local, state, county and federal government operations, disaster relief, search and rescue, and other public activities. Elements of today's infrastructure are significantly outdated or need protections and modifications to mitigate risks to the NAS. Modernization of the air traffic control system would also support dynamic airspace management around space launch and reentry operations, allowing for a more efficient NAS.

For example, Congress has directed the FAA to modernize and deploy air traffic control (ATC) systems to integrate space launch and reentry operations (LRO) data directly onto air traffic controller displays – including integrating into the En Route Automation Modernization (ERAM) system – and automate systems to enable near real-time tracking, management, and rerouting of air traffic during such operations.[8] The FAA Air Traffic Organization's Space Data Integrator (SDI) operational prototype must become an official FAA program with a dedicated funding stream, but additional upgrades to the SDI system are needed, including the rapid deployment of the NAS Space Integration Capability (NSIC) and subsequent updates. Prioritizing the development and deployment of such systems is consistent with the FAA's 2019 Airspace Access Priorities Aviation Rulemaking Committee (ARC) Final Report recommendations,[9] would lessen the workload burden on air traffic controllers actively managing the NAS and ensure the full integration of LROs into the NAS.

Without sufficient investment to maintain and update ATC infrastructure and automation, the continuity of the air traffic control system, the work of aircraft performing special purpose operations, essential government operations, space launch and reentry operations, disaster relief,

[8] *See*, The FAA Reauthorization Act of 2024, Pub. L. No. 118-63, sec. 630 (https://www.congress.gov/bill/118th-congress/house-bill/3935/text).
[9] *See*, Federal Aviation Administration, Airspace Access Priorities Aerospace Rulemaking Committee (ARC), "ARC Recommendations Final Report." August 21, 2019

and search and rescue activities will be negatively impacted. Changes to the budget process would improve the safety, efficiency, and resilience of the ATC system.

The protection of radio spectrum[10] supporting aerospace communications, navigation, and surveillance is foundational for safe operation in civil aviation and commercial space. Significant pressure from other industries, such as the mobile telecommunications sector, to access spectrum currently reserved for or adjacent to aerospace use must be resisted. Changes to consumer products can be accomplished quickly. However, changes in aerospace spectrum use or requirements involve extensive international coordination, multiple government agencies, and key industry sectors considerations followed by complex safety-mandated upgrades of aircraft, and specialized group equipment dependent on allocations and policy decisions. Satellites already in operation are not able to be retrofitted to accommodate changes to spectrum allocations.

(3) Global Interdependence.

Geopolitical uncertainty injects risk into the supply chain. Economic relations with trading partners are disrupted due to internal or external factors through changes in government, in political and trade posture vis-à-vis the United States, foreign invasions, and non-state actor interference in transportation avenues.[11] Enhancing supply chain resiliency requires identifying the sources of essential inputs and alternative sources and inputs. Risks are compounded by the highly regulated civil aviation environment that requires agency approval of new materials, uses, and sources. It is imperative that the United States become less reliant on adversarial nations for critical resources in raw material, manufacturing, components, and assemblies.

In addition, civil aerospace export controls are intended to support national competitiveness while preserving national security. Without clear definition and consistent interpretation, it is impossible for an operator to determine compliance with the myriad regulations leading to a shrinking of the supply chain.

(4) Legislation, Statues, Regulation, and Policy.

The aerospace sector is heavily regulated by multiple federal, state, and local agencies. While the FAA is the most prominent federal agency, aerospace activities are also subject to the Environmental Protection Agency (EPA), Occupational Safety and Health Administration, Department of Transportation (DOT), Department of Commerce (DOC), Department of State (DOS), Department of Homeland Security (DHS), Department of Defense (DOD), and the Federal Communications Commission (FCC), among others.[12] Further, The aerospace sector is particularly impacted by continuing resolutions and government shutdowns, as it relies on constant interaction with the FAA and other federal agencies to function effectively, efficiently, and productively. Changes to the budget process would improve the safety, efficiency, and resilience of the ATC system.

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[10] Radio spectrum is the radio frequency (RF) portion of the electromagnetic spectrum, see, Federal Communications Commission. *See,* "Radio Spectrum Allocation", Federal Communications Commission (https://www.fcc.gov/engineering-technology/policy-and-rules-division/general/radio-spectrum-allocation).

[11] Attacks and conflicts in major shipping lanes, e.g., Red Sea, Arabian Sea, Indian Ocean, South China Sea, Persian Gulf, Horn of Africa, and Gulf Aden.

[12] According to Adelphi University, there are more than 2,000 federal agencies, any one of which may contract for a major end item or aerospace service from the private sector. *See,* "The Federal Bureaucracy" (https://libguides.adelphi.edu/c.php?g=745658&p=9242744).

The agency must broaden applications for summary grants for risk-similar products and operations. The FAA should also provide guidance during the development of new industry consensus standards to ensure that the resulting standards are considered acceptable means of compliance for the agency's performance-based regulations. Similarly, the DOD is a major consumer of U.S. aerospace sector products; it has acquisition policies that make it difficult or impossible for new suppliers to enter the marketplace, limiting competition, and resulting in fewer suppliers. The DOD should leverage its grant programs by transitioning more projects from research and development into commercially funded projects. In addition, the DOD should consider sustained, multi-year grants to allow for the continued development of aerospace products and services.

The FAA's required documentation is not universally accepted electronically despite several government mandates to enable digital transactions. The FAA still relies heavily on antiquated legacy technology and paper or email transactional records. While the FAA has begun to adopt digital technology in targeted, isolated offices and services, it has not developed and implemented a system wide methodology with proper security measures and adequate support to ensure functionality. Fraudulent activities vis-a-vis paper-based documentation[13] make adoption of digital technology more urgent. In addition, the FAA should hasten the development and deployment of the Licensing Electronic Application Portal (LEAP) tool to allow for digital tracking of licensing applications.

(B) Authority, Purpose, Objectives, and Duties

Authority: Pub. L. 117-328, Division Q, Section 106 ([Page 135 STAT. 5256]), the Aerospace Supply Chain Resiliency Task Force was to be composed of not more than twenty-one (21) individuals. The composition of the task force as directed by Congress set forth in Appendix 1 – Task Force Membership.

Purpose and Objectives: Under Section 106 of the Consolidated Appropriations Act,[14] the task force was to identify and assess risks to U.S. aerospace supply chains, including the availability of raw materials and critical manufactured goods, with respect to major end items produced by the aerospace industry; to identify and assess risks to the infrastructure of the NAS; and to identify best practices and make recommendations to mitigate those risks and support a robust U.S. aerospace supply chain.

- Identify supply chains risks to "major end items" (Sec. 106(a)(1))—
- Raw material—
- Critical manufactured goods—

- Identify NAS infrastructure risks (Sec. 106(a)(1)(B))—

[13] *See*, *e.g.*, "Koito Delivered 150,000 Faulty Seats for 32 Airlines to Airbus and Boeing", AIN Media Group, February 11, 2010 (https://www.ainonline.com/aerospace-news/air-transport/2010-02-11/koito-delivered-150000-faulty-seats-32-airlines-airbus-and); "Ghost in the Machine: How Fake Parts Infiltrated Airline Fleets, Bloomberg, Oct. 11, 2023 (https://www.bloomberg.com/news/features/2023-10-11/fake-parts-found-on-boeing-airbus-jets-plague-airlines); and "Fake-parts scandal pushes aerospace giants to rethink safeguards", American Journal of Transportation, Feb. 22, 2024 (https://www.ajot.com/news/fake-parts-scandal-pushes-aerospace-giants-to-rethink-safeguards) regarding fraudulently completed certification documents on civil aerospace engine parts.

[14] *See*, Authority: Pub. L. 117-328, Division Q, Section 106 ([Page 135 STAT. 5256]).

- Assess identified risks (Sec. 106(a)(1))
    - Supply chain(s)
    - NAS infrastructure

Duties: Engage with the aerospace industry to document trends in changes to production throughput and lead times of major end items produced by the aerospace industry.

- Determine the extent to which United States aerospace supply changes are potentially exposed to significant disturbances, including the existence of and potential for supply chain issues such as chokepoints, bottlenecks, or shortages that could prevent or inhibit the production or flow of major end items and services
- Explore new solutions to resolve such supply chains issues identified under paragraph (2), including the use of—
    - Existing aerospace infrastructure, and
    - Aerospace infrastructure, manufacturing capabilities, and production capabilities in small or rural communities
- Evaluate the potential for the introduction and integration of advanced technology to—
    - Relieve such supply chain issues, and
    - Fill such gaps
- Utilize to the maximum extent practicable existing supply chain studies, reports, and materials in carrying out the activities described in this subsection, and
- Provide recommendations to address, manage, and relieve such supply chain issues.

(C) Meetings

The Task Force held its first meeting on January 10th and 11th, 2024, in-person at the DOT headquarters. Subsequent in-person meetings were held on 3-4 April, 26 June, and 18-19 September 2024, as published in the Federal Register. Portions of the subsequent in-person meetings were open to the public to gather additional perspectives and receive briefings from the DOD and the Bureau of Labor Statistics (BLS), among others. Between in-person meetings, the Task Force had regular online meetings that refined the information necessary to provide this report to Congress.

(D) Major Risk Categories

The Task Force identified four major risk categories that threaten all contributors to the aerospace supply chain: workforce; critical resources; geopolitics; and U.S. policy, law, and regulation. Although these risks categories overlap in some areas, these categories provided the best method for organizing the relevant information in this report given existing supply chain studies, reports, and activities.

The documents listed in Appendix 2 – Supply Chain Studies, Reports, and Other Materials - were provided for general information and background on these four major risk categories.

(1) Workforce

Many industries are facing a shortage of technical talent; the ability to attract and retain sufficient human resources in aerospace is exacerbated by the special requirements and needs of the aviation safety authorities and the industry. The ability to attract and retain sufficient human resources in aerospace is exacerbated by mandated knowledge, skill, and certification requirements. The U.S. aerospace is statistically the safest industry and will continue to improve. The failure of a specific system creates a negative ripple effect that categorizes the industry generally instead of addressing the root cause of the failure. This leads to an intense and increasing public scrutiny on the workforce down to the lowest mechanic that is unique to aerospace. This generalization is demoralizing to the current workforce and can discourage new entrants. The issues are intensified by the decreases in aerospace training centers, the attractiveness of aviation as a career, and stagnation in compensation and other benefits.

(i) Key inputs

Many positions in civil aviation require certificates to be issued by the FAA,[15] making the industry uniquely and critically dependent upon the knowledge and skills of senior individuals with practical work experience. Unlike automotive, nuclear power, maritime, and other design, manufacturing, and operating sectors, individuals in the aerospace industry are subject to the direct oversight of a government agency through the certification process. The certificate holder must have the knowledge gained through training *and* experience to fulfill regulatory and commercial obligations.

The stability of the FAA's skilled workforce is itself a supply chain risk, as the agency must issue a certificate or license before productivity can commence. Inadequate human resources, coupled with knowledgeable personnel departures, significantly delays essential government engagement with industry that is vital to heavily regulated aerospace products and operations. The FAA's inability to keep up with rapidly changing technology, replace its loss of workforce continuity and knowledge, and interact transparently with the industry has become a chokepoint in the aerospace supply chain.

The "great resignation" refers to the accelerated rate of departures, primarily among the baby boomer generation, during and after the COVID-19 pandemic. Approximately 3.2 million more people retired in the third quarter of 2020 than in the same period of the previous year.[16] This wave of retirements created a knowledge and talent vacuum, placing an additional strain on the remaining qualified and capable workforce and negatively impacting productivity. This trend significantly impacted the aerospace sector wherein a large portion of the workforce is near retirement age.[17]

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[15] *See, e.g.*, Title 14, Code of Federal Regulations, parts 61 to 68, 91, 110 to 121, 140 to 147, 170. for certificate qualification requirements. S*ee, also*, "Aerospace Careers: Helpful Hints", Federal Aerospace Administration (https://www.faa.gov/jobs/career_fields/aerospace_careers/asi/helpful_hints).

[16] *See*, "The pace of Boomer retirements has accelerated in the past year", Pew Research Center, Nov. 9, 2020 (https://www.pewresearch.org/short-reads/2020/11/09/the-pace-of-boomer-retirements-has-accelerated-in-the-past-year/).

[17] *See, e.g.*, "New generation of aircraft mechanics hoping to fill gaps amid worker shortage: Nearly 1/3 of the current aircraft mechanic workforce are at or near retirement", Fox Business, Aug. 29, 2023 (https://www.foxbusiness.com/fox-news-travel/new-generation-aircraft-mechanics-hoping-fill-gaps-amid-worker-shortage) and "Vital Signs 2024: The Health and Readiness of the Defense Industrial Base", National Defense

Like all federal agencies, the FAA is restricted from asking personnel about retirement age[18] and lacks a comprehensive and consistent recruitment, training, and personnel management program. As a result, succession planning rarely occurs and the agency's functions are regularly disrupted by retirements and onboarding of new personnel.

Workforce prediction and analysis is frequently problematic for both the public and private aerospace sectors. Government agencies do not fully or effectively collaborate to collect and analyze information that can track and forecast appropriate levels of skilled labor and required personnel.[19] Data collection based upon surveys and required business submissions may not provide needed information. Myriad federal and state agencies are charged with collecting, cleaning, correlating, and calibrating data, and interagency collaboration rarely occurs. The Women in Aviation Advisory Board made several recommendations to the FAA that included improving government collection of aviation workforce gender, race/ethnicity, and pay parity data that should be considered to track workforce changes in the aerospace industry.[20]

The Department of Labor (DOL) is responsible for developing, maintaining, and improving the nation's Workforce and Labor Market Information System (WLMIS).[21] WLMIS data is essential for efficient, well-functioning labor markets. Efficient use of this data will support assessment of "current domestic education and manufacturing workforce skills for the relevant sector and identified gaps, opportunities, and potential best practices in meeting the future workforce needs."[22] The DOL should consistently track enhanced unemployment wage records over time that include occupational job titles, hours worked, credentials, and job site locations. Comprehensive labor market information is essential to predicting worker, job, and skill shortage.[23]

The job market since 2019 has shifted dramatically, partially caused by the "great resignation"[24] and fluctuating turnover rates.[25] Unless well-paying aerospace jobs are filled by the next generation, the U.S. economy will struggle. Some aerospace employers are experiencing the

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Industrial Association (https://www.ndia.org/-/media/sites/ndia/policy/vital-signs/2024/2024_vital_signs_final.pdf?download=1).

[18] *See*, *e.g.*, "Opportunities Exist for FAA to Strengthen Its Workforce Planning and Training Processes for Maintenance Technicians", U.S. Department of Transportation, Office of the Inspector General, May 2, 2023 (https://www.oig.dot.gov/library-item/39465).

[19] This is particularly true in when it comes to new technologies that require specialized skills, such as UAS, AAM, spacecraft, space facilities, and new expanding communication channels.

[20] "Breaking Barriers of Women in Aerospace: Flight Plan for the Future", Women in Aerospace Advisory Board, March 2022 at 72 (https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/WIAAB_Recommendations_Report_March_2022.pdf).

[21] *See*, Title 30 U.S. Code of Federal Regulations, § 652.300 (https://www.ecfr.gov/current/title-20/chapter-V/part-652/subpart-D).

[22] *See*, "America's Supply Chains", Executive Order 14017, Feb. 24, 2021 (https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains/).

[23] *See*, "Many Americans Are Struggling and Need Better Information To Make A Comeback," U.S. Department of Labor Workforce Information Advisory Council (WIAC), Aug. 31, 2021 and "Recommendations to Improve the Nation's Workforce and Labor Market Information System,: Recommendations of the Workforce Information Advisory Council to the Secretary of Labor" June 26, 2023 (https://www.dol.gov/sites/dolgov/files/ETA/wioa/pdfs/WIAC_2023_Recommendations_to_Improve_LMI.pdf).

[24] *See, "*The Great Resignation Didn't Start with the Pandemic", Havard Business Review, March 23, 2022 (https://hbr.org/2022/03/the-great-resignation-didnt-start-with-the-pandemic).

[25] *See*, "Employee Retention & Attraction", Gallup (https://www.gallup.com/467702/indicator-employee-retention-attraction.aspx).

effects of stagnant practices and policies that cause potential employees to opt for other industries.[26]

Demographic shifts, an aging population, and regional population changes challenge recruitment for all industries. However, the aerospace industry is particularly challenged by such trends as jobs tend to be centralized in areas conducive to industry operations. Demographic studies suggest that aging populations in developed countries lead to smaller workforces, while regional shifts indicate that traditional aerospace hubs may face difficulties in attracting workers. These changes could result in fewer young people entering the workforce which, combined with regional shifts, makes it harder to recruit and retain talent. Many jobs require unique technical skills and certificates which further limit the pool of qualified candidates for aerospace positions.[27]

Enrollment in engineering and aerospace-related degrees at post-secondary institutions have not fully recovered from the decline during the COVID-19 pandemic.[28] Stagnant enrollment for engineering and aerospace-related degrees at higher education institutes threatens the future pipeline for the aerospace workforce.[29] A shrinking pool of graduates and growing demand in the broader economy means fewer qualified candidates positioned for employment within the aerospace sector, particularly when prospective technically-skilled employees are in demand from competing industries. The aerospace industry faces intense competition for engineering talent from technology giants that offer higher salaries, more attractive benefits, flexible schedules, and more traditional office working conditions, making it more difficult for aerospace firms to attract and retain skilled engineers.[30] The recent significant loss of U.S. manufacturing jobs in the last several decades resulted in fewer individuals pursuing careers in skilled trades. The Economic Policy Institute (EPI) found that the loss of manufacturing jobs has reduced interest in skilled trades and "blue collar" manufacturing careers.[31]

Without traditional incentives and with new employee expectations, aerospace companies struggle to retain an appropriately experienced workforce and hire new personnel. The sector requires a workforce that supports operations 24-hours a day and seven days a week. The COVID-19 pandemic shifted employee expectations towards remote or hybrid work models and more flexible working conditions. Reportedly, 70 percent of aerospace employees expressed a preference for hybrid work models, and 60 percent cited flexible working conditions as a key factor in job satisfaction.[32]

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[26] *See, e.g.*, "10 Pros and Cons of Being an Aircraft Mechanic", Indeed, March 19, 2024 (https://www.indeed.com/career-advice/finding-a-job/pros-and-cons-of-being-aircraft-mechanic) and NDIA, *supra*, note 16.
[27] *See, e.g.*, "The Pipeline Report: Increased Awareness, Test Protocol Improvements Will Bolster Mechanic Pipeline", Aerospace Technician Education Council (ATEC), Dec. 21, 2023 (https://assets.noviams.com/novi-file-uploads/atec/ATEC-2023-PipelineReport-20231221.pdf).
[28] *See*, National Student Clearinghouse Research Center, "Current Term Enrollment Estimates: Spring 2024", May 22, 2024 (https://nscresearchcenter.org/current-term-enrollment-estimates/).
[29] *See*, ATEC Pipeline Report, *supra*, note 27.
[30] *See, e.g.*, "Aerospace, Defense Industries Struggle to Attract Talent, National Defense Magazine, July 24, 2023 (https://www.nationaldefensemagazine.org/articles/2023/7/24/aerospace-defense-industries-struggling-to-attract-talent) and "Why It's Difficult To Hire (And Retain) Quality Tech Talent", Forbes, Jan. 22, 2024 (https://www.forbes.com/sites/forbestechcouncil/2024/01/22/why-its-difficult-to-hire-and-retain-quality-tech-talent/).
[31] *See*, "The state of American retirement: How 401(k)s have failed most American workers," Economic Policy Institute, 2020 (https://www.epi.org/publication/retirement-in-america/).
[32] *See*, NDIA, *supra*, note 16 at 40.

The industry's failure to adapt to flexible work expectations creates higher turnover rates and additional difficulty in attracting new talent. The decline of traditional pension plans in government and industry impacts the ability to retain workers, and an EPI study indicates that the loss of pensions led to increased turnover and decreased job satisfaction.[33] A less stable and experienced workforce impacts quality and productivity and safety.[34]

Apprenticeship programs provide a pathway to obtaining and maintaining the necessary skills to fulfill the aviation industry and government workforce needs, but they are difficult to establish and maintain without the full support of all stakeholders.[35] Employers, unions, employees, and the government must work together through the aviation workforce grant programs created by recent FAA reauthorization legislation to recruit, train, and retain talent.[36]

Registered apprenticeships recognized by the U.S. DOL and states create opportunities for grants and funding. The programs require strict training standards that prioritize quality and safety, equipping apprentices with transferrable skills and allowing them to pursue opportunities within the sector. This mobility benefits the workers and the industry by creating a larger and more adaptable talent pool.[37] By creating registered apprenticeship programs that fulfill the requirements for the aerospace workforce, the FAA and employers would create a stronger, more resilient aerospace workforce that is essential for the continued improvement of our nation's aerospace supply chain.

(ii) Risk Analysis

Individuals in the aerospace workforce are ultimately responsible for the safety and security of the NAS. Unless enough qualified safety professionals are available to perform critical tasks for the entire aerospace system safely and efficiently, risks to the aerospace supply chain will exist.

Reviews of general employment information and the special skills required for air traffic controllers, airways transportation system specialists, engineers, pilots, and maintenance

[33] *See., e.g.,*, EPI, *supra*, note 32 and "Will 2024 Be The Year Of The Pension Comeback?", Forbes, Dec. 18, 2023 (https://www.forbes.com/sites/dandoonan/2023/12/18/will-2024-be-the-year-of-the-pension-comeback/).
[34] *See,* "What do people really want in their work? Meaning and stability," American Psychological Association, March 4, 2024 (https://www.apa.org/monitor/2024/01/trends-meaning-stability-workplaces) and "State of the Global Workplace", Gallup, (https://www.gallup.com/workplace/349484/state-of-the-global-workplace.aspx).
[35] For example, the International Association of Machinists and Aerospace Workers (IAMAW) and Boeing apprenticeship program in the Puget Sound combines classroom and on-the-job training (https://www.iam-boeing-apprenticeship.com/).
[36] Sec. 625 of the FAA Reauthorization Act of 2018 (Pub. L 115-254) created two grant programs authorized at $5 million each annually to support aerospace technician workforce development and pilot education. Sec. 440 of the FAA Reauthorization Act of 2024 (Pub. L. 118-63) quadrupled funding, expanded eligibility, and created a third program to support aerospace manufacturing workforce development.
[37] *See*, "Aviation Apprenticeship Tracking Tool", NATA, (https://www.nata.aero/products-and-services/apprenticeship-guidance).

personnel[38] indicate the skilled worker shortage in the transportation sector[39] negatively impact the industry.[40]

Youth have limited access to information on potential aerospace careers.[41] For decades, individuals have been encouraged to pursue academic degrees that do not translate into technical skills required to perform essential aerospace safety functions.[42] Both the U.S. government and private industry must reinvest in creative initiatives to develop the aerospace workforce, such as raising awareness of aerospace careers, reestablishing robust apprenticeship programs, and identifying other novel methods of growing the workforce. Government agencies need additional information to support industries like the aerospace sector which have direct impacts on the safety, security, and economic stability of the American public. The Department of Education, through the Division of Academic and Technical Education (DATE) and other relevant programs must support the development of aerospace careers and additional pathways for technical training and the development of skills. In addition, fully integrated information and data is needed to obtain, maintain, and retain a productive workforce.

The loss of knowledge and declining numbers of available talent in the aerospace sector requires a new methodology for recruitment and training, not only for technical understanding but also relating to U.S. government requirements for positions. The aerospace workforce must be knowledgeable on aviation regulation, statutes, and agency directives to be effective.[43] Government and industry should collaborate to develop a baseline knowledge of aerospace requirements and regularly share training between the public and private sector to ensure that both are aware of the latest government and industry actions relevant to their industry.[44] Without adjusting recruitment and training methodologies, the ability to obtain, maintain, and retain a productive workforce will remain elusive.

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[38] *See*, "Demand for new technicians in the aerospace industry between 2021 and 2050 by region", Statista, April 22, 2024 (https://www.statista.com/statistics/631685/technician-demand-global-aerospace-industry/); "Understanding the Pilot Shortage: A Career Outlook for Aviators", Thrust Flight, Feb. 8, 2024 (https://www.thrustflight.com/pilot-shortage/); Occupational Outlook Handbook: Air Traffic Controllers, U.S. Bureau of Labor Statistics, April 17, 2024 (https://www.bls.gov/ooh/transportation-and-material-moving/air-traffic-controllers.htm); Airways Transportation System Specialists for Environmental, Radar, Navigational Aids, and Communications require certification from the FCC.

[39] *See*, "Aerospace industry grounded by lost jobs and lack of staff", Financial Times, July 20, 2022 (https://www.ft.com/content/93736968-8fcf-425f-b8e5-fcd9736d37f6).

[40] "Transportation as an Economic Indicator: Transportation Services Index", U.S. Department of Transportation, Bureau of Transportation Statistics (https://data.bts.gov/stories/s/Transportation-as-an-Economic-Indicator/9czv-tjte/).

[41] Youth Access to American Jobs in Aerospace (YIATF) Report, Federal Aerospace Administration, Sept. 28, 2022 (https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/5703).

[42] "White Collar Versus Blue Collar Job Market", The Wealth Advisor, April 30, 2024 (https://www.thewealthadvisor.com/article/white-collar-versus-blue-collar-job-market).

[43] *See, e.g.*, "'A National Concern': Student Scores Decline on U.S. History and Civics", U.S. News and World Report, May 3, 2023 (https://www.usnews.com/news/education-news/articles/2023-05-03/a-national-concern-student-scores-decline-on-u-s-history-and-civics) and The Hill, *supra*, note 18.

[44] *See*, Subcommittee Report on the Workforce Development and Training (WDAT) Task, Federal Aerospace Administration Safety Oversight and Certification Advisory Committee (SOCAC), Dec. 13, 2021 (https://arsa.org/wp-content/uploads/2019/11/SOCAC-WDATReport-12142021.pdf).

The difficulty in retaining skilled workers is increased when benefits are misaligned. Recent research found that American workers believe that defined benefit pensions plans are an important tool for recruitment and retention.[45]

Without traditional incentives and with changing workforce expectations, aerospace companies struggle to retain skilled, appropriately experienced personnel and to attract a new talent pool to the workforce. Employers face an unstable and inexperienced workforce and increasing training and other costs which decrease production.

(iii) Recommendations

(a) Request the Department of Labor:

(1) Accelerate the Workforce Information Advisory Council (WIAC) recommendations to track in a longitudinal manner enhanced unemployment wage records that include occupational job titles, hours worked, credentials, and job site locations.

(2) Align its definitions, categorizations, data collection, and standard occupational classifications (SOC) codes with the certificates and skills required by the FAA in new and existing positions. Alignment ensures the government can establish and track essential safety positions within its own departments and regulations.

(3) Create a mechanism for studying market and competition data and trends to provide reliable information on relative wages for entry level and experienced government and industry aerospace personnel.

(b) Increase inter-agency collaboration and ensure that government agencies must work together to enhance cooperation on employment, education, and technology.

(c) Define FAA level responsibility:

(1) Request aerospace labor statistics and workforce requirements. For example, request and obtain specificity on positions requiring certificates, the age of the related workforce, and associated turnover rates.

(2) Ask DOT and FAA to establish a public-private partnership that creates a workforce study inside WIAC focused on the aerospace industry's needs.

(3) Technical and safety outcome similarities with other executive departments to share design, production, operation, and maintenance knowledge and standards.

(4) Create a mechanism for studying market and competition data and trends to provide reliable information on relative wages for private and public sector aerospace personnel at all levels of experience.

(5) Identify segments of the aerospace industry with lower barriers to entry, such as Unmanned Aerial Systems (UAS) and Advanced Air Mobility (AAM), as an introduction to the industry and a pathway to develop further interest in other aerospace areas.

[45] *See*, Forbes, *supra*, note 33.

(6) Work with the Department of Education (ED) to integrate aerospace themes and concepts into primary and secondary curricula and activities. Work with the ED to provide free tools to more schools.

(7) Diversify the workforce – particularly within underrepresented communities. Use recommendations from previous workforce task forces and leverage the cross-agency work of the Advanced Air Mobility Working Group.

(8) Coordinate with technical workforces from other departments and agencies to cross-train or exchange employees with a focus on career development in the safety agencies that control similar technology in other industries, i.e., automotive, defense, and nuclear power. Defining the scope of BLS data.

(d) Develop collaborative education opportunities involving regulators and industry that establish training and experience standards recommended in the report from the Safety Oversight and Certification Advisory Committee's (SOCAC) Subcommittee on Workforce Development and Training.[46]

(e) Establish the National Center for the Advancement of Aerospace (NCAA) to provide collaboration and coordination among all aviation sectors and government agencies to obtain, train, and retain a diverse, skilled, and capable aerospace workforce.[47]

(f) Continue funding for programs created by the recent FAA authorization legislation to develop the maintenance, pilot, and manufacturing workforce (Sec. 625 Aviation Workforce Development Programs).

(g) Encourage FAA and industry to adopt registered apprenticeship models to build a talented and robust pipeline.

(h) Implement the recommendations of the National Institute of Retirement Security to create a favorable environment for private-sector employers to offer defined benefit pension plans. Promoting retirement security assists in addressing employee recruitment and retention in a tight labor market.[48]

(2) Critical Resources

Critical resources include the air traffic control system infrastructure and automation, airport infrastructure, and aircraft operated for commercial, public, or military operations (e.g., passenger and cargo transport, air carrier, and legacy aircraft performing special purpose operations, or supporting local, state, county, and federal government operations, disaster relief, search and rescue, and other public activities).

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[46] *See*, FAA SOCAC WDAT report, *supra*, note 44.

[47] The U.S. House of Representatives has twice passed legislation to establish an NCAA by strong, bipartisan majorities. The National Center for the Advancement of Aerospace Act of 2022 (H.R. 3482) (https://www.congress.gov/bill/117th-congress/house-bill/3482) (passed by a vote of 369-56 on Sept. 28, 2022 and the House version of the FAA Reauthorization Act of 2024 (H.R. 3935) (https://www.congress.gov/bill/118th-congress/house-bill/3935/text) was approved by a vote of 351-69 on July 20, 2023 (*see*, sec. 303).

[48] *See*, "Policy Ideas for Boosting Defined Benefit Pensions in the Private Sector", National Institute on Retirement Security, May 2024 (https://www.nirsonline.org/wp-content/uploads/2024/05/NIRS_Boosting-DB-Pensions-in-the-Private-Sector_FINAL.pdf).

Minerals and other materials essential to the continuity of the service and aircraft are equally critical resources. Processing and manufacturing of essential minerals are also internationally dependent.

Spectrum supporting aerospace communications, navigation, and surveillance is also a critical resource for the safe operation of the NAS. Currently, the assignment of spectrum generally is managed and coordinated to ensure international compatibility. Changes in aerospace spectrum use or requirements involve extensive international coordination followed by complex – and potentially impossible to implement – upgrades of aircraft, spacecraft, and specialized group equipment. These changes are expensive and sometimes iterative as demonstrated in the ongoing C-Band 5G developments.

Aviation parts, due to their high levels of quality and performance expectations, are generally expensive to manufacture. With any difficulties in the supply chain and with pressures to manage costs experienced by both manufacturers and end-users, counterfeit parts and parts that are inadequately documented can enter the supply chain and compromise the high levels of safety and performance that are achieved. As parts or materials become difficult to achieve, unscrupulous providers are motivated to "cut corners" or to substitute inferior components.

(i) Key inputs

Materials generally essential to all aspects of the aviation system are summarized in the Aerospace Industries Association *Securing the U.S. Aerospace and Defense Critical Minerals Supply Chain* document.[49] Most of the raw materials essential to aerospace and aeronautical development must be obtained from other countries. The ability to obtain raw minerals from U.S. sources is curtailed by federal and state environmental laws.

Use of new or different materials is curtailed by aerospace certification requirements which entail development of experience or tests and conformity to an approved specification,[50] a process that can take decades, not just years. The FAA's inability to adapt to new or different materials or new technology in older aircraft is problematic.

The need to continue support for older systems extends to all aircraft certificated by the agency as well as the infrastructure supporting the NAS' critical infrastructure and systems. The agency's essential role in national security requires system redundancy to ensure the continuation of the NAS, even if one system is compromised. Older aircraft use legacy computer chip technology and, while there is a push to ensure newer computer technology can be manufactured in the United States, the need for older generation chips remains. Rigorous certification processes and requirements, further, inhibit the ability to efficiently update avionics with newer generation chips, and so even for modern aircraft the chips in use are typically not interchangeable with current generation chips.

Congress has also directed the FAA to modernize and deploy ATC systems to integrate space launch and reentry operations (LRO) data directly onto air traffic controller displays – including through the En Route Automation Modernization (ERAM) system – and automate systems to

[49] *See*, "Securing the U.S. Aerospace and Defense Critical Minerals Supply Chain", Aerospace Industries Association, (https://www.aia-aerospace.org/wp-content/uploads/Securing-the-U.S.-Aerospace-and-Defense-Critical-Minerals-Supply-Chain-One-Pager.pdf).
[50] *See*, *e.g.*, Title 14 Code of Federal Regulations, § 25.603.

enable near real-time tracking, management, and rerouting of air traffic during such operations.[51] The FAA Air Traffic Organization's Space Data Integrator (SDI) operational prototype must become an official FAA program with a dedicated funding stream, but additional upgrades to the SDI system are needed including the rapid deployment of the NAS Space Integration Capability (NSIC) and subsequent updates. Prioritizing the development and deployment of such systems is consistent with the FAA's 2019 Airspace Access Priorities Aviation Rulemaking Committee (ARC) Final Report recommendations,[52] and would lessen the workload burden on air traffic controllers actively managing the NAS while bolstering the efficiency of NAS management during space launch and reentry operations.

Assignment of radio spectrum is essential to civil aviation movement, growth, and capacity. Further, protection of current spectrum allocated for safety of aerospace operations is critical to maintaining safe and regular operations. New uses of spectrum adjacent to civil aviation spectrum bands may include significantly greater power levels or alternative waveforms in comparison to the environment for which certified avionics were designed to operate in.

Adjusting aerospace spectrum use requires significant Federal and international coordination. In the United States, the oversight and management of radio spectrum is performed by two different entities.[53] Internationally, aerospace radio spectrum use must be coordinated through treaties and bilateral agreements using standards established by the International Civil Aviation Organization (ICAO) and the International Telecommunications Union (ITU) World Radiocommunication Conference.[54] For a full discussion of this complex issue, *see*, Appendix 3 – Spectrum Band Protection.

Protection of the current spectrum availability without interference is essential to the proper functioning of aerospace communication/navigation systems. For example, any interference or reallocation of the "X-band" (8025-8400 megahertz) would jeopardize the downlink of critical Earth observation data essential for weather monitoring, agricultural production, national security, and international transportation, among many other critical functions. The reallocation or harmful interference of spectrum in that band would jeopardize the availability and viability of information provided by the Earth observation industry.

(ii) Risk Analysis

[51] The FAA Reauthorization Act of 2024, Pub. L. No. 118-63, sec. 630 (https://www.congress.gov/bill/118th-congress/house-bill/3935/text).
[52] Federal Aerospace Administration, Airspace Access Priorities Aerospace Rulemaking Committee (ARC), "ARC Recommendations Final Report." August 21, 2019 (https://www.faa.gov/sites/faa.gov/files/advisory_rulemaking_committees/AAP%20ARC%20Report%2008-21-2019%20Final%20COMPLETE%20%282%29.pdf).
[53] The Federal Communications Commission (FCC) manages non-federal uses of radio spectrum, while the National Telecommunications and Information Administration (NTIA), within the Department of Commerce manages federal use of radio spectrum, including use for public safety and scientific endeavors.
[54] *See*, *e.g.*, "Final Acts of the WRC-23", ITU World Radiocommunication Conference 2023, Dec. 15, 2023 (https://www.itu.int/wrc-23/).

Most critical minerals in aerospace must be imported from foreign nations. Transportation accounts for an increasing percentage of the economy[55] and its stability depends upon stability in critical resources.

Without the ability to support old, new, and next generation aircraft and equipment essential to the NAS infrastructure and operations on an international basis, vital communications and national security is at risk.

Spectrum, by its nature, is limited. Interference with the aerospace band can threaten the NAS, and the band reserved for aerospace operations cannot easily or quickly be transitioned to another portion of the spectrum. Spectrum encroachment has already shown to introduce unacceptable risks to the NAS and aerospace operations.

(iii) Recommendations:

(a) Fully fund the National Defense Stockpile. Congress should appropriate funds to revitalize the National Defense Stockpile Transaction Fund. In addition to stockpiling material, the NDS has existing authority to fund recycling initiatives from military surplus, fund studies and qualification of domestic sources, and loan material, among other statutory responsibilities.

(b) Improve access, both domestic and foreign based, to critical mineral and manufacturing inputs. With legislative and regulatory restrictions on sourcing critical minerals under consideration, policies that drive such restrictions must first reflect the realities of today's global markets. Transitioning supply chains to alternative sources should be deliberate, strategic, and incentivize U.S. industry's early adoption of risk mitigation strategies, supplier criteria, domestic suppliers, and investment in trusted sources, where U.S. capacity is unavailable. Closing markets without readily available alternatives, in the short term, may have the unintended consequences of augmenting U.S. vulnerabilities. Therefore, engagement with U.S. industry at all tiers of the supply chain – from producers to end users – is critical to ensure that measures aimed at increasing transparency in strategic and critical mineral supply chains do not impose undue administrative burdens on suppliers or lead to unintended consequences.

(c) In approving new, novel, unique, and different uses of alternative materials in design of aerospace products, articles, and services, direct FAA to use its discretion to use "otherwise acceptable to the administrator" to the greatest extent possible to allow ongoing and future use of best available technology.

(d) Fully fund the modernization and full deployment FAA ATC systems, including SDI and NSIC, to enable automated and near-real-time management of the NAS during space launch and reentry operations.

(e) Protect aerospace spectrum allocations, particularly in the "X-band" and other spectrum that may impair operational safety from interference or reallocation.

[55] *See*, "Contribution of Transportation to the Economy: Final Demand Attributed to Transportation", Bureau of Transportation Statistics (https://data.bts.gov/stories/s/Transportation-Economic-Trends-Contribution-of-Tra/pgc3-e7j9/). *See also, "*Value Added by Industry: Transportation and Warehousing as a Percentage of GDP", Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org/series/VAPGDPT).

(f) Provide cost mitigation for affected entities including through partial allocation of revenue gained from the respective spectrum auctions.

(g) The Task Force endorses the following mitigations to ensure adequate and protected spectrum is always available to critical aerospace operations:

(1) National Telecommunications and Information Administration (NTIA) and FCC must develop a consensus position before introducing any change to spectrum use. For novel uses of spectrum (new waveforms, different power outputs), FCC must expand the analysis to cover adjacent band interference and extend the review period to ensure continued operational safety within the NAS.

(2) Require and fund collaboration and cooperation with international bodies to accommodate radio spectrum for aviation operations expansion into non-traditional routes and operations within a long-term strategy plan.

(3) Ensure that spectrum allocations supporting satellite operations are protected and preserved.

(3) Global Interdependence

Aerospace is a global industry. The materials and manufacturing capability needed to sustain its growth have no politics. Often, the raw materials and processing capabilities necessary to manufacture and maintain the NAS and aerospace products are only derived from nations with hostile governments, weak institutions, and/or domestic unrest that limit access to these vital resources. Geopolitics that threaten the aerospace industry create a ripple effect on the United States and world economies. Geopolitical factors threaten both access to, and delivery of vital resources.

Further, international cooperation on aviation safety among countries must ensure open access to safety information regarding the design, production, operations, and maintenance of civil and military aircraft. ICAO was developed to codify the safety recommended practices established by for signatory states; however, geopolitics negatively impact the full collaboration envisioned.

Domestic and foreign military aircraft are accepted into the American fleet for restricted category type certification; the standards used to modify, operate, and maintain military aircraft of the type accepted for use and sold by the U.S. Armed Forces must be known to ensure the continued airworthiness of essential civil aviation operations.

The continued development and adoption of international standards are essential to civil aerospace operations, particularly the emerging commercial space segment. Consistent participation by federal agencies in providing advice during the development of voluntary industry consensus standards is essential to their acceptance as a means of compliance for performance-based rules.

(i) Key inputs

Currently, the U.S. government policy is based on the principle that existing export controls do not impede U.S. national competitiveness while preserving national security. However, aerospace manufacturers, suppliers, and operators feel the impact of inhibited competition because of muddied or nonexistent regulatory definitions and interpretation by various federal departments. This discourages competition and leads to a shrinking of the supply chain. Fully engaging U.S.

industry in the review process will help to clarify or, in some instances, create necessary export controls.

Obtaining critical minerals and raw materials from U.S. resources is bottlenecked by state, environmental, and public concerns and requirements. Robust industry standards would enhance the space industry for human space flight, proliferation of space ports, and more. It is the industry's responsibility to develop standards in coordination with FAA.

(ii) Risk Analysis

Geopolitics threaten supply of critical resources in aerospace creating a ripple effect on the U.S. and world economies. Geopolitical factors threaten both access to, and delivery, of vital resources. The current use of the term "intelligence activities", for example, is subjective and inappropriately inhibits the flow of information and services. Without clear definition and consistent interpretation, it is impossible for an operator to determine compliance with the myriad regulations. Right now, the FAA has different direction between space and aviation, both enveloped in the aerospace sector. Currently, the FAA is prohibited from promoting aviation industry standards, yet it is required to promote and support space-centric standards.

(iii) Recommendations:

(a) Improve interagency cooperation, including increased collaboration between the Departments of State and Commerce, for aerospace export controls, particularly in civil aerospace.

(b) Ensure U.S. civil aerospace export controls do not impede U.S. national competitiveness while preserving national security.

(c) The DOS and DOC should provide additional guidance on navigating the export control rules to aerospace companies to increase clarity and predictability when navigating the process.

(d) Congress, and the DOC must ensure that aerospace products and services do not receive duplicative classification under International Traffic and Arms Regulations (ITAR) and Export Administration Regulations (EAR).

(e) DOS, DOC, and other relevant agencies should undergo a review of products, data, and services classified under ITAR controls and reclassify such products, data, and services and, to the maximum extent practicable, reclassify products, data, and services to EAR controls.

(f) The U.S. government should promote and expand the aerospace industry's data collection and data sharing capabilities and seek to harmonize requirements with trusted partners. The U.S. government should identify additional opportunities to fully implement bilateral agreements with mutual acceptance of products wherein it would be appropriate to provide mutual acceptance of products, free of bureaucratic approvals, and allow for the automatic validation of others which meet objective criteria.

(g) DOC and DOS must revise definitions and controls related to defense services and end-use, and end-user-based export controls such that they:

(1) Define the term "intelligence activities,"

(2) Add a carve out to both the descriptions of military assistance and intelligence assistance to exclude products and services that are designed for and offered to the

commercial marketplace (BIS should do this too in its definition of "support" relating to US person activities),

(3) Refine the text to narrow the scope of the restriction to military and intelligence end users (which would then exclude civil government agencies), and

(4) Work with BIS to better define the jurisdictional scope of what will fall within the new DDTC defense services rule vs what is intended to be regulated by BIS's new proposed US person activity and licensing rules relating to intelligence end users.

(h) Remove all non-safety or security tariff barriers.

(i) U.S. government agencies should actively support and participate in the development of these space-centric industry standards and best practices within accredited and recognized standards development organizations as recommended by OMB Circular A119.[56] U.S. government officials participating in standards development processes should not dictate the content of industry standards, but instead provide guidance when appropriate to ensure that industry standards are able to be accepted as means of compliance for performance-based rules.

(4) Legislation, Statutes, Regulation, and Policy

Funding for services essential to American safety, security, production, and human resources must be adequate to sustain old infrastructure and assets, maintain NAS operation, and develop and implement new products, while providing oversight on activities conducted by industry. The aerospace industry is first among equals with its support of essential government functions while driving economic stability. However, congressional inaction and reliance on continuing resolutions (CRs) or shutting down the federal government creates instability in all industries. The aerospace sector is particularly impacted by CRs and government shutdowns, as it relies on constant interaction with the FAA and other federal agencies to function effectively, efficiently, and productively. To the maximum extent practicable, government shutdowns and CRs must be limited to ensure the safe and efficient management of the NAS and the wellbeing of the aerospace sector.

The FAA is running two different NAS systems, one old and one new. The older system is 30 to 50 years old, and it requires urgent attention. With so many older systems, there are hurdles to getting parts and many of the companies are no longer in business. The FAA must keep its own inventory of spare parts, or it must repair or reverse-engineer parts at the depot level. By modernizing and upgrading these systems the FAA will be able to focus more energy and resources on new technologies and keep them current. Funding of the DOT and the FAA must be equal to the agencies' responsibility to ensure Americans are afforded safety, security, and opportunities to innovate and produce.

In the last several years the inaction of government agencies to meet mandated deadlines has hampered segments of the industry and its ability to expand operations internationally, without recourse.[57] The FAA creates ever changing policy and agency directives that dictate compliance

[56] *See*, "OMB Circular A-119: Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities", Office of Management and Budget, Executive Office of the President, effective January 27, 2016 (https://www.whitehouse.gov/wp-content/uploads/2020/07/revised_circular_a-119_as_of_1_22.pdf).

requirements without public knowledge or input.[58] While the FAA Reauthorization Act of 2024 addresses FAA activity in all these areas, it is critical for the FAA to effectively implement this direction.

The DOT and other executive branch agencies must coordinate to fully support the critical aerospace industry. To meet its obligations to support American safety, security, production, and human resources, the DOT and the FAA must also be considered first among equals. The DOT and the FAA need to lead the agency-collaborative effort and ensure efficient and effective communication among the executive branch agencies so use of knowledge, technology, and professionalism can be multiplied rather than stymied.

Further, the FAA must fully embrace statutes that require acceptance of electronic records and recordkeeping. The FAA uses myriad electronic databases and systems and even its Office of Chief Counsel communicates by electronic mail. Yet applicants, certificate, license, approval, and authorization holders are either forbidden or actively discouraged from using ubiquitous applications, systems, and programs for obtaining, storing, and retrieving data.

(i) Key inputs

To a highly regulated industry, continuity of government operations and appropriations of adequate funding is central to stabilizing the economy, government relations, international agreements, and other essential government functions. Aerospace operations are particularly impacted by continuing resolutions or lapses in funding. Consistent and constant daily interaction with the FAA and other federal agencies are required for aerospace to function effectively, efficiently, and productively. Without adequate agency funding, sustainment of the current system, advancements in technology, capability of personnel will further decline.

Without proper resources, the FAA will continue to experience delays in all aspects of its operations. Obtaining needed resources for its old and new infrastructure and continued NAS operations, for issuance of approvals and certificates for current and future certificate, authorization, and approval holders, and for the increase in oversight is essential to efficient and effective government and private operations.

In addition, appropriate resources should be granted to the FAA Office of Commercial Space Transportation (FAA-AST) to improve the efficiency and throughput of Part 450 licensing for commercial space launch and reentry operations critical for supporting national goals and national security. The FAA-AST must improve personnel expertise, management, and response times to applicants, as well as expeditiously issue additional advisory circulars, to ensure the efficient processing of Part 450 licenses and meet the 180-day mandate for processing licensing applications.

Design, production, operation, and maintenance of civil aviation end items, commercial space vehicles, and spaceports can and are directly impacted by the actions of many local, state, and

[58] The FAA Reauthorization Act of 2024 (Pub. L. No. 118-63) included multiple provisions aimed at improving consistency in FAA policy development. For example, Sec. 205 addresses the development and promulgation of regulatory materials and Sec. 821 requires the Department of Transportation Inspector General to audit FAA's Flight Standards and Aircraft Certification Services regarding the consistency of the interpretation and application of policies, orders, guidance, and regulations.

federal safety agencies, e.g., EPA,[59] OSHA, as well as the actions of impact independent agencies and commissions. The aviation safety regulations require applicants and certificate holders to continually show compliance with design, production, operation, and maintenance standards. Lead times to change materials or processes in aviation are double and triple those that can be made in other industries.[60] When deadlines for compliance with one agency's rules are impossible due to the aviation safety agency's delays, inabilities, or knowledge of the conflict, the public pays, not the federal government. Collaboration among agencies may be directed by executive order, but the legislative branch can provide direction when citizens are caught in Catch-22 situations by conflicting regulatory requirements.

Design, production, operation, and maintenance of civil aviation products and articles require constant, consistent, and open communication among the applicant or certificate holder, the user, the maintainer, the public, and the agency. Communication is vital to the development and processing of applications. Any interruption in personnel directly impacts the schedule for both the agency and industry.

It is not just ATC that suffers from legacy systems; reliance on pen and paper-based systems and transactions still permeates the FAA; despite numerous legislative studies[61] and executive directives. The agency's internal databases and tracking systems are antiquated, do not communicate with each other, and are not user-friendly.

The design of every aircraft must be approved by the FAA before production commences. To produce, operate, or maintain aircraft documents, *e.g.*, manuals, records, and the like must be created, disseminated, and followed. The process is currently very paper-intensive, thousands of documents are exchanged, some numerous times. The current system relies on a physical document centric approach, established in the 1960s, that no longer meets the need for accurate and timely presentation of data. Agency personnel need ubiquitous digital tools that support enterprise systems and model-based system engineering (MBSE) practices. The use of current technology also creates a single source of reference enabling real time exchanges which lessens miscommunications, errors in transmission, loss of data and other safety and security risks. The use of digital tools will prepare the FAA for approving new and innovative end items that enhance safety and address supply chain issues.

Similarly, the FAA relies on legacy, paper-based systems and records for certification documents, operation, production, and maintenance records. Authorized individuals must physically sign documents, when ubiquitous software and enterprise systems are more secure. Requiring certificate holders to use inefficient paper, susceptible to fraud and that lacking transparency does

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[59] Banning of halon used in critical safety design features of civil aircraft is an example of a direct impact. Similarly, the use of potable water, fuels, plastics, other materials controlled by the federal government are used in civil aerospace.

[60] Changes in materials and processes require action by the aerospace industry and the FAA to show and find compliance with aerospace safety standards. When changes need review or approval by the FAA, its constrained resources and constantly changing personnel make the lead time impossible to calculate by either the agency or industry. *See, U.S. House of Representatives Committee on Science, Space, and Technology, Subcommittee on Space and Aeronautics, "Space & Aeronautics Subcommittee Hearing – Risks and Rewards: Encouraging Commercial Space Innovation While Maintaining Public Safety." September 10, 2024 (https://science.house.gov/2024/9/space-aeronautics-subcommittee-hearing-risks-and-rewards-encouraging-commercial-space-innovation-while-maintaining-public-safety).*

[61] *See*, "Information Technology: Agencies Need to Develop Modernization Plans for Critical Legacy Systems" (GAO-19-471), U.S. Government Accountability Office, June 11, 2019 (https://www.gao.gov/products/gao-19-471).

not allow for robust data mining and analysis to monitor and mitigate inventory levels, fluctuations in supply and demand, and supplier network bottlenecks.

Robust digital platforms provide quality, real time information. Regulators, designers, producers, operators, maintainers, and suppliers will be able to more readily identify sources of potential issues. Digital platforms improve safety by reducing reaction time and mitigating risks associated with fraudulent activity by providing information more transparently and securely.

Government action negatively impacts aerospace sector competition in several ways. Certification delays increase the time and cost for existing and new companies to enter the marketplace.[62] [More directly, certain laws, regulations, and practices limit competition for both civilian and defense aviation products and services. For example, the FAA is currently reviewing its regulations regarding the availability of instructions for continued airworthiness that design approval holders are required to produce and make available to anyone required to comply. Failure to enforce those regulations has led to competitiveness concerns. Similarly, companies wishing to provide maintenance services to the DOD report challenges accessing critical data necessary to perform the work.[63] The DOD also fails to broadly utilize alternative parts and repair processes (*e.g.*, FAA Parts Manufacturer Approval (PMA) parts and Designated Engineering Representative (DER) repairs) on DOD-operated commercial derivative aircraft, allowing the contractor that sold the system to the government to maintain a monopoly on its maintenance.[64] The DOD itself has expressed concerns about the risk defense industrial base consolidation poses to national security.[65] Aircraft radio systems are based on performance standards published as Technical Standard Orders (TSO) from the Federal Aviation Administration. These standards are based on legacy performance standards. As new consumer products are introduced with tighter spectrum tolerances, legacy TSO products are challenged since they are based on 20-year-old performance standards. When the government sells parallel spectrum, the unintended consequences the inability

[62] *See*, "New Realities of Certification: Manufacturers' Winding Road to Finish Line", Kerry Lynch and Cathy Buyck, Aviation International News, July 1, 2024 (https://www.ainonline.com/aviation-news/business-aviation/2024-07-01/new-realities-certification-manufacturers-winding-road).

[63] FAA's failure to enforce instructions for continued airworthiness (ICA) rules (*i.e.*, 14 CFR § 21.50(b)) and the resulting lack of access by airlines and maintainers led Congress to direct an FAA Aviation Rulemaking Committee (ARC) on the issue in the FAA Reauthorization Act of 2024 (sec. 349, Pub. L. 118-63). Similarly, while 10 U.S.C. § 2320 provides DOD with broad rights to maintenance technical data for systems it purchases, some contractors withhold maintenance data by claiming it is "detailed manufacturing or process data" and therefore exempt from disclosure. See, *e.g.*, "The Navy Wants Industry's Help to Reduce Sustainment Costs," Carlos Del Toro, Defense One, Aug. 28, 2024 (https://www.defenseone.com/ideas/2024/08/navy-wants-industrys-help-reduce-sustainment-costs/399149/); "New Source of Tension Emerges Between Contractors and DoD", Tom Temin, Federal News Network, Nov. 15, 2023 (https://federalnewsnetwork.com/defense-main/2023/11/new-source-of-tension-emerges-between-contractors-and-dod/).

[64] The Senate's FY 2019 National Defense Authorization Act (S. Rep. No. 115-262 (2018) at 239) included report language stating that, the FAA "has an effective system for approving parts, repairs, and alterations. The FAA's existing certification process allows the DOD to maintain its commercial derivative fleet without duplicative review or approval. The [Senate Armed Services Committee] believes leveraging existing FAA certifications can provide the DOD cost and schedule efficiencies that should be pursued to the greatest extent practicable." The report urged "the Department to prioritize the use of non-developmental and commercially available items with existing FAA certifications as long as the use of those products do not compromise safety or security requirements established by the Department of Defense." Despite the congressional directive, the DOD has not embraced broader use of FAA approvals.

[65] *See*, DOD report, footnote 2, *supra*.

for aviation products to perform as they were intended and the direct negative affect on the legacy equipment results in a stressing the of the supply chain.

(ii) Risk Analysis

When Congress is unable to pass authorizations and appropriations it is detrimental to the stability of the American economy, the government's workforce, health, safety, and security. The instability is exacerbated by government shutdowns, which double the time it takes to obtain action from agencies that must develop and implement action plans that only allow for "essential services". Unnecessary barriers to design, production, operation, and maintenance in aerospace create multiple disincentives for the agency and the public it is to regulate. Use of new materials or processes in older products or for development of future products and articles is discouraged. The vigorous application of policy over the performance-based regulatory framework in 14 CFR has hindered communications, and the timely consideration and approval of civil aviation products and articles.

Failure of federal agencies and independent commissions to collaborate on statutory and regulatory changes directly impact aviation safety regulations and the aerospace industry.

The post-COVID federal government hybrid work policies have impaired this essential communication. Industry personnel find it difficult to create schedules for advancement and completion of certification efforts as federal government employee work hours vary significantly. Further, the agency has removed its employee directory from public view, has created general email addresses, and changes key personnel frequently, making essential communications among and between agency key personnel and industry problematic.

The lack of digital technology discourages workforce recruitment, innovation, and real-time exchanges between the FAA, certificate holders, and the public. While the FAA has begun to adopt digital technology in targeted, isolated offices, and services, it has not developed and implemented a system wide methodology with proper security measures and adequate support to ensure system wide functionality. Recent incidents of fraud associated with paper-based documentation[66] make adoption of digital technology more urgent.

Competition is the organizing principle of modern, free-market economies. The United States promotes vigorous market rivalry on a global basis to enhance efficiency and consumer welfare, thus encouraging innovation, growth, and economic resiliency. [67] The Department of Defense has stated that competition is "an indicator of the necessary industrial capability and capacity to deliver the systems, key technologies, materials, services, and products the Department requires to support its mission."[68] However, the U.S. government itself maintains policies that undermine competition in the aerospace supply chain. Failure to address them will result in further consolidation of the

[66] *See, e.g.*, AIN Media Group, Bloomberg, and American Journal of Transportation, *supra*, note 12.
[67] *See, Competition", U.S. Mission to the Organization for Economic Cooperation & Development, (https://usoecd.usmission.gov/competition/).*
[68] *See*, "State of Competition within the Defense Industrial Base", Office of the Under Secretary of Defense for Acquisition and Sustainment, Department of Defense, Feb. 2022 (https://media.defense.gov/2022/Feb/15/2002939087/-1/-1/1/STATE-OF-COMPETITION-WITHIN-THE-DEFENSE-INDUSTRIAL-BASE.PDF).

industrial base, higher prices, and slower technological advancement, which in turn means lower-quality products and services for consumers and the government alike.

(iii) Recommendations:

(a) Congress must create a mechanism to ensure continuity of funding for the FAA and other federal agency functions (addressing personnel, supporting systems, and technology) critical to the operational activities, safety, and management of the NAS, the aerospace sector, and its end users. Further, Congress must also resolve to ensure adequate funding for the FAA to address anticipated needs for personnel and refreshed technology based on multi-year inputs from the FAA. Further, Congress should also resolve to ensure adequate funding for the FAA to address anticipated needs for personnel and refreshed technology based on multi-year inputs from the FAA. The FAA must formally collaborate with all executive agencies during the rulemaking process to ensure that any U.S. government regulatory changes consider the impacts on the aerospace sector. The regulatory agencies might consider the use of electronic systems like artificial intelligence to ensure stakeholder are properly notified of notices.

(b) Address government policies that undermine competition and cause defense industrial base consolidation. Promote consistency in interpretation of rules and between rules, guidance, and policy.

(c) Swift implementation of the FAA Reauthorization Act of 2024 key provisions.

(E) Conclusion

The Aerospace Supply Chain is constantly evolving, with a wide range of risks that can impact the ability to efficiently operate and maintain operations. Supply chain resilience does not rely on a single “fix” and cannot be fully achieved as it is not a stagnant, unmoving target. Instead, the aerospace supply chain must be reviewed and analyzed - from the regulator to every regulated party - to determine more succinctly where bottlenecks to innovation and the application of new technology to older equipment can be more efficient and effective. The Task Force, in reviewing the Aerospace Supply Chain resilience, has concluded the following:

- Our aerospace supply chain is vulnerable to labor shortages, obstacles in critical materials, and the health of supporting infrastructure. Investment in these three areas, well beyond today’s current levels, will be needed to ensure that the aerospace supply chain is able to operate in the presence of supply chain disruptions
- Unlike other parts of the economy in the U.S., the Aerospace Supply Chain is uniquely dependent on the smooth operation of, and collaboration across regulatory entities, especially the FAA. In many cases, key work can only be done by people who have required credentials, repairs and maintenance often require additional government oversight, and the personnel responsible for oversight are subject to Congressional authorization and appropriation timelines.
- Because the Aerospace Supply chain is tied to global operations, global interoperability requirements, and bilateral or multi-lateral agreements, actions taken in the U.S. cannot be seen as independent of the broader global environment.

Small businesses are distinctly disadvantaged in the aerospace industry since the ability to obtain and maintain the certificates and quality standards depend largely on processes and procedures that demand myriad papers to establish compliance. The Small Business Administration has shown a small to medium size business must spend more of its dollars to keep up on the mounds of paper necessary to achieve and maintain federal agency compliance; bigger businesses can amortize the cost over a larger number of employees.[69]

While aerospace is the most regulated industry in the United States with obligations to aviation safety agencies internationally, it can also become the most resilient to shortages if the ability to pivot rapidly is allowed without undue consternation or restraint. The key risk areas identified in this report: Workforce; Critical Resources; Global Interdependence; and Legislation, Statutes, Regulation, and Policy each have factors that can be proactively addressed through updates in national policy, in improved interagency coordination, and through adequate and consistent funding to ensure continuity of critical people, infrastructure, and materials. Implementing these recommendations will not only improve the resilience of the aerospace supply chain – it will enhance the American economy and the overall health, safety, and security of the nation.

[69] *See*, "Final Report of the Small Business Paperwork Relief Task Force (SBPRTF)", U.S. Small Business Administration, June 27, 2003 (https://advocacy.sba.gov/wp-content/uploads/2019/07/Final-Task-Force-Report_June-2003.pdf).

APPENDIX 1 – TASK FORCE MEMBERSHIP

The statute required individuals representing each of the following:

Organization Name	Acronym	Members
Aeronautical Repair Station Association	ARSA	Sarah MacLeod Christian Klein (alternate)
Aerospace Industries Association	AIA	Dak Hardwick Di Reimold (alternate)
Air Traffic Control Association	ATCA	Carey Fagan Rugger Smith (alternate)
Aircraft Electronics Association	AEA	Richard (Ric) Peri Mike Adamson (alternate)
Aircraft Owners and Pilots Association	AOPA	James Coon Murray Huling (alternate)
Airlines for America	A4A	Bob Ireland Justin Madden (alternate)
Association for Uncrewed Vehicle Systems International	AUVSI	Michael Robbins Max Rosen (alternate)
Commercial Spaceflight Federation	CSF	Isaiah Wonnenberg Mary Guenther (alternate)
Flight Safety Foundation	FSF	Deborah Kirkman Hassan Shahidi (alternate)
General Aviation Manufacturers Association	GAMA	Paul Feldman Joe Sambiase (alternate)
Vertical Aviation International	VAI	Christopher Martino
International Association of Machinists and Aerospace Workers	IAMAW	Mr. Jody Bennett Peter Greenberg
Society of Professional Engineering Employees in Aerospace	SPEEA2	Brandon Anderson Faraz Khan(alternate)
National Air Transportation Association	NATA	Jenny Ann Urban Keith DeBerry (alternate)
National Business Aviation Association	NBAA	Doug Carr
Professional Aviation Safety Specialists	PASS	Carlos Aguirre Jana Denning (alternate)
Transport Workers Union of America	TWU	Gary Peterson Mark Erler (alternate)

APPENDIX 2 – SUPPLY CHAIN STUDIES, REPORTS, AND OTHER MATERIALS

- https://www.atec-amt.org/pipeline-report
- https://www.nirsonline.org/reports/genx/
- https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/5563
- https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/WIAAB_Recommendations_Report_March_2022.pdf
- https://assets.noviams.com/novi-file-uploads/atec/ATEC-2023-PipelineReport-20231221.pdf
- https://nscresearchcenter.org/current-term-enrollment-estimates/
- https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/5703
- https://arsa.org/wp-content/uploads/2019/11/SOCAC-WDATReport-12142021.pdf
- https://advocacy.sba.gov/wp-content/uploads/2019/07/Final-Task-Force-Report_June-2003.pdf
- https://www.faa.gov/sites/faa.gov/files/advisory_rulemaking_committees/AAP%20ARC%20Report%2008-21-2019%20Final%20COMPLETE%20%282%29.pdf
- https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/addressing-continued-turbulence-the-commercial-aerospace-supply-chain

APPENDIX 3 – SPECTRUM BAND PROTECTION

General commercial demand for spectrum continues to increase,[70] especially for spectrum supporting mobile communications. The pressure to reallocate federal-use spectrum to support these services and the new uses of available spectrum (e.g., supporting 5G and plus mobile communications or new waveforms) result in significantly different spectrum interference environments. Any unintentional effect on aeronautical safety functions in long-standing spectrum ranges must be avoided.[71]

While commercial demand for radio spectrum increases rapidly, each iteration results in significantly different spectrum interference environments that must be tested for unintentional interference with aeronautical safety functions and essential NAS safety requirements. Thus, implementing fleet-wide changes in aerospace systems have significantly longer timeframes and supply chain constraints in comparison to commercial communications equipment cycles that are not controlled by safety regulations. Adverse effects, especially those with operational safety implications, drive costly unplanned redesign, update or replacement of existing equipment. Mitigation is critically needed, such as through direct allocation of spectrum auction proceeds earmarked to offset costs forced on affected spectrum users and system suppliers.

Aerospace operations, a backbone to every aspect of health, safety, and security assurance must continue to grow for the economic and welfare goals within the United States. Operations such as Commercial Space, AAM, UAS services, and very-high-altitude and space operations will increase the need for reliable aerospace communications, navigation, and surveillance (CNS) services where they operate.

Properly managed spectrum would guarantee protection of essential aerospace operations and services that reliably provide safe transportation of goods and mobility for the American public.

[70] See, e.g., "National Spectrum Strategy", The White House, Nov. 2023 (https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf).

[71] The possibility that 5G would interfere with the operation of aircraft radio altimeters at low altitudes resulted in a cautious approach from regulators and costly retrofits and modifications for operators. *See*, "Aerospace Comments on FCC Receiver Standards" to Docket No. 22-137, Aerospace Industries Association, Air Line Pilots Association, International Aerospace Spectrum Resources, Inc., the Boeing Company, Collins Aerospace, The General Aerospace Manufacturers Association, Office of Engineering and Technology, Federal Communications Commission, June 27, 2022 (https://www.fcc.gov/ecfs/document/1062800047167/1).

APPENDIX 4 – ADDITIONAL CONSIDERATIONS

In addition to the four major risk categories (Workforce; Critical Resources; Global Interdependence; and Law, Regulation, and Policy), the Task Force identified other categories that ensure the ability of the aerospace supply chain meet public and private needs in current and future environments.

Cybersecurity Protection and Response

Protection against, and recovery from cyber-attacks is an increasingly critical capability for increasing portions and segments of the aerospace supply chain systems.

While the Task Force was not asked to address cyber-security issues, members recognize the importance of protecting old, new, and future computer systems that create, retain, and exchange critical safety and security information on aerospace components, systems managing aerospace operations, and delivery of transportation services.

The Task Force encourages expansion of the whole-of-government approach to coordinating information on cyber-criminal activity, on developing new approaches to defend against cyber-attacks, and on mechanisms to increase the resilience of systems against cyber-attacks.