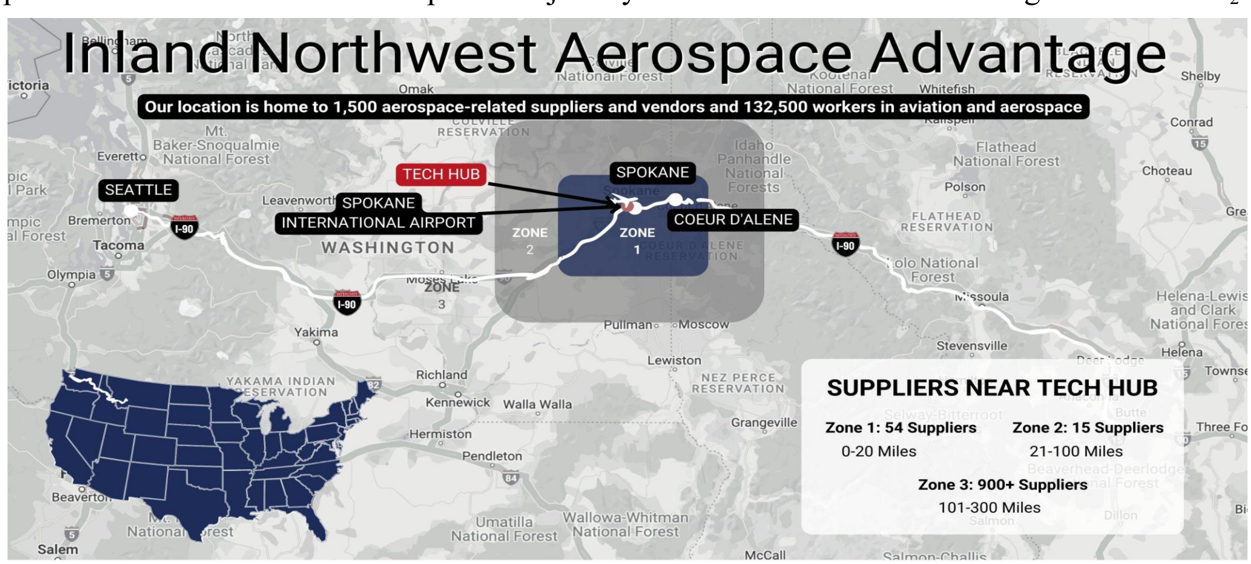
This consortium proposes to immediately advance U.S. leadership and national security through creation of the American Aerospace Materials Manufacturing Center ("the Center") to develop new domestic supply chains to meet the immediate demand for high-rate production of advanced composite aerostructures in defense and commercial markets. The EDA Tech Hub designation will propel our domestic supply base by creating a testbed facility to advance large thermoplastic composite (TPC) aerospace materials like ribs, beams, doors, bulkheads and stiffened skins. This market-disrupting, high-rate production solution maintains the same performance of most advanced composite aerostructures flying today at low production rates. High production of TPC is a key enabler to accelerate the aerospace industry's goal of net-zero carbon emissions by 2050, and presents a unique opportunity to upskill the current workforce, coordinate with Tribal nations and workforce leaders, and utilize the best-practices for supporting underrepresented communities, in both Washington and Idaho, to model the next generation of American aerospace jobs.

These key technology focus areas (KTFA) include advanced and next-generation materials (KTFA #10), which done at TRL six through nine advanced production systems, uses model based engineering, machine learning (KTFA #1) and automation (KTFA #4). Our consortium is ready to begin Phase 2 of the Tech Hub application because failure to develop these technologies in our domestic supply chains is a threat to American access and market share of crucial, sustainable, aerospace and defense systems. Our consortium reflects every level of academia, local, state, tribal governments, small and medium manufacturers, global corporations, labor and regional workforce organizations, local chambers of commerce, and economic development groups, all with the common goal to develop the American supply chain and good -paying jobs at all skill levels in this field of advanced 21st century manufacturing. Confident in the consortium's ability to achieve self-sufficiency within three years and global competitiveness within 10 years, the proposal has the support of Boeing, Lockheed Martin, and Raytheon. More defense OEMs, NASA, and the PNNL national lab, are coordinating with us for Phase 2.

The Inland Northwest is an ideal location for a Tech Hub of global significance. With 1,500 aerospace-related suppliers and 132,500 workers in aviation and aerospace,[1] the region has the world-class workforce needed to meet immediate and next-generation domestic development and production needs to reverse the upward trajectory of American reliance on foreign materials.[2]



The Combined Statistical Area (CSA) of Spokane-Spokane Valley-Coeur d'Alene[3] is centered on the I–90 corridor, bridging Spokane, WA, with the rapidly developing rural communities of Coeur d'Alene, ID (pop. 56,733)[4] and Post Falls, ID (pop. 44,194).[5] In five years, this CSA has seen a 12% population increase and 9.5% job increase, outpacing the national growth of 3.8%.[6] Projections reflect an 11.5% increase by 2027.[7] Together with a group of competent faculty and research scientists and engineers drawn from this region's highly collaborative colleges and universities, the CSA has the educational expertise to expand offerings and develop training programs for every aspect of the testing and production process.

The Center will repurpose a former manufacturing plant, less than a mile from Spokane International Airport, into a world-class "lab to market testbed" that will house the largest TPC fabrication and automation equipment in the U.S. The 386,000 sq. ft. facility will enable hands-on training, classroom education, new technology development and validation, and scalable manufacturing strategies to enable domestic production of immediate and next-generation aerospace enterprise. The Center's physical and cyber security will meet the standards of global commercial and defense industry leaders, the Dept. of Defense, and NASA.

Advanced TPC materials are key enablers to sustainable air travel and future global competitiveness for every form of aviation[8] and many other applications. To reduce costs, weight, and fuel consumption, manufacturers agree that the next generation of narrow body commercial aircraft will have composite wings, and likely a composite fuselage,[9] demanding unprecedented manufacturing and production requirements to shift to liquid compression molding and TPC. These same advances in sustainable aviation will reduce the impact on climate change, according to NASA.[10] Thermoplastics drastically reduce energy usage and capital investment costs of traditional composites. Factory footprints are reduced as less time is spent on-tool from efficient press-based lamination, stamp forming for isothermal tooling, and batch production. Costly factory HVAC systems in layup areas are eliminated as the polymer is not compromised by factory temperature or humidity. Cold storage and logistic challenges associated with uncured thermoset polymers are eliminated because of the dramatic energy reductions offered by polymerization (curing) at the reactor at large scales instead of chemical polymerization applied to every part. TPC uniquely offers 100% recyclability or recoverability by simple mechanical grinding and/or compounding for re-use in non-structural parts (ex. system brackets and commercial interiors) or use in other commodity markets.

In partnership with NASA, the Center will advance game-changing technologies to reduce aviation emissions to meet net-zero carbon emission goals by 2050. As members of NASA's Advanced Composites Consortium,[11] which allows partners to take advantage of each other's expertise, consortium members Boeing, Lockheed, Advanced Thermoplastic Composites Manufacturing, Electroimpact, and other defense OEMs would use the shared physical space to advance the goals of NASA's HiCAM program[12] potentially expanding to include academic partners. Collaboration to develop global, high-rate production demands and lightweighting will also support NASA-Boeing Sustainable Flight Demonstrator Project[13] to advance aerodynamics and fuel efficiency, utilizing a collaborative, physical space for NASA-approved partners. The Center would quickly attract private investment in new companies in the aerospace supply chain. New U.S. innovations and production capabilities would rapidly reduce America's heavy reliance on foreign materials and production, reversing dangerous security and economic trends with sustainable alternatives.

Over 40,000 single-aisle and widebody airplanes are projected to be delivered by Boeing and its competitors over the next 20 years.[14] This pace reflects 100 new aircraft a month,[15] putting intense pressure on the current supply chain, yet presenting a unique opportunity for American suppliers to catch up to global competitors.[16] While Boeing is actively developing these advanced materials, the U.S. lacks the infrastructure to demonstrate scalability. Advanced materials have successfully reduced cost and weight in commercial and defense applications, but the U.S. does not have existing capability to meet domestic demands and compete globally for high-rate composite fabrication of larger structures. New technology development and validation, and scalable manufacturing strategies, are imperative to increase domestic production of immediate, and next-generation, aerospace enterprise. New automation systems with proven viability are essential to meeting the sustainable, next-generation aircraft manufacturing needs of the global marketplace and increase self-reliance on these essential supply chains. American

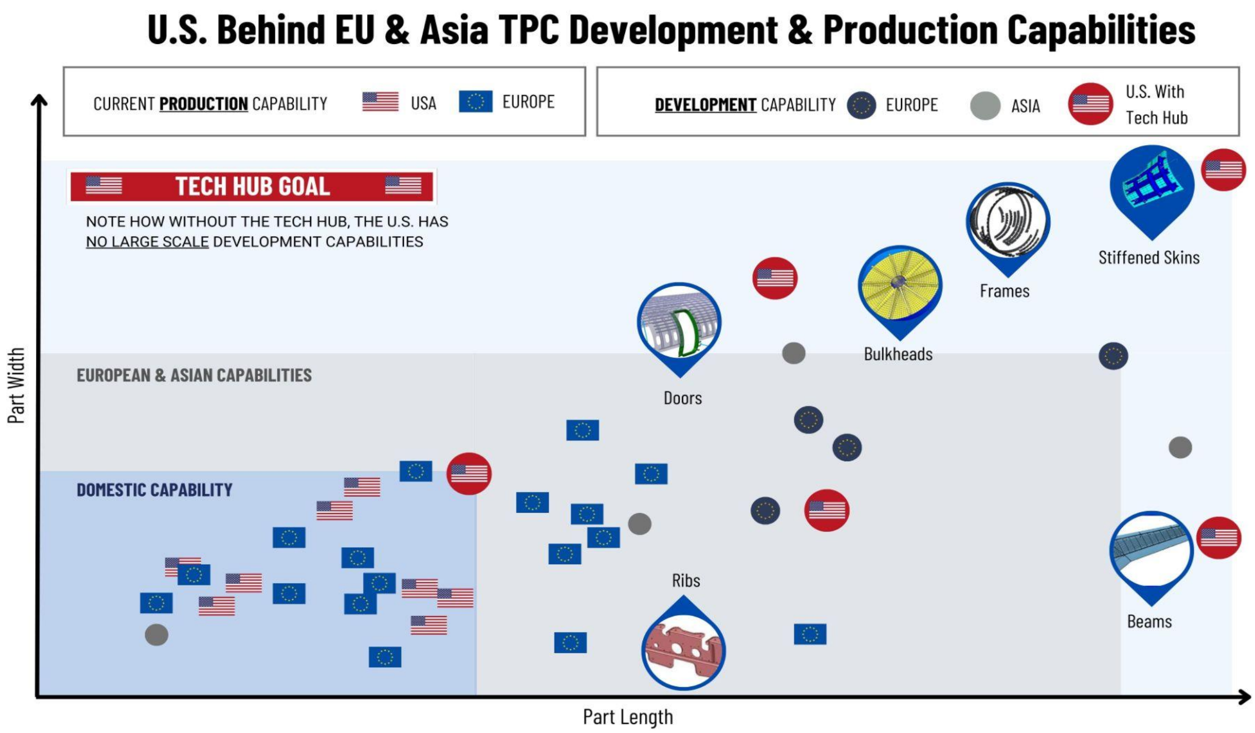


Figure 2: TPC, Stamp Forming Scale Global Landscape, Consortium internal

capabilities for large TPC fabrication are far behind other nations, and expansions of large scale fabrication facilities in Europe and Asia over the next two to four years will only serve to further widen this gap. The Center's advancements will make the U.S. more self-reliant and competitive.

The Center will be a testbed for maturing "lab to market" TPC to TRL nine, transitioning research into the initial low production rates of new programs. High rate production will then be transitioned to suppliers with established TRL/MRL nine facilities. Achieving this production scale will drive market change, potentially expanding domestic capability by a factor of more than 20x. For both economic and national security, the U.S. cannot miss this inflection point. The Center will cultivate new domestic suppliers to meet these high-production rates in the U.S.; enable innovation from characterization to validation, assembly to packaging;

incorporate best-practices in workforce and education programs; and foster rapid supply chain growth by attracting an influx of buyers, venture investors, and entrepreneurs. Coordinating from the outset with our educators, workforce and economic development partners, the Center will incorporate and multiply proven systems of hands-on training, recruitment, and upskilling for our rural and underrepresented communities, supporting new jobs at every skill and experience level.

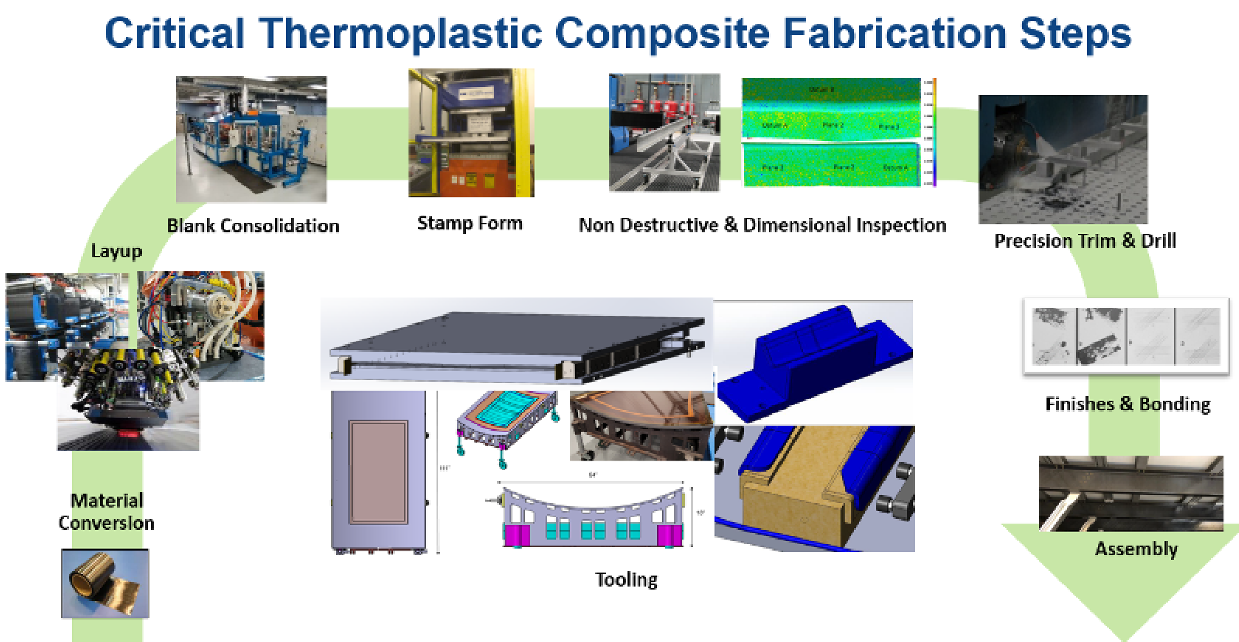


Figure 3: Critical Steps and Contributors to Thermoplastic Composite Fabrication Value Stream, Boeing internal

Current domestic equipment size is sufficient for sub-scale demonstrations of application manufacturing to TRL five, but the Center's goal is developing these essential technologies from TRL six through nine, requiring demonstration of capability at full scale. Each step of the value stream above reflects an opportunity to build new and expanded industry suppliers and workforce at a broad range of skill levels needed to support this new domestic supply chain. Optimized automation and systems integration are essential for achieving high-quality, efficient, and repeatable fabrication at the necessary rate.

Our university partners are leaders in our KTFAs, and each have deep relationships with our industry and workforce partners. Gonzaga University, a leader in applied thermoplastic composite technology research, has announced a new Institute for Informatics and Applied Technology that builds on its long-standing School of Engineering & Applied Science, where students work in related fields of materials science and manufacturing, tribology, finite element analysis modeling, and real-world composite applications (e.g., airplane seating models).[17] The University of Washington leads FAA-supported research into the development of advanced composites, boasts hands-on training in the design of next generation, high performance airplanes, and is building a new research program with an advanced robotic Automated Fiber Placement (AFP) system. The University of Idaho is expanding its robotics and aerospace programs and conducting research with NASA on bacteria-resistant polymers. Eastern Washington University is a leader in smart manufacturing, where students work with industrial robots and structural weight reduction of composite materials. Our workforce partners will inform the certification and upskill training programs at Spokane Community College and North Idaho College, and K-12 programs in the Coeur d'Alene and Spokane public school systems and Elevate North, to offer technical and early STEM pipeline programs.

The immediate priority for the Center is TRL six through nine development in high-rate TPC manufacturing and adoption of related workforce development programs. Proven best practices of our consortium will guide how the Center attracts new workers and maintains a talented and diverse workforce. The Center will adopt a "hub and spoke" approach focused on rural and tribal accessibility, new pipeline programs with K-12 schools, coordinated industry partnerships with secondary[18] and technical schools to open new apprenticeships,[19] and improved mid-career upskilling to ensure high-wage, high-quality jobs. Consortium members are experienced in meeting the evolving needs of the aerospace workforce such as automation, robotics, artificial intelligence, and sophisticated tooling with the best practices for the region with hands-on mobile training programs and hub-and-spoke models. The Machinists Institute's mobile training units currently offer flexible, in-demand aerospace and manufacturing training on employer job sites and in rural communities to support pre-apprentice and pre-employment training. A current design is led in partnership with the Latino Civic Alliance and can also be used for hand-on STEM K-12 programs and career exploration.

In addition to Boeing, our consortium is in discussion for Phase 2 planning with NASA, Raytheon, Lockheed Martin and other defense OEMs to support the defense and commercial goals of the Center as a direct path to American leadership in maturing technologies to TRL nine, bringing multiple large sized materials to market within the first ten years, attracting investment and expansion of the full domestic supply chain for aerospace. This next generation of lightweight materials is imperative for meeting net-zero carbon emissions by 2050. The Center will accelerate development of the aerospace domestic supply chain by serving as a testbed to harden technologies at initial low production rates of new programs in Tier 1 and Tier 2 supplier work, then transition higher production rates through new domestic suppliers through entrepreneurial interest and private sector investments for companies at a projected 20x growth rate of current capacity. This consortium combines expertise in engineering, advanced materials, and aerospace with the best practices of Tribal, Latino, labor, regional workforce, and academia, to bring U.S. sustainable aero materials production capabilities in line with global competitors, repatriate essential supply chains, and create a bigger, more inclusive American workforce.

Appendix
American Aerospace Materials Manufacturing Center

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