



**Statement of  
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Vice President, Technology and Environment  
Pratt & Whitney**

**before the**

**Subcommittee on Aviation  
Committee on Transportation and Infrastructure  
U.S. House of Representatives**

Mr. Chairman and members of the subcommittee, I am Alan Epstein, Vice President of Technology and Environment at Pratt & Whitney (P&W), this country's foremost manufacturer of aircraft engines with over 75,000 engines in the field. We have been making innovative airplane engines for over 90 years under the slogan "Dependable Engines." Pratt & Whitney is part of United Technologies Corporation (UTC), a global technology corporation with a long history of pioneering innovation in aviation, climate control, safety and security systems, and elevators. We are a company focused on manufacturing and servicing what we manufacture. Our approach is to seek advantage through technical innovation across the value chain.

I am here to speak on the state of American aviation manufacturing. My remarks come from the perspective of a supplier and maintainer of aircraft equipment, specifically engines. This is a very timely discussion because aerospace represents 10% of this country's manufacturing output and is America's largest manufacturing export, with a trade surplus of about \$80B a year. While marquee aircraft make about half of this total – famous names such as Boeing, Cessna, Gulfstream, and Bell – the export of aircraft subsystems and components, such things as engines, nacelles, landing gear, generators, and avionics are of equal value. Many of these are made by United Technologies. Indeed, much of the subsystem content of the world's civil aircraft is American – even if the airplanes carry the name of European, Canadian, Brazilian, Japanese, or even Chinese companies.

American aviation manufacturing is about more than just dollars, it is also about jobs. About 1.7 million Americans are employed in this industry, and their pay is 44% higher than the national average at almost \$93,000 per year.

This industry has done very well lately, with trade balance growing at a rate of about 7% per year. The success of American aviation manufacturing is a result of our investments and our people – people who drive innovation, quality, and productivity. It's about cutting edge technology combined with manufacturing prowess. This success also depends upon, to a perhaps unappreciated degree, effective industry-government

partnership. The continued, healthy growth of this American manufacturing industry is critically dependent on all of these factors.

The most recent surge in aircraft orders has a lot to do with a technical innovation introduced by Pratt & Whitney, the PurePower® Geared Turbofan™ (GTF) engine, which entered commercial service last year. Our investment in this technology totaled about \$1B over 25 years. This first billion was needed to develop and demonstrate the technology. Now, GTF engines will be powering airplanes built on four continents. To make this happen, we are investing another \$10B in product development and manufacturing. The GTF engine and the competitive response thus stimulated have resulted in the orders of more than 8,000 new aircraft with a list price over \$800B. The sales success stems from the GTF engine's 16% reduction in fuel burn and three quarters reduction in noise footprint. For example, when the new, GTF-powered airplanes take off from New York's LaGuardia airport, about half a million fewer people will be impacted by noise.

The aforementioned improvements are the result of decades long investment in engine design technologies. In the aviation business, however, advanced technology for manufacturing is at least as important as it is for design. Manufacturing technologies are an enabler of design innovation but are also important for improving productivity and cost. Aviation is a business in which it may be easier to design a new product than to make it for a cost the market will accept, as many famous names in aviation have learned over the decades. Successful companies must aggressively pursue improvements in manufacturing. We are enthusiastic members of the National Network for Manufacturing Innovation sponsored by the National Institute of Standards and Technology (NIST) and are helped by additional DoD initiatives in this area, such as the Materials Affordability Initiative.

For Pratt & Whitney, the success of our engines means that we will be doubling production over the next few years, requiring significant investments in plants, machinery, and people. I would like to focus on the manufacturing aspects of this expansion. The plans we are executing are about more than just expansion – they are about bringing new technology and innovation to the manufacturing process. We are bringing moving engine assembly lines to our facilities in Connecticut and Florida, cryogenic machining to Maine, new powder metal and coating capabilities to New York, hybrid airfoil assembly to Michigan, and isothermal forging and additive manufacture to Georgia, to name a few.

People are an important part of this expansion. Pratt & Whitney plans to hire 25,000 people over the next decade to enable expansion and account for retirements. Aerospace industry demographics are such that the replacement of retiring workers and the retention of their specialized skills are a major concern. You can't make the best products if you don't have the best people. In response to this concern, Pratt & Whitney has partnered with universities across the nation to help foster the next generation of aerospace engineers. The historically strong NASA and the more recent FAA partnerships with American universities have been extremely important. Our workforce concerns also extend to the factory floor. We need a manufacturing workforce with 21<sup>st</sup> century skills. So, we support community colleges and trade schools to stimulate such

education for young people in states in which we operate, including Connecticut, Maine, New York, Georgia, Michigan, Pennsylvania, Texas, and Florida. If we believe as a nation that aerospace manufacturing is important, then education of the future workforce must be a critical focus.

More than technology has changed since the days when the landmark Pratt-powered Boeing 747 entered service in 1970. In those days, we manufactured 80% of our engine content in-house and sourced 20% from our supply base. Now we make only 20% in-house and source 80%. Of the 80% we purchase, we buy 80% from over 500 direct U.S. suppliers. Thus, our concerns for innovation, for quality, for people extend to our supply base as well. This supply base is heavily strained at the moment as the industry expands production. This is a very capital-intensive business. Investments in infrastructure, equipment, and people are needed up and down the aviation supply chain. In addition to capacity, supplier quality is of particular concern to our industry. This is an area of intense industry focus now.

The federal government has important roles in keeping US aviation manufacturing healthy. Two that stand out are thoughtful, effective regulation and the seeding of innovative technology in both product design and manufacture. The relative strength and experience of the FAA as a regulator is an important competitive advantage for U.S. manufacturers. The FAA regulates the design, manufacture, and maintenance of aircraft to ensure the astonishing safety of civil aviation we have come to expect. To design, manufacture, and sell the very best aircraft, we need the very best regulators. Our ability to bring new products to market and to innovate in the design and manufacture of these aircraft requires timely response, mature judgment, and some degree of flexibility from regulators.

FAA production certification is necessary as we introduce new manufacturing technologies and new suppliers. As part of our manufacturing expansion for the GTF engine programs, Pratt & Whitney, working with the FAA Manufacturing Inspection District Office (MIDO), gained FAA Production Certification at new engine assembly sites. The FAA has also supported Pratt & Whitney in approval of many of our new GTF engine suppliers who provide safety-critical, prime reliable parts. Partnering with the FAA through its Organizational Designated Authority (ODA) System has proven extremely helpful in providing flexibility and effectively adding capacity. ODA for manufacturing approval works, and it works well. In 2016, Pratt & Whitney, with FAA MIDO approval, doubled its ODA members in support of the GTF engine manufacturing ramp up. We plan to expand this program for the next several years, consistent with production demands.

Most recently, the FAA has been proactive in reaching out to industry to explore the certification implications of new manufacturing technologies, such as additive manufacture.

As Benjamin Franklin said, “an investment in knowledge pays the best interest.” So I think it appropriate to comment on new technology. As a technology stimulator, NASA sees its role as an initiator of new technology, but the FAA is the safety gatekeeper, and nothing is more important to new technology than safety. Both NASA

and the FAA fund universities and partner with industry to advance the state of the art in aviation design and manufacturing technologies. Over many decades, NASA and the FAA have been important partners in the advancement of American aviation. Progress here has been profound, with the result that commercial aircraft are the most efficient and safest form of transportation. The P&W geared turbofan engine may have had its initial technology parentage in partnership with NASA, but it was clear from the beginning that dialog with the FAA on the safety and certification of its new technologies was of prime importance. We are currently working with the FAA and NASA on even more advanced technologies to create value for airline customers and communities by further reducing fuel burn, emissions, and aircraft noise.

One of the most exciting developments in aviation in several decades is the new NASA X-plane initiative, which aims to demonstrate technology that may enable dramatically improved civil aircraft for the future. Both design and manufacturing technologies are included. Some of the approaches proposed present certification challenges, and these must be explored with the FAA. This seed research is far in advance of what industry can justifiably fund. Should it prove viable, industry will need to invest much larger sums to bring such airplanes and systems to market.

The FAA also advances aviation technology in areas within its scope of regard. For example the FAA's CLEEN (Continuous Lower Energy, Emissions and Noise) program aims to reduce noise and emissions in and around airports. Since concerns about noise are probably the largest impediment to the expansion of the U.S. air transportation system (and certainly a major cause of community complaints), this work can have profound impact on the aviation infrastructure of this country. From our observations, the FAA and NASA research programs are well coordinated.

One major concern for industry is the aging FAA certification workforce. The FAA's demographics are similar to that of the aviation industry as a whole. A lot of talent will be retiring over the next few years. To provide the support U.S. manufacturers need, the FAA must be properly funded and able to hire and train their replacements, preferably before the experts are gone. A strong, competent, flexible FAA is an important partner to U.S. industry.

The FAA, partnering with industry and trade associations, must also continue to progress delegation of responsibilities to certificate holders where practical, in order to enhance flexibility to meet its customer requirements, while not compromising aviation safety. Pratt & Whitney applauds and strongly supports the actions already deployed under the FAA Accountability Framework initiative and looks forward to teaming with the FAA under the AIR Transformation over the coming years.

Other nations recognize the strength American aviation manufacturing brings in both an economic and a strategic sense. During the same period that the U.S. dropped its investment in civil aeronautics research by 40%, the EU increased its investment by a factor of more than 10. Perhaps even more concerning, China, the newest entry to the commercial airplane business, has announced large levels of investment in civil aviation technology, both for airplanes and, most recently, billions for engines. The message here is

that while small, federal investment in civil aviation is a critically important component of this country's largest manufacturing export industry and must be protected and nurtured if we are to maintain our position. We need adequate funding for research and regulation.

Aviation manufacturing is alive and well in the United States. This industry is comprised of healthy businesses that plan to expand their output and employment across the country. There are challenges including a strained supply chain capacity and an aging workforce that must be addressed. Competition is fierce. Other countries realize the economic and strategic importance of civil aviation and are ramping up their investments. For the long term health of America's largest manufacturing export industry, it is important that we continue the public-private partnership that has served this country so well.

Thank you for permitting me to address this important topic on which I am so passionate.