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Hearing on NASA's Aeronautics Mission: Enabling the Transformation of Aviation
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Statement of
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Madam Chair, Ranking Member Babin, and Members of the Committee, thank you for the opportunity to testify today. The following remarks deal with NASA's continuing contributions to aeronautics research and development; they represent my personal views, not those of any organization, although they are informed by many years of working with start-up companies, government agencies, and university students. All of these groups, and indeed, the general public, are aware of the many technology advances that promise to transform aviation – not just in the distant future, but in the next decade, and perhaps in the next few years.

Headlines from multiple national and international magazines, dated this month and this week, tout these technologies and the imminent advances in aeronautics that may result. The technologies include many in NASA's research portfolio: autonomy (including machine learning, accurate flight sensors and actuators, control theory), high-power efficient electric propulsion, new fuels and batteries, and advanced methods for aero-structural prediction and optimization. Increasingly capable and reliable autonomous systems, will reduce the cost of commercial air transport, enable on-demand aerial delivery of various goods, and increase the safety of both piloted and unpiloted aircraft. New fuels and high-power electric systems enable a new generation of environmentally-sustainable propulsion, while advances in aerodynamic and structural design permit entirely new types of aircraft from small supersonic aircraft with dramatically reduced noise and emissions, to atmospheric satellites that fly without pilots at altitudes above passenger aircraft. This is why an unprecedented number of students are enrolling in aerospace courses and clubs, why computer science is the largest degree program at Stanford, and why many of our students are interns at companies that did not exist just a few years ago. It is certainly one of the most interesting periods in the development of civil aviation.

But many students, most aviation-related start-ups, and even many aeronautical researchers, have little idea of what NASA is doing in these technology areas. Articles in the popular press deal

with flying cars, electric airplanes, on-demand delivery, and new companies working on supersonic prototypes. But in many of these articles, NASA goes unmentioned. Compelling images of autonomous aircraft delivering blood to clinics in Rwanda do not feature NASA logos, and technical papers from NASA researchers often appear long after companies have needed to provide a demonstration to investors. The large number of future flight concepts and new companies makes it difficult for NASA to function as it has for many years, with a few large, well-known aerospace companies as partners. Without a return to larger NASA aeronautics budgets, NASA may need to focus on a reduced set of intriguing future aircraft.

NASA Aeronautics has taken several steps to encourage partnerships with emerging companies that may have good ideas but need help implementing an analysis or optimizing a design. However, a limited number of Strategic Thrusts and Grand Challenges along with NAE reports and discussions among groups such as the Aeronautics Research and Technology Round Table, may not be sufficiently accessible to the increasingly diverse set of companies, researchers, and technologies of interest. An alternate approach, that has worked well for some space exploration projects, involves a broader range of researchers and organizations in the planning process. Decadal studies have been undertaken by NASA Aeronautics in the past and may provide a means of accommodating a larger number of companies and research topics.

Whatever the structure, NASA must continue to identify and develop critical technologies, create aircraft concepts that can improve people's lives without damaging the environment, support students, companies, and advanced research, all within a budget that is dwarfed by that of a few well-funded start-ups. That they have been able to make such contributions despite these constraints is a testament to the creative engineers and administrators who keep NASA Aeronautics making a difference to the future of flight.

Dr. Ilan Kroo is the Thomas V. Jones Professor of Aeronautics and Astronautics and Director of the Aircraft Aerodynamics and Design Group at Stanford University. From 2010 to 2015 he was the founding CEO of Zee.Aero (now KittyHawk), a company developing electric VTOL aircraft, returning to Stanford in his current position. Professor Kroo consulted for several companies and government agencies including Aerion Corporation and Desktop Aeronautics. Between 1982 and 1985 he served as a Research Scientist in the Advanced Aerodynamic Concepts Branch at NASA's Ames Research Center. Dr. Kroo has over 150 publications in the fields of aircraft design, multidisciplinary optimization, and aviation and the environment, including 9 granted patents on supersonic aircraft concepts and personal air vehicles.

Dr. Kroo has served on many panels and committees advising the U.S. government, industry, and academia. He is currently a member of the NASA Aeronautics and Space Engineering Board and the AIAA Aircraft Design Technical Committee. He has won many awards for his work in aircraft design including the American Institute of Aeronautics and Astronautics (AIAA) Lawrence Sperry Award, the Dryden Lectureship in Research, and the Multidisciplinary Optimization Award. Dr. Kroo is a member of the U.S. National Academy of Engineering and Fellow of the AIAA. He received B.S., M.S., and Ph.D. degrees from Stanford University.