Personal Air Vehicle Sector

National Aeronautics and Space Administration
Vehicle Systems Program

NASA Conducts Feasibility Analysis and Component Testing on Quiet, Highly Affordable Aircraft Concept

Future small aircraft that are as quiet, comfortable, safe and affordable as autos could provide an on-demand air transportation system that permits significantly faster travel for rural and regional trips. NASA is developing the technologies for these small aircraft, and applying these technologies to advanced vehicle concepts in order to understand the potential benefits to society. The Tailfan concept shown utilizes an advanced ducted fan for low noise and safety, and a dramatically simplified skin stiffened structure to reduce manufacturing costs.

For more information:
http://avst.larc.nasa.gov

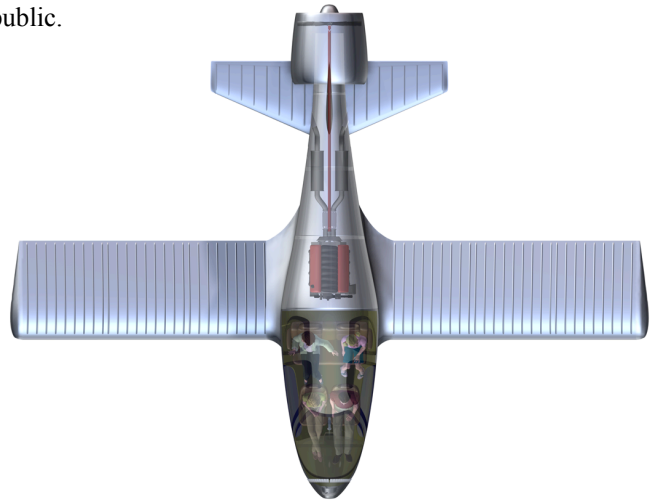
Next Generation General Aviation Aircraft Promises to be Quiet and Much Less Expensive

The future Personal Air Vehicle on-demand market will certainly evolve from the current GA market as technologies and capabilities are developed to affect a larger market share.. Currently, NASA is developing small aircraft technologies for self-operated, on-demand vehicles in such areas of quiet propulsion, low-cost structures, and flight control that permits auto-like ease of use and low cost licensing. In addition, NASA is assisting in developing modern certification practices that permit manufacturers to utilize quality assurance based processes for improved safety and cost.

The self-operated market will likely evolve into missions that align themselves to the transportation needs of rural/regional and intra-urban travel. Rural and Regional communities are already dependent on General Aviation (GA) and can provide a start-up PAV market, even with near-term airspace issue constraints. A sufficiently centralized population base doesn't exist for this large portion of the U.S. geographic area to support hub and spoke operations with full service, low fares and frequent flights, therefore this is a prime candidate for on-demand service. The Rural and Regional PAVs will bear many resemblances to GA aircraft since they will share a common infrastructure and a takeoff and landing distance requirement of less than 2500 feet. However, current small GA aircraft cater primarily to enthusiasts with an emphasis on performance, ignoring or avoiding vehicle characteristics that a typical traveler would require. In order for these vehicles to be considered transportation devices, the minimum qualifications of ease, safety, noise, and comfort must be present. In addition the concepts must be economically viable and environmentally friendly to be able to compete with the alternatives mobility choices of autos or airlines.

This NASA Langley concept is a design that involves the incorporation of new technologies and certification regulations with a biasing of design decisions for affordability instead of performance. An advanced ducted fan provides low cabin and community noise, a skin-stiffened structure provides dramatically lower assembly costs, and advanced quality assurance based certification provides the ability to use modern manufacturing processes and automotive-like products for lower costs and improved quality and safety.

The concept is centered about an automotive V-8 engine located close to the center of gravity (nominally the Corvette LS-1 engine) with operation only up to 4000 rpm, and directly driving a reduced tip-speed ducted fan. The shorter fan blades generate higher frequency noise, with the duct shielding and absorbing the propulsion noise through embedded acoustical liners. The use of an auto engine involves additional weight compared to aircraft engines, as does the use of a ducted fan compared to the use of a propeller. However, the combination of the two permits a total propulsion system cost reduction of over 60% while maintaining a reasonable time between overhaul, and an extremely quiet integration. This 'fake-jet' balanced V-8 propulsion integration also permits the elimination of noise, vibration and harshness over a big-bore tractor engine installation, great visibility, and the elimination of the exposed propeller that has perceived safety issues to the public.



Rural/Regional Next Generation GA
Highly Affordable Mission Concept
(5 place, non-pressurized, 200 mph cruise,
500 mile range, near all weather, $75,000)

Rural/Regional Next Generation GA
High Performance Mission Concept
(5 place, pressurized-turbo, 300 mph cruise,
500 mile range, near all weather, $125,000)

The structure is radically simplified for manufacturing with twelve-fold reduction in labor due to the use of a highly symmetric structure with reduced part count, and a reduced unique part count. An all aluminum structure utilizes automotive manufacturing methods with an untapered, skin-stiffened wing. The same parts are used for both sides of the wing simply by flipping the three spars, and using the same four ribs. Rivets or laser welds are used in recessed troughs to attach the wing components, under a mylar-like wing covering for smoothness and weather protection. Identical vertical and horizontal tails utilize the same pressing molds and the same wing skin-stiffened construction. An axis-symmetric tailcone is used with integral frames pressed into each quarter panel, and a fan duct made up of four identical sections. The combination of unique parts production and tooling, along with the decreased assembly labor and a dramatically reduced propulsion system cost are responsible for the lower cost.

This $75,000 concept solution is based on a 2000 unit/year production rate, to permit affordability in the transition market between the current low production GA market and the high volume production of a future PAV market. Once a substantial market exists, and large production volumes are present, many of the performance compromises could be eliminated through investment in a higher tooling based designed and an optimum engine designed specifically for aircraft use.

Current efforts include the certification of a LS-1 engine through a 150 hour FAA endurance test to demonstrate the reliability, lifespan, and ability to certify a Quality Assurance (QA) based product, instead of the current FAA certification standard of Quality Control (QC). The intent of QA based certification is not to bypass the important role of the FAA to insure safety, but to permit certified processes (instead of parts) to enable safer small aircraft products. As long as small aircraft have to use specialty, small production volume, QC based parts, there is little chance of small aircraft being of any significance to the majority of mobility consumers.