Project Pioneer - Robert E. Smith, Jr.

The Beginning

Growing up in Pulaski, Tenn., as a young boy during the depression era, Robert E. Smith Jr., current Arnold Engineering Development Center (AEDC) aerospace engineering consultant, never dreamed a country boy like himself would end up at a world-renowned place like AEDC. Based on his love of gas-engine-powered model airplanes, Smith chose a path that would forever change the course of aerospace engine testing technology.

After graduating from high school in 1947, he attended Vanderbilt University as a mechanical engineering major. He graduated magna cum laude in June 1951.

June 1951 was an incredibly eventful month for Smith. Five days after graduation, he married his college sweetheart, and now wife of 54 years, Beverly Patterson. Ten days after the wedding, he started to work for the Arnold Research Organization (ARO, Inc.), operating contractor at AEDC. His first workday was the day President Harry S. Truman dedicated the center, June 25, 1951.

With no buildings in existence at AEDC except for the warehouse, Smith reported to St. Louis to begin his work so he did not attend the dedication, but was aware of the unique mission the center was about to embark upon. He had no idea what role he would play in the success of the center until years later.

"I thought it would probably be a few years' tenure," he said. "It turned out to be an incredible 40-year career. It's been a great place to be!"

Looking Back

After serving 40 years in various engineering and management positions for various Sverdrup companies at AEDC, Smith humbly looks back on his career, and the contributions he made to AEDC's mission.

While the construction of the AEDC test facilities was in progress, the operating contractor, ARO, Inc. sent employees to aircraft and engine test facilities all over the country for hands-on training. Smith had the opportunity to go to Cleveland, Ohio, and work with what was known at the time as the Lewis Laboratory of the National Advisory Committee on Aeronautics, which eventually became National Aeronautics and Space Administration or NASA. At the time, Lewis Lab was the premier U.S. government laboratory engaged in jet engine testing, development and research.

After a year in Cleveland, Smith moved to AEDC in the summer of 1952 and began his pioneering work to evolve improved standard test equipment and test techniques that would advance the state-of-the-art for testing jet engines.

"I was fortunate to be assigned to Lewis Lab because before jet engine altitude testing started at AEDC, Lewis was doing the same types of tests, but only on a smaller scale," Smith recollected.

His first task was to help design the special test equipment and service systems required to install jet engines in the test cells that were under construction by the Corps of Engineers for the U.S. Air Force. Those first test chambers were essentially copies of the test chambers that were liberated by the Allied Armies in Germany during 1944.

Early in his career, Smith conceived, designed and developed the basic engine thrust stand measuring system for Engine Test Facility (ETF) test cells. After less than one year of design, construction, and development, the thrust stand was operationally ready on schedule and supported the first sea level test in the ETF Run-up Stand in August 1953.

This same thrust measuring system also supported the first altitude jet engine test at AEDC. This inaugural altitude engine test was conducted in ETF Test Cell T-1 during April 1954. These systems and their successors have been the standard for determination of air-breathing engine performance in the altitude test cells at AEDC for many years. The basic elements of his design are now in widespread use throughout the engine test community.

"Project responsibility for the engineering design and development of these high accuracy measuring systems was a challenge for a young guy like me, but it was very successful," he said. "I am pleased to have been a part of the project team."

His original design represented a major advance in the U.S. state-of-the-art for jet engine thrust measurements at altitude. These new AEDC systems provided thrust measurements with two to four times better accuracy and precision than other contemporary systems.

A short time later, he and Roy Matz, an ARO co-worker, conceived, designed, and developed a new measurement system for engine airflow that continues to provide the standard baseline for airflow measurements in the ETF test cells. This Smith-Matz critical flow venturi system is included as a national standard in the fluid meters code of the American Society of Mechanical Engineers (ASME) and is also an international standard.

"Both of these standard ETF measuring systems were designed to meet the contemporary (late 50s - early 60s) need and included growth provisions to meet needs of the future as best as we could project it," he explained. "We anticipated that engines would be larger as time passed and they were. We were able to include enough provisions for growth that the useful lifetime of these test equipment items turned out to be not days or months, but years."

His work in the application of these two measurement systems contributed significantly to advancing the state-of-the-art standards in resolving the thrust and drag of high performance jet aircraft beginning with the F-104, F-111, C-5, and B-1, and continuing to succeeding generations of such aircraft.

For 14 years, Smith managed ETF's Research Branch and then the T-Cell Division in developing the technology base and designing special test equipment and facilities for high-speed air breathing engines and liquid and solid rockets. During this time, he managed the original experimental research efforts in supersonic combustion of hydrogen at AEDC. For this research, he and Dr. R. P. (Bob) Rhodes were jointly awarded the first

General H. H. Arnold Award presented by the Tennessee Section of the American Rocket Society in 1961.

Again, using experimental and analytical works of many investigators, Mr. Smith developed and refined hardware design methods for the first exhaust gas ejector-diffusers, which were utilized in the jet engine test cells at AEDC. He was a major contributor to the extension of these methods to the design of ejector-diffusers for rocket motors when altitude ground testing of such motors was initiated in the late 1950s.

In the 1960s, Smith envisioned a direct real-time relationship of the experimental engine-performance measurements from the engine test cells with computational results from the engine mathematical model. This vision was enabled by nearly simultaneous breakthroughs in high-speed cycle balance engine math models at the USAF's Propulsion Lab and high-speed data processing at AEDC. His advocacy for this relationship led to the first-generation AEDC system, which provided on-line comparison of experimental results with math model results.

During the late 60s and the early 70s, he led the small team of AEDC engineering specialists that developed the design requirements for the Aeropropulsion Systems Test Facility (ASTF). The subsequent AEDC advocacy process for this large facility was led by the AEDC Chief Scientist, initially Dr. Bill Heiser and subsequently Dr. Jim Mitchell. Throughout the advocacy process Smith provided technical support to the Chief Scientists.

The advocacy process was ultimately successful and led to the construction of ASTF that was completed in 1984 at a cost exceeding $600 million. Smith remembers the ASTF advocacy as "some of the most challenging and rewarding years of my career were supporting the Chief Scientists through special documents, meetings, and conferences with national leaders in Congress, DoD, industry, and academia."

Retirement

After retiring in 1991 as Vice President and Chief Scientist of Sverdrup Technology, Smith continued his service as an aerospace engineering consultant specifically in the development, operation and maintenance of jet engines.

"My current role as a consultant to the USAF's Propulsion Product General Manager (PPGM) affords a unique opportunity to remain engaged and learn what's being done better in the jet engine world," he explained. "My role also provides the opportunity to be disappointed occasionally because the engine community - aka the Engine Mafia- sometimes repeats mistakes of the past largely because of significant and increasing losses in corporate memory at all levels - system project offices, T&E centers, sustainment centers, government labs, and engine manufacturers. I am a very strong believer that to maintain U.S. aerospace superiority a few new failures must be induced as part of the search for the true location of the leading edge of any new capability. However, there is not enough time or money to allow for the luxury of repeating failures from the past."

His best advice to the newer and younger employees of the center is to, "pay attention to what you know, humbly respect what you do not know, do good work, and look around to learn what others are doing in the engine community so next time you can do your tasks better."

He has always considered education a major part of his success and encourages young workers of today to make the most of an education and to take it all with them when you go to a job.

"My education has been a keystone. If I do not learn something new everyday, I figure I am really in trouble. I make sure every day of my life that I learn something, sometimes it is a good thing and sometime it is a bad thing, but in the end, each bit of learning counts."

Smith also believes in giving back to the community and staying involved. He is a committed servant to his church, First United Methodist in Manchester, and to his community having served many roles in education, civic affairs, and governance for the Coffee County community.

"In addition, I believe it is necessary to commit a fair portion of my time and energy to organizations that serve my profession such as AIAA and NSPE. It appears to me that, in recent years, the Team AEDC management and engineering staff is participating less in professional development," he said. "By less participation I mean attendance in meetings with fellow professionals, participation in seminars, and giving of presentations is now less than it was a decade or so ago."

His advice to practicing engineers of today is to give professionalism its fair share commitment along with other key commitments including your God, family, and work.

Smith hopes AEDC will still play a significant role in the United States' defense program for years to come.

"I hope the U.S. will maintain its resolve to have a superior defense capability that includes aerospace testing before deployment. If Congress and the country can make that commitment; there will always be a role for AEDC."

What Smith wants to be remembered most for in this life is that he is a man of integrity and that he strived to perform each new task a little better than the last.

"I would like to be remembered as a loyal friend, as a competent mentor, as a respecter of persons and most of all as a believer in an omnipotent God."

In regards to AEDC, Smith said, "The AEDC team working together, has, for over half a century, made major contributions to the security of our country and it's rewarding to have been a part of that."

Continued Education and Accolades

Smith also earned a Master of Science degree from UTSI in mechanical engineering. He is a graduate of UCLA's Modern Engineering for Engineering Executives and of the

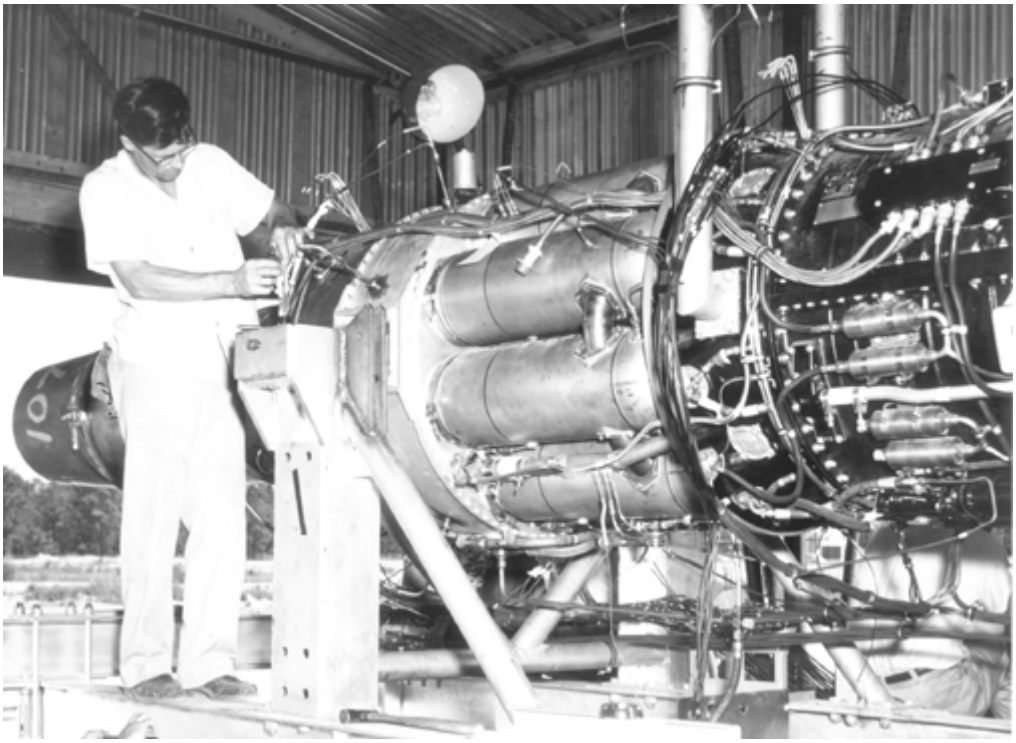
Senior Management Program of the American Management Association. He served as an associate professor (adjunct) at UTSI from 1969 until 1996.

He was inducted as a Fellow of the American Institute of Aeronautics and Astronautics in 1988.

He was honored as an AEDC Fellow in June 1990 for his technical and managerial leadership in developing and implementing new approaches for ground testing and evaluation of air-breathing and rocket aerospace propulsion systems

In 1992, he received the Distinguished Alumnus Award from the Vanderbilt University School of Engineering.

He was awarded the 1995 Wright Brothers Lectureship in Aeronautics on the topic Integration of Airframes and Engines by the American Institute of Aeronautics and Astronautics.

In 1996 the Rheinisch-Westfalischen Technischen Hochschule and UTSI selected him as the Quick-Goethert Lecturer.

In February 2005, Smith was named the Engineer of the Year by the Nashville chapter of the Tennessee Society of Professional Engineers. He was the first engineer from the aerospace field to receive this award, which is presented annually to a professional who has had a lifetime commitment to engineering in Middle Tennessee.