THE LAMS STORY

Martin C. Elkes

The introduction of a new technical capability into an operating component is a long and difficult process; whether it be the introduction of a new rifle (Armalite Model 15 or M-16) into Vietnam, an F-111 aircraft into the Air Force, or an improved navigation system for Agency field use. For various reasons, only a small percentage of the new so-called "good ideas" identified in research or operations actually get into the field as operational gear. It is only natural that many people and organizations have a great skepticism and show considerable caution in supporting new ideas prior to their successful demonstration.

Among the factors which can have an important bearing on whether or not a risky research and development program reaches fruition and is deployed in the field are the people associated with the program. Sometimes a good program survives this skepticism and caution mainly because of the drive, persistence, skill, conviction, and understanding of the people involved. The LAMS—LORAN Airborne Modular System—story is a case in point.

The Requirements

In Southeast Asia in the mid-sixties, the Agency needed a rapid means for determining where and when our aircraft went down, so that the crews could be rescued more quickly. Agency personnel needed to know the exact positions of small indigenous teams reporting the movement of enemy troops and supplies. Agency aircraft needed a more precise position location and navigation system for infiltration and exfiltration of personnel, for more efficient aerial photographic mapping, and for dropping supplies under nighttime or IFR (Instrument Flight Rules) conditions. The Agency's Marine Branch needed a better navigation system for small craft and a better way of coordinating the air and marine operation at night. These situations required smaller, lighter, less complicated equipment, preferably at lower cost. Ground support for the equipment had to be minimal, and the equipment had to be accurate at long ranges and low altitudes. These needs were perceived by Agency personnel in the field and at Headquarters, but they were not formally documented and published requirements at the time. In addition, the Office of Research and Development, DD/S&T, needed even smaller navigation systems for the emplacement vehicles (small, unmanned airplanes, blimps, helicopters, ground-roving vehicles, boats, and submersibles) then being developed.

State of the Art of Navigation in the Mid-1960s

A number of different navigation systems were in use or under development in the mid-1960s. Some of these had features which would meet some of the Agency operational requirements but none of them had enough of the desired characteristics. TRANSIT navigation satellites were being launched and navigation sets were being built, but they were too large, too heavy, and required too much human attention to get a position "fix." The OMEGA system was being partially implemented by the Navy; that system was planned eventually for world-wide coverage, but it would only provide position accuracies to thousands of meters, instead of to the hundreds of meters or less needed by the Agency. At that time the receiving equipment was too large and too heavy. The DECCA navigation system had a number of chains or ground stations installed, primarily in Europe, but the range over which it was useful was much too small for Agency use. The Air Force's TACAN/VORTAC navigation systems were not useful at the low altitude at long ranges required by Agency operations. The inertial navigation systems were too large and drifted too much. The LORAN equipment in the Air Force planes was too large and unsuitable, although its accuracy was acceptable. The LORAN ground stations installed and operated in Southeast Asia by the Coast Guard and the USAF provided coverage for the entire area.

Since navigation was such an important problem for DoD, there was some improvement work going on in each of the systems enumerated above but none of the systems was being developed quickly enough or in a configuration to meet Agency needs.

The Approaches

Because equipment to meet Agency needs was beyond the state of the art and the technical risks were significant, several parallel approaches were undertaken. Different groups within ORD funded LORAN, TRANSIT, and OMEGA research after a large number of other systems had been considered. Of these three systems, navigation sets using the LORAN system were eventually developed and employed by the Agency in Southeast Asia. The remainder of this article will be about that program.

During ORD's technological survey in 1967, it was found that Teledyne Systems Corporation (TSC) was building a breadboard model to test a promising new concept for LORAN receivers. Their approach would lead to a navigation system design considerably smaller and lighter than the more conventional approaches, if they could make it work adequately. The proposed equipment appeared to meet some of the requirements for team location and downed aircraft location which had been discussed in October and November 1967. Attending were representatives from the Office of the Special Assistant for Vietnamese Affairs (SAVA), Special Operations Division (SOD/DDP, now SOD/DDO), Technical Services Division (TSD/DDP, now OTS/DDS&T), Far East Division (FE/DDP), and ORD/DDS&T. Further refinements of the requirements were made, and possible solutions were discussed from November 1967 through February 1968, inside and outside of the Agency.

To firm up the requirements and to initiate tests, ORD funded a small measurement program to assess the capabilities of the Teledyne breadboard equipment. By April 1968 the results of the first field test were available and were presented to Agency as well as Army, Air Force, and the Naval Applied Science Laboratory personnel. Based on the results of the test, ORD recommended the research and development of a prototype manpack LORAN receiver. In May 1968 the Special Assistant for Vietnamese Affairs formally requested the development of the receiver, and the contract was started that month. The equipment was to be 60 cubic inches in size and weigh approximately three pounds. Because of technical difficulties, the size grew to 132 cubic inches, the weight to five and a half pounds, and the delivery was seven months later than originally scheduled; but even with that size and weight growth, the receiver was only one-tenth of the size and weight of the Air Force's LORAN sets, the ARN-92 and ARN-85.

Immediately following delivery of the models, operational tests were conducted in the United States and abroad. During the period December 1969 through March 1970, the equipment was tested in the following LORAN chains: U.S. East Coast, North Atlantic, Norwegian Sea, Mediterranean Sea, Northwest Pacific, and Southeast Asia. In Southeast Asia tests were made at Ubon and Nakhon Phanom, Thailand; Pleiku, Cam Ranh, Chu Lai, and Ton Son Nhut in South Vietnam; and in Laos. In addition to testing the manpack LORAN system on the ground in Southeast Asia, it was tested aboard an H-34 helicopter, using a short-whip antenna extended out the door. The helicopter tests were made at Udorn, Thailand, at Saravane, Laos, and in a deep valley about 15 miles from Saravane. To further check the performance in realistic operational situations, the equipment was tested on a rubber tree plantation near Saigon and in rugged mountain terrain near Long Tieng in Laos.

The equipment was described and shown in operation at the Agency stations in [redacted] Vientiane, Saigon, [redacted] and at more than 15 Defense Department headquarters.

The complete ARN-92 LORAN receivers were costing the Air Force approximately $90,000, plus $70,000 to $100,000 each for installation. ORD felt that it was essential that the unit cost for Agency LORAN sets be significantly less than that (in the range of $1,000 to $15,000) to have much chance of being widely used for such applications as indigenous observation teams, aircraft tracking, and marine operations. The most important sub-systems could be common to Agency, Defense, and civilian systems. One way to get the price down was to get the production up on those sub-systems for mass production economies. The Agency production quantities would not be large enough by themselves; therefore, it was considered essential to get other users involved in the production and development of LORAN subsystems the Agency could use. To this end, ORD, the Agency, and Teledyne described the equipment and the tests to as many potential users as they could.

Shortly after the field tests, a cable was received from Vientiane station requesting assistance in improving the night-drop mission. That mission was to fly over a specified point on the ground at night, in or near hostile territory, drop supplies, precisely, and return to base safely. SOD, TSD, SAVA, and ORD representatives met to discuss the request and recommend a course of action. A contract incorporating these requirements was let in May 1970 with Teledyne for the development of two airborne LORAN line-of-position (LOP) systems to provide Agency aircraft with a precision drop capability. The LORAN receivers developed under the previous contract were incorporated into these LOP's. These equipments were delivered in the fall of 1970 and tested in the Virginia area, in Southeast Asia, and at Eglin Air Force Base. Again, a joint ORD-SOD-TSC team tested the equipment. The equipment was tested in an H-34 helicopter, a C-123, a Beech Baron, a Twin Otter, and a Porter aircraft for a total flight operational time of nine hours in Thailand and Laos. The accuracy attained with these aircraft with the LOP equipment was consistently better than 70 meters. Perhaps the most impressive demonstration of the instrument's accuracy was the blind operational air drop made at a mountain top site in Laos near Long Tieng. Four packages were parachuted into a drop zone approximately 30 meters by 40 meters—without seeing the drop zone—from a Twin Otter aircraft from an altitude of about 500 feet. At Eglin Air Force Base additional accuracy and drop tests were made, including drops from Agency aircraft to Agency marine craft operated by SOD.

Following these successful tests, a contract was let in February 1971 for the development of 10 LORAN Airborne Modular Systems (LAMS) and auxiliary equipment for use in Southeast Asia. The requirements were backed by SAVA and DDP, the funding was provided by DDP, and the technical supervision was by ORD/DDS&T. This improved LAMS system provided an accurate position location system, a preprogrammed flight plan capability, a flight-following capability, and "time-to-go" indicators. The flight-following facility permitted a ground station to know accurately at all times the position of the aircraft. The "time-to-go" indicators provided the pilot with an accurate indication of the time remaining before the aircraft passed over a preprogrammed check point or the target. The equipment features needed by the Agency were provided in a small and light enough form so that the equipment could be used by Agency aircraft on their unique missions.

After seemingly insurmountable technical, financial, and contractual problems too complex to enumerate, the dedicated DD/S&T-DDP-SAVA team finally deployed units in Southeast Asia in 1972. SOD/Air Branch took the first equipment [redacted] in the spring of 1972 for tests and operational use.

Operations

Since its deployment in SEA, the LAMS aircraft equipment has been used extensively in the F-58T, the CH-47, the H-34, and the H-500 for helicopter infiltration and extraction; in the Twin Otter, Caribou, C-47, C-123, Porter, and C-130 for resupply; and the VOLPAR for photo-reconnaissance. The navigation equipment was moved from one aircraft to another as the need arose, because there were not enough navigation systems to equip all aircraft. The LAMS sets were averaging 64 hours flight time per month per set.

Some examples of typical operational applications of the LAMS equipment were as follows:

a) *A Specific C-130 Aerial Delivery Resupply Mission.* A mission was ordered to resupply an operational site in Laos which was under attack by hostile forces at the time. The LAMS equipment was installed in C-130 aircraft in 28 minutes. The crew, which had never used the LAMS equipment prior to this mission, was given a one-hour briefing using a video tape and TV monitor to show them how the equipment functioned and was to be employed. The mission was flown during daylight hours under IFR conditions; a rain storm had moved into the drop zone area and the crew had no visual contact with the ground at any time during the drop. Four check points and the drop point were programmed into the LAMS computer. The initial drop was made using only the LAMS. Radio contact with the ground confirmed that the bundle landed 60 meters north of the drop zone. Corrections were made in the LORAN coordinates and a new drop point was programmed. Five more drops were made and all five landed on the drop zone. The LAMS was then programmed for the return flight to home base and the aircraft returned safely.

b) *Resupply of Skyline Ridge Outposts.* The defense perimeter outposts on Skyline Ridge, overlooking [redacted] Long Tieng, were resupplied regularly by LAMS-equipped Twin Otters during battles for the base in 1972. The aircraft flew low, between mountains, from a more southern base to a point near Long Tieng. The aircraft then flew a direct line, preprogrammed into the LAMS, and literally climbed the mountain. As the aircraft crested the Skyline Ridge, it made a steep climb, a "U" turn, dropped the supplies to an outpost, and then ducked below the crest of the mountain. Without such a precision navigation system, air resupply of Long Tieng for a three-month period of fighting in mid-1972 would have been far more difficult.

c) *Caribou Night Resupply Missions.* The LAMS equipment was regularly utilized in Caribou aircraft for resupply missions. Usually the Caribou would resupply several teams on one night mission by programming into the equipment the LORAN coordinates for each drop zone. The aircraft navigated to each drop zone, made one pass to drop the supplies, and then proceeded to the next programmed drop zone. This proved to be a secure and relatively safe method of resupply in hostile areas at night.

d) *Twin Otter Resupply Missions.* The LAMS equipment was installed in Twin Otter aircraft for the purpose of resupplying operational teams in remote and mountainous areas lacking easily identifiable ground features. The map coordinates of the ground team were converted to the LORAN coordinates and programmed into the LAMS computer. This system guided the pilot to the team's general location. When the aircraft arrived in the area, air-ground radio contact was established with the team to confirm the exact location. Ground signals, such as smoke or panels, were then placed in the drop zone for the aircraft to make the drop. This close positioning of the aircraft, usually within a quarter of a mile, eliminated the necessity of flying search patterns to find the teams and thus reduced the exposure of the aircraft and the ground team to hostile action.

e) *Helicopter Missions.* The LAMS was the primary navigational aid on helicopters flown in weather and visibility conditions which otherwise would have caused cancellation of the mission. The LAMS equipment was used to locate the helicopter landing zone on infiltrations/extractions of both personnel and supplies.

f) *Photo Missions.* The LAMS equipment was installed in VOLPAR aircraft utilized for photographic missions. During much of the year, climatic conditions prevented the air crews from effectively using visual references to navigate to the mission area, so the LAMS was used. Once the photo mission area was reached, the LAMS equipment was programmed to navigate each photographic leg and to print the LORAN coordinates on the film. The improved precision in flying the legs saved much film and time and reduced exposure of the aircraft. When the mission was completed, the LAMS equipment was programmed for the return flight to home base.

The LAMS story is a good illustration of what can be done by a small group of individuals banded together voluntarily in an interdirectorate team to increase the Agency's capability in a field operational situation. In particular, the coordinated and cooperative approach taken by a group of key players from SAVA, the Special Operations Division of the DDP and ORD was a key to the success of this project. They worked together in the face of many difficulties with an outstanding *esprit de corps,* inspired by dedication to their common goal.

Epilogue:

The LAMS equipment is still in use; it will be refurbished and continued in service. If the Agency had waited for others to produce the LAMS or its equivalent, it would still be waiting.

A prototype of a subminiature LORAN receiver (the size of a package of cigarettes) has been developed by the Agency as a follow-on; it is expected to be a model widely used for Agency, Defense and civilian applications. The Coast Guard and the Agency jointly now are funding the development of a subminiature, improved, LAMS-like equipment incorporating the subminiature receiver.