Historian's Corner

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Commercial Atlas

Atlas has evolved over a period of 55 years from an Inter Continental Ballistic Missile (ICBM) to, with its Centaur upper stage, one of the world's premier expendable Space Launch Vehicles. It also involves the transformation of Atlas/Centaur from a Government managed program (USAF/NASA), into a Company managed Commercial program, to the current Atlas V EELV USAF managed program.

The Atlas ICBM was developed by General Dynamics Convair for the US Air Force. It first flew in 1957. Centaur, America's first liquid hydrogen/oxygen upper stage, was developed by Convair for NASA to launch seven Surveyor missions that soft landed on the Moon to assess surface conditions in preparation for the Apollo manned missions. Centaur's first successful flight was in 1963.

By the early 1970's, Atlas/Centaur had become one of the Nation's premier systems for launching geosynchronous satellites and planetary escape missions. Under management by NASA Lewis Research Center (LeRC, now Glenn), from 1971 through 1982 Atlas/Centaur launched 39 missions at an average of 3-1/4 missions per year at better than 92% mission success (total of 3 failures). Of 39 missions, 23 (59%) were commercial communications satellites (Intelsat & Comstar) with launch services procured through NASA. During this period, Centaur (atop either Atlas or Titan boosters) successfully launched NASA missions to every planet in our Solar System except Pluto (NASA's Pluto mission was launched on an Atlas V in January 2006).

During the 1970's and early 1980's there was some limited evolution of the Atlas/Centaur launch vehicle to enhance performance. Specifically, the propellant tanks on the Atlas booster were lengthened to contain more propellant and booster engine thrust was increased. Centaur's avionics were updated from analog to digital systems. But with few exceptions, improvements to incorporate new mature technology, address quality issues of hard-to-build or install parts, and to streamline manufacturing and launch processes, were rejected based on the government/industry belief that non-mandatory changes increased the risk of flight failure.

The first Space Shuttle launch in April 1981 sounded the death knell for all US expendable launch vehicles; e.g., Atlas, Delta, and Titan. US National policy was to launch all future US missions using the Shuttle. The original Shuttle intent was to support up to 55 launches per year at a marginal payload launch cost of $118 per pound (not including development and infrastructure costs). Influenced by the US Shuttle decision, the Ariane expendable launch vehicle was developed by Europe to accommodate their launch needs.

The Atlas/Centaur program, still managed by NASA LeRC, was in a "going out of business" mode for the next seven years to launch previously planned missions. From 1983 to 1989, Atlas/Centaur launched eight times, with two failures (75% mission success). During this period, there was no incentive for NASA to invest in their expendable launch vehicles. Only "make it work" changes (to fix launch failures) were authorized; design improvement changes were not allowed.

The Challenger disaster in January 1986 changed everything. Based on the Shuttle's failure, the unanticipated high cost of Shuttle missions, and the success of Ariane, the US decided that their soon-to-be-terminated government managed expendable launch vehicle programs would instead be turned over to contractor management, and the government would procure their launch services commercially.

General Dynamics acquired the remaining Atlas/Centaur Program assets from NASA in exchange for performing one launch service (AC-69 CRRES). These assets included the Intellectual Property; one mostly completed vehicle, lots of parts, and the Launch Complex 36 ground support equipment at Cape

Canaveral. The Commercial Atlas I configuration was essentially the same Atlas/Centaur used in the late 1980's by NASA, but with a larger all aluminum payload fairing. Eleven of these "commercial" Atlas I's were flown, but three of these suffered in-flight failures (73% mission success). As a result of these failures and industry consolidation, General Dynamics agreed to sell the Atlas Program to Martin Marietta in late 1993.

While Atlas I missions were ongoing, General Dynamics developed the Atlas II (MLV II) for the US Air Force and commercial users. Atlas II incorporated a large number of improvements that had been developed or prototyped over the past decade, mostly under government sponsorship. This funding was provided via Independent Research and Development activity and Technology Initiatives. Ironically, General Dynamics was not permitted to implement any of these improvements while Atlas/Centaur was a NASA program.

A common perception by the government (and perhaps also General Dynamics) was that launch vehicle changes which improved either performance or reliability would also increase recurring cost. Atlas II proved the opposite; major performance and reliability improvements resulted in substantially reduced hardware, assembly, and launch processing costs. A good example was Atlas II's replacement of Centaur's jettisonable insulation panels with fixed foam insulation. This one change eliminated a complicated jettison event, significantly improving reliability. Vehicle weight was also reduced, improving payload performance. Launch vehicle processing time and complexity at Cape Canaveral was reduced. Both vehicle hardware and operations costs were significantly lowered. 1,100 part numbers were eliminated. Other changes incorporated into Atlas II provided similar benefits.

In addition to major configuration changes, a philosophy of continuous improvement was adopted and institutionalized by the Atlas commercial program. Continuous improvements primarily addressed parts availability problems, quality issues, assembly difficulties, and launch processing impacts. A straightforward, non-bureaucratic process for evaluating and accepting improvement changes was instituted, along with a rigorous Systems Engineering assessment and approval process. As a Commercial Program, Government approval and funding of changes was not needed, although customers were kept informed. Expendable launch vehicles offer the optimum platform for continuous improvement; each vehicle performs its mission, and then is discarded. Configuration control need only last until each vehicle is launched.

Starting with Atlas II, the vehicle evolved into Atlas IIA with upgraded Centaur engines and IIAS with strap-on solid rocket motors. At Lockheed Martin, evolution proceeded with the Atlas IIIA with a new Russian RD180 booster engine, IIIB with an upgraded Centaur, and the current Atlas V Evolved Expendable Launch Vehicle (EELV) family for the USAF with a new booster, new strap-on solid rocket motors, new Centaur avionics, and new payload fairings. In addition to these major evolutionary steps, component and subsystem changes to be used in the next family, were incrementally incorporated and flight proven on the current vehicles. From 1995 on to completion of the Commercial Program, probably no two Atlas vehicles flown were identical.

Both our government customers and LM company management were initially very dubious of the Atlas continuous improvement philosophy. However, as Atlas continued to fly successfully, this approach was at first reluctantly tolerated, and then finally embraced. US Government customers now very much see the benefits of Atlas continuous improvement. The same NASA customer that would not consider flying a change for the first time in the 1990's, is now very supportive of flying major new systems for the first time on their Atlas missions.

How did this continuous improvement philosophy affect cost and reliability? During the 1990's, Atlas did become cost competitive with Ariane and other international launch vehicles of similar performance capability. And beginning with Atlas II, Atlas has achieved 100% mission success. This includes all 100 Atlas flights since March 1993, and encompasses at least 20 "first of a kind" vehicle configurations, where flight failures are more likely. Evolutionary development, coupled with a continuous improvement

philosophy, has served Atlas very well. In late 2006, the Atlas V and Delta II & IV Programs were combined under a new company, United Launch Alliance (ULA). Although this signaled the end of the Commercial Atlas Program, the philosophy of continuous improvement has been retained at ULA. Now that the Space Shuttle Program has been completed, Atlas V is being man rated for delivering Astronauts using commercially provided spacecraft.