

Single Stage to Orbit
Review

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In *Single Stage to Orbit*, Andrew J Butrica details the development and eventual cancellation of the single stage to orbit concept, specifically the SSX (Single Stage eXperimental and later Space Ship eXperimental) program. As Butrica emphasizes throughout the book, the SSX vehicles tended to focus on two key ideas: single stage to orbit and aircraft-like operations. Single stage to orbit means just as it says and aircraft-like operations means the capability for fast turnaround time and not needing a standing army to operate the spacecraft.

The story of the single stage to orbit vehicle truly begins in the late 1800s when visionaries such as Jules Verne, who wrote *From the Earth to the Moon...*, began describing vehicles that could take humans to the moon and further and were primarily single staged. These ideas, however, did not really begin to turn into practice until the early 1980s during the Reagan administration. At this time, supporters of the DC-X program, such as Newt Gingrich, and supporters of space-based defense systems, such as Max Hunter and Daniel Graham, pressured Reagan to develop a space policy. Reagan's space agenda therefore focused on two fronts: the commercialization of space by providing companies with more realistic methods for getting into space and the development of space-based weaponry that could be used against other satellites and incoming ballistic missiles (the "Star Wars" system that became the Strategic Defense Initiative (SDI)). Since the Space Shuttle was not fulfilling the role necessary for SDI, various designs, including the National Aero-Space Plane (NASP), Continental/SemiGlobal Transport (C/SGT), and SSX. Max Hunter, Daniel Graham, and Jerry Pournelle eventually drove SSX through the Phase I and Phase II designs, but eventually due to funding restraints and a new administration, Phase III was delayed and the SSX took on new names (DC-X, Delta Clipper, and DC-XA). Eventually, the Delta Clipper was tested and proved itself successful on initial test flights, but a human error resulted in the destruction of the vehicle on the fourth test flight of the second iteration and a compilation of budget constraints and the end of the inability to justify further funding resulted in this being the last flight of the program.

Before examining the book's arguments, a discussion of the author is in order. Andrew J Butrica has written several well-known books, which span a variety of topics from a history of Air Products and Chemicals Inc to writing about Reagan in the Cold War. He wrote *Single Stage to Orbit* as the historian for NASA's X-33 program and is currently a historian on the Defense Acquisition History Project, which was created by the Secretary of Defense. One would

thus expect him to have a clear understanding and relatively objective, if not conservative, view of the program; in fact, the book shows him to be rather objective.

Throughout the book, Butrica presents several key arguments as to why the program proceeded the way it did. First, he emphasizes the Cold War thinking that drove the project. Second, he emphasizes the waste of the various organizations, especially NASA, when they were developing and testing this program. Third, he states the importance of visionaries and the media in the development of these projects. It is likely that Butrica chose this method in which to argue the book since it most clearly describes the way in which the program was started and ended. The program started in order to support SDI programs such as Brilliant Pebbles mini-satellite program. The lack of SDI support by the end of the project was not the sole reason that it failed, however. Butrica argues that the agencies in charge of the program wasted a great deal of time, effort, and money by changing their focus over the span of the various SSTO projects. This is due largely to the fact that the program extends for such a long time, the SSTO program changed departments multiple times (from ARPA to NASA for example), and that NASA is simply not very adept at implementing the “faster, smaller, cheaper” scheme and programs seem to grow out of control. It should be noted, however, that the ultimate failure of the program was due to the fact that the DC-XA program was smaller and therefore certain protocols were sacrificed, such as ensuring that brake lines were all attached. It is also interesting to note how Butrica places emphasis on the role of visionaries, especially near the beginning of the book, stating that they create the initial ideas for all these things and then begin the initial drive forward. Furthermore, science-fiction TV shows like Star Trek served to generate public interest in space projects in the 1980s.

A point of interest is that Butrica included a short passage in the back of the book entitled “Bibliographic Essay,” which summarizes his sources for information on the project. Especially interesting is his first sentence, “Finding primary records on the SDIO’s SSTO program and the Delta Clipper in traditional repositories proved to be largely unrewarding.” Fortunately, it Butrica seemed to get lucky and found three key people: Steve Hoeser was involved in the DC-X project, was Max Hunter’s spokesperson, and kept very good notes on various meetings and collected a great deal of documentation regarding SSTO vehicles. Tim Kyger worked in Congress fighting to keep the DC-X program alive and therefore had a great deal of information

on that front. Finally, Doug Stanley worked at NASA's Langley Research Center and was very involved in the X-33 project and also made the Langley DC-X records available to the author. These all appear in numerous locations throughout the footnotes along with various other references, such as books by or about other key members of the program.

Although the SSTO history occurred almost exclusively after the Apollo program ended (Reagan did not begin pushing the program until he was elected in the 1980s), the SSTO idea certainly made an appearance in the initial Apollo designs, namely the NOVA direct ascent plan, which was partially based off of SSTO ideas. Although the Earth-based NOVA rocket would not be single-staged, it would send a single craft to directly land on the moon and come directly back, which no stages in between. Furthermore, although the SSTO program occurred after Apollo, it had largely the same ends: to continue the space race through the weaponization of space. Both programs ended when they no longer served to beat the Soviets. As discussed earlier, once the Cold War was long gone, the SSTO program was ended since SDI was used to justify its existence. We can also subject the SSTO program to Launius's five categories, although three of the categories stand out. First, the SSTO program, like Apollo, was clearly a tool of public/foreign policy that was used to beat the Soviets. Second, the SSTO program resulted in a great increase in space hardware: rocket designs, composites, fuel tanks, to name a few. Third, the SSTO program emphasizes the history of technology and science. Although the program was largely driven by space-based weaponization, people such as Gingrich drove the program for the commercialization of space and the need to SSTO vehicles before people could begin to grasp the scientific values of space. As a side note to this program, NASA did a great deal in making it possible for companies to get into the space business.

Possibly the most important decision of this program was that to cut funding to the DC-XA program after it had a largely successful testing process since this in reality marked the end of the SSTO program. Although the X-33 Phase II took place after this, it was clearly a last-ditch attempt to save the program. It is not clear why NASA cut funding to the DC-XA in favor of the X-33 since it would likely cost about \$120 million to replace the crashed Delta Clipper while it decided to spend nearly a billion dollars on the X-33 prototype. The technical issue at place is obviously the unconnected brake line that resulted in one of the landing gears not extending prior to landing. But this was a minor human factors issue, of which there would

certainly be many on a project such as this. In fact, it is surprising that there were no significant failures until the seventh flight of the DC-X/DC-XA vehicle. However, the political climate simply would not support another DC-XA vehicle and instead moved on to one last shot at SSTO, the X-33, since there were no longer any driving national security concerns that were making an SSTO vehicle important. In short, the program was cancelled since there was not enough political or popular support for such an expensive program, even though the program started at a time when there was sufficient support for it.

In conclusion, in Single Stage to Orbit, Butrica adeptly lists reasons for and describes the birth and death of the Single Stage to Orbit Program in a way that is applicable to space programs in general.

Author Reference Used:

http://klabs.org/mapld05/invited/butrica_bio.htm

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