Are we Thinking of Earth to Orbit Transportation Requirements in too Complicated a Way?: The Idea of "Everyman's Rockets"

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Abstract - Launch Vehicle Systems and their launch platforms have become incredibly complex over the years as hardware sophistication followed, along with computational capabilities provided by computers. Pump-fed engines, continue to hold forth, with some firms choosing to even add stage flyback capability. The unavoidable result is that even those firms that advertise low launch costs, are far from our original vison of truly low cost to LEO. In this brief summary paper, I describe an approach in which emphasizes simplicity, commonality, and use of a family of vehicles of graduated sizes to meet the common range of payloads. The vehicle family is designed with such intentional commonality that lower stages of smaller vehicles can serve as upper stages of larger vehicles. Unique, modern propulsion is described, as well, in which the combustion chamber walls remain cool, the propellants are pressure-fed from common bulkhead tanks, resulting in single tank stages. The goal is ultimate simplicity from which to derive minimum cost, and maximum reliability. Such a vehicle family shows promise of costs to LEO of an order of magnitude lower than today's costs.

I suggest that we may be thinking of Earth to orbit transportation requirements in too complicated a way. For example, the article by Zapata and Jones (1999) presents what is likely to be a long, difficult, and expensive way of providing reliable and cost-effective Earth to orbit transport. The insistence on airline-like operations is the stumbling block. That requirement introduces an order of magnitude increase in complexity in the vehicles, the launch/horizontal landing facilities, and in the operations themselves that flows through the entire concept.

Compare that approach to the Universal Space Launch Vehicle (USLV) fleet, which is comprised of a family of four sizes of simple 3-stage vehicles the employ such high commonality that the first stage of a smaller vehicle can serve as an upper stage on a larger vehicle. They launch vertically from a platform above a water basin to muffle the sound pressure levels at launch. The first two stages parachute into the sea for recovery by well-deck barge for return to the launch facility re-assembly line. The recovered stages are pre-cleaned and inspected while on the barge, during the voyage back to port. The third stage remains in orbit for use in extending the orbiting facilities, or can be fitted with vestigial wings and thermal protection for reentry and horizontal landing on a shallow water channel. The water landing strip is aerated avoid solid water impact loads, to thereby allow safe very high approach speeds. Underbody strakes extend during final approach to initiate waster contact and generate spray to increase Wing In Ground (WIG) effect upon surface contact. WIG greatly enhances lift of wings as the approach the surface allowing the use of smaller, more durable wings. A sufficient number of these simple vehicle stages can be built to meet launch demands as they evolve. The stage sizes and vehicle sizes are readily customized as the need arises by mixing and matching stages. This approach we can build and fly today. It will meet the $200-$400/kg to LEO golden fleece. The "Golden Fleece" was the magical award sought from the Greek Gods by a supplicant. The construction of appropriate shallow water landing strips costs relatively little compared to the concrete runways

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needed for airline-like operations, and can be readily located outside of commercial air travel lanes.

When these vehicles use LOX/sub-cooled propane as the propellants, in single common bulkhead tank stages, pressure-fed Vortex Combustion Cold Wall (VCCW) chambers on plug cluster nozzles, with thrust vector control (TVC) by thrust modulation using in-tank flow distribution valves, with tank pressurization provided by auto-driven intensifiers using main propellants, such systems become "every-man's rockets". Many suppliers can build their own versions. I would like us would quit making the issue of access to space so difficult, and just get on with what we can do today. The whole nonsense of flyback stages is a gimmick in my opinion. The loss in payload per launch eats up most of the possible savings in vehicle cost if you had used a simple enough vehicle in the first place. If you have to fly back the stage, you have made a design error up front. It is not going to be as utilitarian, nor as profitable as it could have been, and it is not readily varied in payload accommodation as desirable for a commercial operation where payloads may vary in volume and mass.

I salute those such as Space-X and Jeffrey Bezos and the like. They have undertaken and succeeded at significant challenges. On the other hand, with just a little better mentoring, what huge differences we could have today. Suppose Bezos had chosen to fly sideways instead of up and down. We could have P2P capability already in process. Suppose someone would follow the suggestions I have put forth above. We could be thinking seriously today about civilian space communities in the near-term.

Literature Cited

Zapata, Edgar, and John Olds. 1999. Spaceport Operations Assessment for Space Solar Power Earth to Orbit Transportation Requirements. IAF-99-R.3.02