Bootstrapping Human Evolution into Space with LOX Depots

James A. Martin*

A paper was published in 2011 with the title, "An Exploration Architecture Based on Oxygen Tank Depots" (http://arc.aiaa.org/doi/abs/10.2514/6.2011-7162) and presented at the AIAA SPACE 2011 Conference and Exposition. That paper represents the starting point for bootstrapping human evolution into space. The concept is simple. Liquid oxygen (LOX) can be stored in orbit for long periods. Most vehicles for deep space flight are over half LOX by mass. The starting point is a depot in low Earth orbit, with LOX delivered by commercial suppliers. Deep space flights start by filling up with LOX in orbit, which means the mass launched for the flight is greatly reduced. Over time, LOX depots in other locations are added. The LOX can be supplied from Earth or space sources, however commercial suppliers choose. One or more governments can be involved in the initiation of the depot and the exploration flights. The exploration program would pay commercial suppliers for LOX when delivered to the depot. The depot architecture would reduce the need for large launch vehicles for exploration, and the market would encourage commercial launches. In the AIAA Paper, an example is provided in which the launch mass for an exploration flight is reduced from about 180 Mg to about 80 Mg. Similar reductions can be expected for most flights.

One long-term goal of space flights should be to establish a human presence in space. Transportation infrastructure will be an important part of achieving that goal. Depots with LOX available at various locations, such as an Earth-moon libration point, lunar orbit, and planetary orbits will allow flights with much smaller initial mass. Supplying the LOX to the depots can be accomplished by commercial providers who do not need to be directly involved in exploration flights. The market for LOX at various depots will provide the incentive for commercial providers to develop launch capabilities and infrastructure to extract LOX from space sources. The space sources can be the moon, asteroids or comets, or planets.

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*Member, Space Propulsion Synergy Team.