SPACE EXPLORATION SYMPOSIUM (A3)
Space Exploration Overview (1)

Author: Mr. David Gump
Deep Space Industries Inc., United States, david.gump@deepspaceindustries.com

Mr. Sebastian M. Ernst
Deep Space Industries Inc., Germany, info@s-m-ernst.de
Mr. Daniel Faber
Deep Space Industries Inc., United States, daniel.faber@deepspaceindustries.com

AN ASTEROID-ENABLED EXPLORATION ARCHITECTURE

Abstract

Near Earth asteroids (NEAs) should primarily be seen as resources to support the broader space exploration agenda, rather than destinations in their own right. Bountiful NEA resources crucially enable other space priorities, from Moon-Mars expeditions to commercial and research activity in Earth orbit. Making it possible to "resupply in space" also enables exploration architectures based on reusable elements. The mass penalties of reusability do not sting as much when propellant and structural materials become easily available in geosynchronous orbit, high lunar orbit, and Lagrange points (and eventually even as low in the Earth's gravity well as LEO) where they can substitute for propellant, structures and other elements that otherwise must be launched at high cost from Earth.

Deep Space Industries will present the roadmap and hardware it is developing for asteroid prospecting, harvesting and in-space production. Several asteroid targets are identified that can be visited by nano-scale and smallsat robotic scouts, and then revisited four to seven years later by harvesting machines, which gather selected material for return to high Earth orbit. Expected mass budgets, prices and deltaV costs are presented both for scouting missions and harvesting operations.

In addition, prospecting goals for industry are presented to illustrate needs that go beyond what purely scientific investigations would collect. An example is measuring friability, which determines the energy input and machinery mass required for crushing and grinding asteroid ores into powders for processing. Several technologies for transforming raw ore into products for in-space use are presented, including an additive manufacturing process that operates in microgravity to produce high-strength metal parts.

Basing the space exploration architecture on NEA resources also builds the capacity to deflect asteroids that threaten Earth. Because such an architecture is founded on reusability, the world will have far more assets (transfer stages, deep space habitats, etc.) already in space when a threat arises than if nations and companies continue on an expendable path. We show that the space mining industry is able to develop skills specific to asteroids and infrastructure to react rapidly and with precision when planetary defense is required.

This paper presents the top-level overview of a space exploration architecture based on developing local resources as part of the exploration – the pattern most often seen in sustainable terrestrial exploration.