IAF BUSINESS INNOVATION SYMPOSIUM (E6)
Finance and Investment: The Practitioners' Perspectives (2)

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ASTRODYNAMICS VS. MINING INDUSTRY FINANCING – MODELING VIABLE INVESTMENT STRUCTURES FOR ASTEROID RESOURCES

Abstract

The past decade has seen an advent and subsequent decline of the topic of asteroid resources. We should recap: Why was there a decline? One can clearly separate between technological and economic challenges. An increasing specialization of relevant companies can be observed, addressing various technological aspects. Besides, financially strong proponents did emerge as investors. However, a commitment to a sufficient investment into a complete exploration and exploitation campaign has yet to be made public. A lack of known good investment strategies as well as gaps in international agreements on mineral rights in space are the dominant show-stoppers.

Financial and related logistical aspects of terrestrial mining are well understood by mining companies, governments and the financial industry. Parallels have been drawn to asteroid exploitation, including rather similar scales of total required financial resources and time. However, a key aspect, astrodynamics, has yet not reached the minds of the mentioned actors. Based on in-depth domain experience, this work focuses on finding executable investment strategies and possible pathways around the limitations of current agreements.

A new model is presented that evaluates technological and financial strategies against the entire known population of approximately one million asteroids. Every strategy can be freely defined and systematically varied. Some tested strategies were derived from publicly known details of business models of the past decade. Key variables are the temporal structures of R&D, constructions, operations, cost and investment tranches, as well as return on investment, risk factors and time to value. Fuzzing is also implemented as a concept for creating artificial asteroids. It enables finding economically interesting orbits where the search for new asteroids would make most sense given a certain investment strategy.

First results show, among other findings, that commonly used spectral asteroid taxonomies are only relevant if an asteroid has actually received a spectral classification. The right "form of accessibility" is a much more expensive problem. When estimating the economic value of asteroids, established scientific orbit classifications are superficial if not misleading. A decade is a feasible minimal time to value, while two decades can reduce risk and required investments considerably. Higher investments in the in-situ exploration of tens to hundreds of asteroids can massively reduce the risk of exploitation campaigns. The latter is clearly dominated by potential delays – compared to technical problems on-site. It is costly but viable to hide a target asteroid's location as a means of protecting one's investment.