Trade-off Analysis of ROI for Capability Stepping-Stones to a Lunar Habitat

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Context

- NASA Budget History
- Historic Trend of $/lb to LEO

Problem & Need Statements

Problem: Evaluate the costs and revenues of space markets to develop synergy in investments of capabilities that will break the dis-investment cycle.

Need: There is a need to break the disinvestment cycle, by focusing on reducing launch costs, and insurance premiums, that will lead to a profitable development of space.

Top Level Model

- Stepping Stone Capabilities
- Seed Funding
- Lunar Habitat ROI Calculator

Hub & Moon Trips

- Capabilities: Temporary moon habitat
- Focus: Reduces launch costs

Recommended Priority Investments

1) Debris collection (savings of $1 billion)
2) Launch costs (savings of $800 million)
3) Space Habitats
4) Space exclusive ships (savings of $800 million)
5) Life sustainability

Results

It is feasible to break the disinvestment cycle using capability stepping-stones.

This analysis can be taken and utilized to coordinate various industries by moving them into the emerging space markets. Analysis will also give investors an understanding as to how current and expected conditions affect return on investment.

Trade-off Analysis

- Effect of Launch Cost on Stepping Stone 4
- Effect of No Debris Removal on SS 3

Debris Collection

- Capabilities:
  - Reduced debris
  - Reduce insurance cost
- Focus:
  - Debris collection on insurance costs

Disinvestment Cycle

- Current: USA is spending less on space than ever before
- While spending was high during the space race, new spinoff technologies were developed that are still in use today.
- Launch costs are decreasing but still remain prohibitive for development of space markets.
- The amount of debris in low earth orbit (LEO) continues to increase which could eventually make LEO unhabitable and inescapable.
- A lack of synergy among stakeholder investors creates a disinvestment cycle where space tourism, debris collection, and space habitats are underfunded, and launch costs remain high.

Design

Each stepping-stone was modeled independently using SPEC Innovation’s NimbusSE. These models require input of performance levels and output profit and investment.

High Altitude Tourism

- Capability: Commercial tourism
- Focus: Promote seed funding

LEO Habitats

- Capability: LEO life sustainability
- Focus: Reduces launch costs

Trade-off Analysis

- Stepping Stone 4: Mining vs No Mining

Effect of No Debris Removal on SS 3

Without doing debris collection, the insurance rate for LEO habitats continues to grow, leading to an increased investment of $1 billion.

If mining & manufacturing does not occur during permanent lunar habitation, the required cost of launches drives a continuous increase in the required investment.

Effect of Launch Cost on Stepping Stone 4

Launch costs consist of a large percentage of required investment. From the simulations, the expected break-even point is 8 years, however if launch cost remain high at $1000/lb, the break-even point occurs at 11 years. A cost of $1/lb could break even in 5 years.