Value Modeling for Space Launch System Missions

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Overview

Large scale projects, including the Space Launch System (SLS) are often defined in terms of mass, energy, and cost, rather than value or utility. The attributes describing a particular system are related to a specific value for each set of attributes (Figure 2). By comparing resultant values with specific attribute sets (Figure 3), the usefulness of a launch system for a variety of missions can be determined.

Figure 1: Artist’s rendering of the SLS block 1b

Figure 2: System of developing a value model

Figure 3: Attribute set for a lunar mining mission

Figure 4: sensitivity analyses example for payload coefficient

Impact

A sensitivity analyses is a means of transforming the attribute sets into a linear equation for the model (Figure 4). Resultant equations are a simple and effective way to gauge what the return on a set of missions could be (Figure 5). By including stakeholders’ desires to the equation which defines the value of a particular system, an alternative is given to design by requirements.

\[
\frac{\Delta NPV}{\Delta \text{Payload}} = \frac{NPV_{hi} - NPV_0}{\text{payload}_{hi} - \text{payload}_0} = \frac{NPV_0 - NPV_{low}}{\text{payload}_0 - \text{payload}_{low}}
\]

Figure 5: Resultant value equation for lunar mining mission

Key Findings

The SLS can be tailored to perform a variety of missions, though as a heavy lift launch vehicle it is more valuable to partake in missions requiring the delivery of large payloads across vast distances smaller launch systems are incapable of spanning in a timely fashion.

References


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