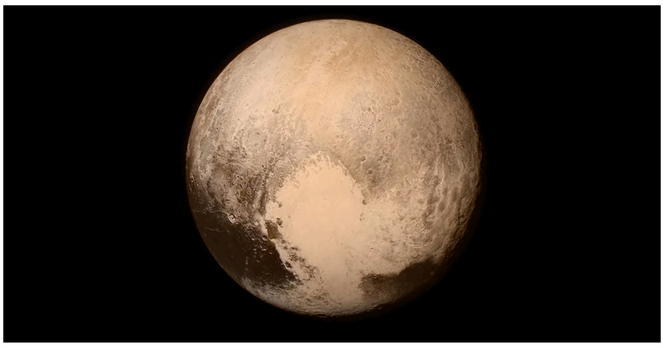
GALORATH

Parametric Method Helps NASA Estimate Pluto Mission Costs



NASA achieves accurate cost estimates with SEER-H™ software for its unmanned Pluto mission.

Background: NASA's Marshall Space Flight Center (MSFC) uses parametric cost estimation to make early cost estimates for a proposed mission to Pluto. Early cost estimates are crucial for budget approval and evaluating various approaches when they can significantly impact the program's cost. MSFC employs a government-developed aerospace cost model, which, though effective at a high level, often lacks the granularity needed for subsystem comparisons. To address this, MSFC has turned to commercial software like SEER-H™, which offers detailed models and an extensive database for generating accurate system, subsystem, and component cost estimates based on real-world experience.

Pluto remains the only planet in our Solar System not yet observed close-up by spacecraft. Studying Pluto is challenging due to its distance and small size. NASA planned to launch the Pluto-Kuiper Express to conduct the first reconnaissance of Pluto and its moon Charon, using advanced technologies to explore the outer Solar System cost-effectively. The mission's goals included characterizing the geology and geomorphology of Pluto and Charon, mapping surface composition, and analyzing Pluto's atmosphere.

Need for a Lower-Cost Approach

Outer Solar System missions are inherently complex and costly. Funding limitations led NASA to cancel the original Pluto-Kuiper Express mission. To address this, NASA solicited proposals for a simpler, less expensive mission under $500 million.

> The proposal emphasized mission success while minimizing costs through careful design and cost management.

MSFC, along with Teledyne Brown Engineering, Los Alamos National Laboratory, and NASA Glenn Research Center, formed a team to meet this challenge. The engineers developed multiple design alternatives and used parametric costing methods to estimate costs accurately. The NASA/Air Force Cost Model (NAFCOM96) provided high-level estimates, while SEER-H™ offered detailed subsystem-level analysis and risk assessment.

Subsystem-Level Analysis

“NAFCOM is excellent for system-level analysis,” said Mahmoud Naderi, aerospace technology technical manager at MSFC. “However, it doesn’t capture differences at the subsystem level. SEER-H™ complements NAFCOM by providing detailed subsystem-level estimates and analyzing risk factors. It allows us to capture technical details and incorporate them into our cost analysis.”

SEER-H™ features approximately 40 knowledge bases for electronic and mechanical elements. It focuses on development and manufacturing cost estimation for low-volume production. The software estimates costs based on the number of components, providing realistic results. SEER-H™ also offers sensitivity analysis to determine the impact of specific project factors, enhancing the accuracy and efficiency of cost estimates.

Generating the Parametric Model

Charles Hunt, a NASA industrial engineer, analyzed proposals for the new Pluto-Kuiper Belt mission using SEER-H™. “I transposed technical specifications into SEER parameters and generated the initial model in two hours,” Hunt said.

> “The model provided immediate feedback to engineers, prompting them to refine their specifications. We iterated quickly, improving the model’s accuracy. SEER-H™’s database enhanced the accuracy by comparing new designs with historical data. I will continue updating the model as the project evolves.”

SEER-H™ and other tools enabled NASA to develop a realistic, well-documented budget for congressional approval. The software’s ability to quickly evaluate alternative approaches saved time and guided engineers toward cost-effective solutions. If approved, the SEER model will be further refined for subassembly and component decisions, helping manage costs effectively throughout the project.