

14TH IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND
DEVELOPMENT (D3)

Space Technology and System Management Practices and Tools (4)

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DECISION ANALYSIS METHODS USED TO MAKE APPROPRIATE INVESTMENTS IN HUMAN
EXPLORATION CAPABILITIES AND TECHNOLOGIES**Abstract**

NASA is transforming human spaceflight. The Agency is shifting from an exploration-based program with human activities in low Earth orbit (LEO) and targeted robotic missions in deep space to a more sustainable and integrated pioneering approach. Through pioneering, NASA seeks to address national goals to develop the capacity for people to work, learn, operate, live, and thrive safely beyond Earth for extended periods of time. However, pioneering space involves daunting technical challenges of transportation, maintaining health, and enabling crew productivity for long durations in remote, hostile, and alien environments. Prudent investments in capability and technology developments, based on mission need, are critical for enabling a campaign of human exploration missions. There are a wide variety of capabilities and technologies that could enable these missions, so it is a major challenge for NASA's Human Exploration and Operations Mission Directorate (HEOMD) to make knowledgeable portfolio decisions. It is critical for this pioneering initiative that these investment decisions are informed with a prioritization process that is robust and defensible.

It is NASA's role to invest in targeted technologies and capabilities that would enable exploration missions even though specific requirements have not been identified. To inform these investments decisions, NASA's HEOMD has supported a variety of analysis activities that prioritize capabilities and technologies. These activities are often based on input from subject matter experts within the NASA community who understand the technical challenges of enabling human exploration missions.

This paper will review a variety of processes and methods that NASA has used to prioritize and rank capabilities and technologies applicable to human space exploration. The paper will show the similarities in the various processes and showcase instances where customer specified priorities force modifications to the process. Specifically, this paper will describe the processes that NASA Langley Research Center (LaRC) Technology Assessment and Integration Team (TAIT) have used for several years and how those processes have been customized to meet customer needs while staying robust and defensible. This paper will show how HEOMD uses these analyses results to assist with making informed portfolio investment decisions. The paper will also highlight which human exploration capabilities and technologies typically rank high regardless of the specific design reference mission. The paper will conclude by describing future capability

and technology ranking activities that will continue to leverage SME input while also incorporating more and more model-based analysis.