

SPACE OPERATIONS SYMPOSIUM (B6)  
Human Spaceflight Operations (1)

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## CHARACTERIZATION AND EVALUATION OF MANNED SPACECRAFT OPERABILITY FACTORS

**Abstract**

As humans increase their presence in space, whether for routine missions to the ISS or to extraterrestrial bodies, it is important to understand how the human element may affect safety and mission success. Often captured as human performance, the human element is hard to quantify. Therefore, determining whether a spacecraft design enhances human performance is difficult to verify. Evidence of the difficulty of designing human systems is seen by the number of accidents caused by human error even in some of the most developed industries like aviation and maritime. The goal of this paper is to define and characterize the factors that influence human performance. Four main categories are spacecraft design, mission operations, human physiology, and user interface. While NASA's Human Systems Integration Standards (HSIS) provides general design guidelines for accommodating humans in spacecraft design, the impact to human performance is not well-understood. To improve this understanding, each of these factors were thoroughly identified and evaluated to determine their relative influence on human performance. For example, anthropometrics is the major design driver for seat sizing and adjustments, but not as influential in determining daily workload. A list of all the possible factors and their influences is captured within this work. An operability index was then created by aggregating these values and their weighted influences. This index captures the relationship between spacecraft design and human performance. The index is intended to help future spacecraft engineers identify designs that promote optimal performance, which can lead to increased safety and mission success. Additionally, it provides a way for engineers to quantify changes to operability across different design iterations. Future work will focus on the verification of this operability index and its application to historical spacecraft to ensure its applicability and robustness.