Paper ID: 15374
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HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
How Can We Best Apply Our Experience to Future Human Missions? (2)

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MICRO-G USABILITY ERGONOMIC ISSUES IN COLUMBUS APPLIED TO TOOL BAG MKII DESIGN DEVELOPING PHASES

Abstract

Knowledge on the human capabilities and behavioral changes due to the human adaptation in 0g conditions applied into the next MSP program phase analyses, in support of crew on orbit payloads activities planned in COLUMBUS European ISS module can be further improved by addressing the crew experiences acquired in the past space missions. Therefore, the crew lessons learned collection is considered crucial to exploit "tacit" knowledge gained by experience of microgravity environment that have to be included as micro-g usability guidelines in the early phase of the engineering design process. In this paper, the usability criteria applied to integrate knowledge on human performance capabilities and design features in the contest of a new Tool Bag design development and refinement phases are described. At this aim, the crew experience based on the use of the existing tool bag currently available in COLUMBUS has been considered and collected by TAS-I Engineering Experts Team through usability evaluation tools (e.g. on orbit scenarios review, interviews, questionnaire, videos). The "user needs" related to the tool bag overall layout, the items operability, visibility, accessibility, the restraints, the labeling, and the stowage issues in Columbus exploited by the ESA/NASA astronauts, working on board for several months, have been collected. The emerged guidelines were included in the design review process aiming to optimize the bag layout and the tools accommodation making them visible and accessible in a glance. Based on this, crew lesson learned have been included in the requirement definition phase. Then, the proposed tool bag design concept was reviewed considering also the impact of the proposed innovative material (ULTEM 9085 thermo plastic) using physical prototypes (based on 3D CATIA models). This approach permitted to quickly identify the tool retention criticalities considering the material characteristics and to optimize the tool bag overall shape. The identified usability criteria based on the human behavior in micro-g environment have been included in the tool bag design refinement. The new design solutions emerged by using "user centered design" approach will be tested on board as additional feedback to improve future COLUMBUS equipment functionality, crew interfaces operability, operative task sequences and crew time issues. In addition, the utilization of 3D printing prototyping manufacturing process and the (FDM) fused deposition modeling technology introduced added values including new ergonomic and technological innovation in the overall design development process.