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USABILITY ISSUES FOR A NEW TOOLBOX USER NEEDS BASED ENABLED BY 3D ADDITIVE MANUFACTURING TECHNOLOGIES FOR ISS COLUMBUS MODULE

Abstract

In the frame of the International Space Station (ISS) Exploitation Program, a new crew toolbox to accommodate the tools currently in use on ISS Columbus Module has been developed by a Thales Alenia Space team supported by the European Space Agency (ESA). The "rethinking" of the design started from the operational experience gained by the astronauts in microgravity environment. In order to improve usability and to save crew time during maintenance tasks, ergonomic methods joined with technological and social values have been applied. The "user centered design" approach permitted to share knowledge across designers, operations and engineering teams and crew members since the early phase of the design process. Innovative design solutions were identified and implemented taking advantage of the new material thermoplastic polymer ULTEM 9085 and 3D Fused Deposition Modeling (FDM) process which introduced innovative issues due to the high potentiality of the 3D additive manufacturing technology. The application of such technology for the manufacturing of a flight component required the qualification and certification of material and processes previously used only for the prototyping. Consequently, functional and mechanical characterization of the ULTEM 9085 have been performed by TAS-I. Several lesson learnt have been collected, and, despite the failures occurred, the final results confirmed that the additive manufacturing process allows to innovate products reducing design development schedule impact, time/cost saving and permit to identify new shape/features and processes for future space applications. The toolbox has been tested on board COLUMBUS during the Mission VOLARE and the crew feedback demonstrated the improved usability which was reflected in the reduced crew time required to carry out maintenance operations. The results, lesson learnt and future perspective will be described in this paper. The aim is to continue to put innovation into the products and pursue the integration of know-how between designers, engineering and operations experts working "on ground" and crew members with "on orbit" experience to improve the "final user" satisfaction and to better understand future equipment functionality, crew interfaces operability, and crew time issues. The "smart team" experience contributed to focus on new methods, new products and new technologies thinking to new services and new ways of working which are considered relevant towards a long term vision for future design developing process in space applications.