

30th IAA SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS (E3)
Strategic Risk Management for successful space programmes (6)

Author: Dr. Jeevan Perera
NASA, United States

ADDRESSING CREW EXPLORATION PHYSIOLOGICAL AND PSYCHOLOGICAL RISKS

Abstract

Long duration exploration missions (LDEMs) impose physiological, psychological and behavioral stress on crewmembers. Crew Countermeasure Systems (crew exercise systems) are an integral part of human spaceflight to combat these stresses. Since mission success for manned exploration missions significantly depends on the both the physical and psychological wellness of crews, significant improvements in crew countermeasure systems will be required to reduce inherent risks as we extend human presence beyond low earth orbit. Some of the current NASA exploration risks include (1) Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance and (2) Risk of Reduced Physical Performance Capabilities Due to Reduced Aerobic Capacity, Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders.

Several areas that have been identified for risk reduction include implementing capabilities that improve exercise efficacy and enjoyment. Specifically, astronauts cited a need to implement features designed to improve crew morale, mood, motivation, crew cohesion and family ties during LDEMs. Additionally, there is need for development of autonomous tools that inform exercise technique to minimize injury due to poor exercise form while maximizing the effects of crew exercise time in conditioning (a virtual personal trainer concept). Significant research and design efforts are ongoing in reducing these risks which will be outlined.

Several evaluations are underway on the International Space Station (ISS) testing prototype hardware and software exercise systems to improve the design necessary to facilitate the next step in extended exploration. The presentation will cover current (used on ISS) and future (MPCV and other exploration vehicles/habitats) exercise hardware systems. Discussion will also include software advancements covering (1) improved user interface software which minimize training requirements, using a customizable software architecture standardized among different exercise hardware platforms with plug-ins for growth and adaptability with current commercial state of the art systems, (2) prototype instructional motion training environments capable of providing technical feedback during resistance exercise, and (3) social running environments to provide scenic landscapes and social experiences that promote connectedness with people back on earth.

The goal in driving these improvements to crew exercise systems is to offer an effective, motivational and socially engaging exercise-training experience for crew members assigned to these long duration exploration missions ensuring crew are optimally conditioned for conducting their objectives.