The long-term goal for this subtopic is to enable planning, designing, and carrying out human space missions of up to 5 years with crew independence, without resupply and without real-time communications to Earth. Specifically, this subtopic's focus is the development of innovations in crew equipment; and the development of technologies for assessment, modeling, and enhancement of human performance; and the development of design tools for engineers to incorporate human factors engineering requirements into hardware and software.

Proposals are solicited that seek to develop technologies that address these specific needs:

- Monitoring and maintaining human performance nonintrusively. Specifically, minimally invasive and unobtrusive devices and techniques to monitor the behavior and performance (physical, cognitive, perceptual, etc.) of individuals and teams during long-duration space flights or analog missions. Technologies to track locations of individuals within habitats, and report on physiological or other state information. Methods and models for human performance prediction, including physical performance, as affected by encumbrances of clothing, space suits, etc.

- Predictive modeling of effects on the crew due to potential spacecraft environments and operational procedures. Develop computational models of the crew environment and of human performance and behavior to simulate the effects of factors that contribute to (or degrade) long-term performance capabilities. Such models of the environment, individual, and group behaviors and performance can be used to simulate and explore the conditions that influence human performance (e.g., fatigue, noise, CO₂, microgravity, group dynamics, etc.). Such capabilities would include digital models of human operators and routine and emergency tasks that interact in the context of the long-duration human exploration environment.

- Tools to aid in design and evaluation of human-system interfaces for speed, accuracy, and acceptability in a cost-effective and reliable manner: Automated analysis of computer-user interfaces for complex display systems to conduct objective review of displays and controls, and to determine compliance with guidelines and standards. Quantitative measures of the effectiveness of user interfaces to be used for task-sensitive evaluations.

- Tools that facilitate the user interface design for human computer interfaces, and for facilitators, such as procedures, labels, and instructions. Tools should assist the designer in incorporating contextual...
information such as the user’s task, the user’s knowledge, and the system limitations.

- Tools to build just-in-time system and operational information software to aid human users conducting routine and emergency operations and activities. Such tools might include effective and efficient job aids (e.g., “intelligent” manuals, checklists, warnings) and support for designing flexible interfaces between users and large information systems. Methods for development of ‘facilitators’ (procedures, labels, etc.) adapted for the development of space vehicle and payload applications.

- Rapid don/doff launch-and-entry and survival suit: a personal ambient environment and individual health and safety protective garment system with antigravity protection, metabolic-cooling and heating, breathing air, thermal protection, zero-atmospheric pressure protection, land and water survival gear, etc. An integrated suit (providing all desired protective functions), as well as a modular suit (allowing user to select ahead of time any of the array of required protection and survival subsystems) approach should be considered. The emphasis for this innovation should be to achieve the desired levels of protection for space travel, as well as for survival on Earth after landing at an unplanned site—all while affording rapid donning in microgravity through one-gravity (1g) environments on the order of 60 s and rapid doffing on the order of 300 s or less. Include accommodation for using the suit for ill, injured, or incapacitated crewmembers, meeting the don/doff goals while providing access for medical monitoring and ongoing treatment.