The goal of effective Human Systems Integration challenges many areas of technology, including distributed data management and control, sensor interpretation, planning and scheduling, modeling and simulation, and validation and verification of autonomous systems. These various technology areas must eventually be integrated into a system-of-systems. Particular emphasis is placed on the following:

**System Engineering Tools**

Technologies, tools, and methodologies are needed that assure development activity is congruent with Exploration Mission capability requirements. Decision support tools are needed to help in the visualization of portfolio balance and clear representation of complex systems as well as a capture method for the interactions/interdependencies/interfaces between system elements.

**System Simulation Tools**

The ability to analyze, synthesize, and develop integrated function-based and simulation-based system architectures in support of Human Systems. Key to this requirement is either the further extension/enhancement of current available SE tools or acquisition/development of tools that will allow for system level concept development and concept simulation.

**System Integration Tools**

The ability to enable human system integration for exploration missions is strongly affected by the structure and architecture of the systems used to sustain and protect the crew. There is a need for the development and evaluation of control architectures and strategies for determining relative benefit, risk, and costs of the utilization of candidate system architectures. Tools for capturing state knowledge of the entire portfolio by project, including dependencies, maturity, and relationships to requirements are also needed.

Capability-based requirements methods require tools and methodologies that enable capture of current practice for
information integration between ground-based systems, on-board systems, and crew systems; goal analysis; surveys of existing and proposed technologies; mapping of technology to tasks; prototyping; integrated testing and evaluation criteria; and development of experienced personnel.

Integration Test Bed Tools and Applications

Integrated ground tests for human exploration missions will provide a test bed for development of hardware, requirements, hardware acquisition strategies, novel system concepts, and management. Tools are needed that provide techniques for real-time analysis; techniques for planning, scheduling, and conducting complex integrated mission simulations; tools to develop system-level mathematical models of missions; and systems engineering and analysis tools for mission architecture studies.

Human-System Integration for Manufacturing and Launch Site Operations

Human-System Integration of Manufacturing and Launch Site Operations addresses the following functional areas: Manufacturing, Spacecraft Processing, Launch Control, Landing and Recovery, Repair and Refurbishment, and Enabling Operations. Specific areas of interest include intelligent work instruction systems; maintainer/launch controller situational awareness; human/robotic maintainer on-board capability; reduced size ground crew training modules; and predictive labor requirement models.

Research should be conducted to demonstrate technical feasibility during the Phase 1 contract and show a path toward a Phase 2 hardware and software demonstration. The contractor will, when possible, deliver a demonstration unit of the monitoring instrumentation for NASA testing before the completion of the Phase 2 contract.