NASA SBIR 2005 Phase I Solicitation

X4  Advanced Studies Concepts and Tools (ASCT)

The goal of this topic is to develop ESR&T (Exploration Systems Research and Technology) tools that advance the SOA (State-Of-Art) for: the study of revolutionary exploration system advanced concepts, system technologies, and architectures; the prioritization of mission enabling technologies; systems engineering analysis, which reduces mission risk; systems design and analysis; and the conduct of exploratory research and development for emerging technologies. The projects to be selected are expected to challenge SBIR companies to take on research projects with higher technology development risk and higher potential payoff than they would, otherwise; and, in addition, are judged to be likely to provide new capabilities to meet NASA's strategic goals and objectives for Exploration Systems. Projects must press the state-of-the-art, display a high degree of innovation, and involve significant technical challenges. Projects must be technically feasible, but the proposer should not assume that the lower the technical risk in a project, the greater the probability that it will be funded. Component-related, system-related, and process-related projects are all of interest. Subtopics of this ASCT topic area include: Technology Systems Analysis Tools - this subtopic includes the development of advanced tools to support: advanced concept analysis; systems architecture analysis; emerging systems technology analysis; technology portfolio assessment and forecast analysis; campaign analysis; technology databases; advanced concept development risk and cost modeling; etc. This subtopic encompasses support for technology road map definition. Systems Design and Analysis Tools - this subtopic includes the development of advanced tools for implementing: an advanced modeling and systems simulation environment; integrated analysis for assessing potential system engineering impacts of new technologies; design and analysis databases; system engineering models; engineering discipline analysis; system level risk analysis; probabilistic risk analysis (PRA); reliability, maintainability, and availability analyses; human factor analysis; life cycle cost analysis; and other systems engineering Figures of Merit (FOM) analyses. This ASCT topic is currently focusing on developing advanced tools, which enable the following:

- Study of revolutionary exploration system advanced concepts, technologies, and architectures;
- Exploratory research and technology in the full range of technical fields related to space exploration;
- Integrated modeling and simulation of exploration systems and mission risk.

Subtopics

X4.01 Technology Systems Analysis
Lead Center: GRC
Participating Center(s): JPL

The goal of this subtopic is to develop new tools to ensure that advanced technology investments are guided by appropriate analyses. These analyses are needed in areas involving all of the various element programs within ESR&T. The analyses will support the definition of technology road maps for ESR&T.

The scope of Technology Systems Analysis Tools includes the development of advanced tools to support technology systems analyses, such as: portfolio analysis; campaign analysis; system technology architecture impact analysis; advanced concept analysis; sensitivity analysis; verification and validation analysis; development cost analysis; and the population of advanced technology databases and information systems. The ASCT analyses planned will be performed using low-fidelity/high-level techniques. They will focus on entry level technologies and notional architectures. Higher fidelity assessments will be performed using ESMD (Exploration Systems Mission Directorate) Simulation Based Acquisition (SBA) resources.

This Technology Systems Analysis Tools subtopic is currently focusing on developing advanced tools which enable the following:

- Conducting exploratory research and development of emerging technologies and advanced concepts with high potential payoff;
- Performing architecture, campaign, and technology analyses to identify and inform portfolio development for relevant exploration applications;
- Technology analysis to identify and prioritize mission enabling technologies;
- Architecture, mission, advanced concept, and technology risk analysis;
- Technology databases, roadmaps, and portfolio development;
- Exploration and implementation of different advanced concepts development methodologies and techniques to enable more effective and efficient study development;
- Development of advanced concepts analyses and sensitivity analyses that can incorporate the full range of technical fields related to space exploration;
- Analysis of advanced concepts, advanced technologies, and portfolio analysis;
- Campaign analysis including the synthesis and analysis of many missions, architectures and competing capabilities and technologies against FOMs;
- Technology analysis that identifies SOA and levels of performance metrics associated with cost- and risk-dependent chronologies (technology datasheets);
- Advanced concept and system technology verification and validation;
- Effective techniques for presenting tradeoffs and recommendations to decision-makers.
**X4.02 Design and Analysis Tools**

**Lead Center:** GSFC

**Participating Center(s):** ARC, LaRC

The goal of this subtopic is to maximize the credibility of the integrated systems analysis efforts being performed within ASCT by providing validated systems design, system analysis, and systems engineering tools. This will include the development of tools to produce: a modeling and simulation environment, design and analysis databases, system engineering models, engineering discipline analysis, parametric-based risk analysis, and probabilistic risk analysis (PRA), etc. This effort will closely coordinate with and support the development of the Simulation Based Acquisition (SBA) system in support of Exploration System Mission Directorate (ESMD) program acquisition and analysis.

The scope of System Design and Analysis Tools includes tool development activities in the following areas: advanced systems simulation modeling environment; design and analysis databases and system models; performance and structural sizing; SBA advanced systems engineering tools for mid-technology level simulation and visualization of life cycle cost, risk, reliability, supply chain logistics, maintainability, availability, and other system engineering Figures of Merit.

This subtopic is currently focusing on the following technology areas:

- Systems engineering tools and discipline analysis tools in support of Simulation Based Acquisition. See ESMD-RQ-0025, ESMD-RQ-0026 and SBA Strategy in the Crew Exploration Vehicle Procurement Bidder’s library ([http://exploration.nasa.gov/acquisition/cev_procurement.html](http://exploration.nasa.gov/acquisition/cev_procurement.html)) for additional information.

- Advanced engineering tools that integrate performance, risk, and cost modeling.

- Development of system engineering tools that implement new analytical methodologies and techniques in support of both ESR&T and SBA activities.

- Advanced systems simulation modeling environment that includes database technologies and data collection tools.

- Seamless integration of design tools, modeling tools, simulation tools, and other systems engineering tools via standards-based software interoperability.

- Novel approaches to assessing the performance, cost, or risk of proposed mission architectures.

- Techniques for characterizing and optimizing investments in Modeling and Simulation.

- Methods to extend and reuse models and simulations over the program lifecycle.

- Model-based techniques for optimizing designs in distributed, multi-organization, multi-contract design teams.