OBJECTIVE: Develop capability for rapid design of space missions that leverages new and evolving space services, commodity components, and emerging technologies. Establish and prove a rapid approach that involves specialist collaborators across multiple organizations.

DESCRIPTION: In the last several years, new developments in space access, small satellites and components, software and communications, combined with the investment of risk capital and other funding, have produced new capabilities for space services. These new services and the infrastructure that enables them have in turn created a fast-changing environment for further development. Mission planning now takes place in that dynamic context. The Air Force continues to deliver traditional capabilities but also has opportunities to do so more effectively and by wholly different approaches by exploiting and repurposing rapidly emerging space systems, services, components, and supporting infrastructure.

In previous generations, Air Force missions have been planned over extended time periods, assuming the availability of certain government assets, products and supporting services, with the government funding new developments that were required. Techniques for analyzing missions and performing trades were created and honed with each new application. Now, mission planners are presented with a fast-changing array of commercial services and unconventional mixes of commercially driven and government-driven capabilities including new technology and software-defined systems, commodity spacecraft components, small satellite buses, and launch and ground systems services. The environment is dynamic, choices are greater, and mission development, including rapid progression from concept to systems requirements to preliminary design, should adapt as well.

Given a set of needs and goals in a broad space-related area, the Air Force will benefit from a rapid capability to interpret needs and opportunities, structure candidate mission architectures, assess available and emerging services and technologies that may be relevant to solutions, and proceed systematically through trades to arrive at multiple feasible approaches. These in turn can be considered with respect to cost, schedule and risks, and the likelihood and degree of meeting goals. In most cases, the mission development capability will rapidly access and combine insight from multiple sources and companies.

Overlaps in different space-related domains have blurred the lines of simpler, focused mission development. Communications now involves GEO, MEO, and LEO over multiple wavelengths, with different antenna types and more use of relays. Satellites have greater on-board processing, increased potential for coordinated operation, more options for deployed subsystems and in-space changes. Launch services are lower cost, more frequent and agile, with emerging options for orbit insertions and transfers. Payloads are more programmable, adaptable and compact. In addition, information management for space systems increasingly leverages software-defined systems and the cloud, from data management to scheduling and operations.
Mission design should keep pace with and help manage the complexity brought by these fast-evolving developments. It is envisioned this will involve model-based design processes, techniques and methodologies to develop conceptual designs that include expedient leveraging of the best new commercially-available and open source tools. A robust but flexible approach accessing knowledge across organizations will take appropriate advantage of software-driven automation and optimization.

PHASE I: Proposal must show, as appropriate to the proposed effort, technical feasibility or nascent capability of space mission design approach and techniques that are compatible with new modes of space development and operation. Proposal may provide example results from this new and enhanced mission design capability on a specific Air Force mission area. Demonstrate reduced time from concept to system requirements, flexible use of evolving architectures and services, and increased options for Air Force programs. Identify capability gaps that slow development, inadequately capture risks, or fail to explore and evaluate feasible but unconventional architectures. FEASIBILITY DOCUMENTATION: Offerors submitting a Direct to Phase II proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility of the proposed development has been met, and to describe the potential commercial applications. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Read and follow all of the feasibility documentation portions of the Air Force 20.1 Instructions. The Air Force will not evaluate the offeror’s related D2P2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE II: Develop and enhance the rapid space mission design capability, and demonstrate the utility in several Air Force need areas for missions that are at different stages of conceptual maturity, including where conceptual development has not yet begun. Provide intermediate products to be assessed by planning teams, summarizing information that captures sensitivity of mission-level outcomes, including schedule, cost and risk, to key architecture and implementation decisions. Carry at least one mission through to system design and development, working with other performers to rapidly assess mission-level impacts of spacecraft, payload, operations, data processing and other elements.

PHASE III DUAL-USE APPLICATIONS: The contractor will pursue commercialization of the technologies developed in Phase II for potential government and commercial applications. Government applications include rapid concept development and maturation for emerging military space missions. There are potential commercial applications to space system design, and evaluation and assessment of new business ventures.

REFERENCES:


KEYWORDS: space mission design, concept development, New space, Concurrent Engineering Models, commercial space, mission planning, simulation