**Amendment 01 – no changes to this SBO document. Corrected opening submission date to March 17, 2020 in beta.sam.gov.**

**Small Business Innovation Research (SBIR) and**
**Small Business Technology Transfer (STTR)**
**Opportunity Announcement**
**HR001121S0007-03**
**Smart Model Repository (SMR)**

**Which program will fund this topic?**
SBIR
**What type of proposals will be accepted?**
Both Phase I and Direct to Phase II (DP2)

**Technology Area(s):** Information Systems
**DARPA Program:** Secure Advanced Framework for Modeling and Simulation (SAFE-SiM)

# I. INTRODUCTION

The Defense Advanced Research Projects Agency (DARPA) Small Business Programs Office (SBPO) is issuing an SBIR/STTR Opportunity (SBO) inviting submissions of innovative research concepts in the technical domain(s) of Information Systems. In particular, DARPA is interested in understanding the feasibility of a Smart Model Repository.

This SBO is issued under the Broad Agency Announcement (BAA) for SBIR/STTR, HR001121S0007. All proposals in response to the technical area(s) described herein will be submitted in accordance with the instructions provided under HR001121S0007, found here: https://beta.sam.gov/opp/d0cde4fb668d40b1982da8296d5349c0/view.

## a. Eligibility

The eligibility requirements for the SBIR/STTR programs are unique and do not correspond to those of other small business programs. Please refer to Section 3.1, Eligible Applicants, of HR001121S0007 for full eligibility requirements.

## b. Anticipated Structure/Award Information

Please refer to Section 1, Funding Opportunity Description provided in HR001121S0007 for detailed information regarding SBIR/STTR phase structure and flexibility.

If a proposer can provide adequate documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of the topic has been met and describes the potential commercial applications, the Direct to Phase II (DP2) authority allows the Department of Defense (DoD) to make an award to a small business concern under Phase II of the SBIR program without regard to whether the small business concern was provided an award under Phase I of an SBIR program. This SBO is accepting DP2 proposal submissions.

For this SBO, DARPA will accept Phase I proposals for cost of up to $225,000 for a period of performance not to exceed 9 months. All Phase I awardees will be eligible to

submit a Phase II proposal at the appropriate time during the Phase I period of performance. They will be contacted by the DARPA Small Business Programs Office via the SBIR/STTR Information Portal (SSIP) and provided with proposal submission instructions and the submission deadline. Phase II proposals will be evaluated in accordance with the applicable DoD or DARPA SBIR/STTR BAA. Phase II selection(s) are at the sole discretion of the government and are subject to funding availability and Phase I performance.

DARPA will accept DP2 proposals for cost of up to $1,500,000, for a base period not to exceed 24-months.

SBIR Phase II awardees pursuant to this BAA will not be eligible to participate in the DARPA Embedded Entrepreneur Initiative (EEI) during the Phase II Period of Performance. Refer to Section 2.6, DARPA Embedded Entrepreneur Initiative (EEI), of BAA for detailed information on EEI.

Proposers should refer to Section 4.1. Proposal Preparation Instructions, HR001121S0007 for detailed proposal preparation instructions. Proposals that do not comply with the requirements detailed in HR001121S0007 and the research objectives of this SBO are considered non-conforming and therefore are not evaluated nor considered for award.

Phase I proposals shall not exceed 20 pages. Phase I commercialization strategy shall not exceed 5 pages. This should be the last section of the Technical Volume and will not count against the 20-page limit. Please refer to Appendix A of HR001121S0007 for detailed instructions on Phase I proposal preparation.

DP2 Feasibility Documentation shall not exceed 20 pages. DP2 Technical Proposal shall not exceed 40 pages. Phase II commercialization strategy shall not exceed 5 pages. It should be the last section of the Technical Volume and will not count against the 40-page limit. Please refer to Appendix B of HR001121S0007 for detailed instructions on DP2 proposal preparation.

**c. Evaluation of Proposals**

Section 5, Evaluation of Proposals, in HR001121S0007 provides detailed information on proposal evaluation and the selection process for this SBO.

**d. Due Date/Time**

Full proposal packages (Proposal Cover Sheet, Technical Volume, Price/Cost Volume inclusive of supporting documentation, and Company Commercialization Report) must be submitted via the DoD SBIR/STTR Proposal Submission website per the instructions outlined in HR001121S0007 no later than **12:00 p.m. ET, April 20, 2021.**

## II. TOPIC OVERVIEW

**a. Objective**

Define, develop and demonstrate a simulation asset, discovery, exploration and management architecture consisting of workflows, software, and data structures, capable of ingesting a wide-variety of artifacts (data, models, documentation, algorithms, etc.), and providing users with the ability to configure assets for theater-wide, multi-domain, faster than real-time simulation assisted mission analysis.

**b. Description**

Increasingly warfighters and decision-makers need to explore future operational and technological innovation concepts in a joint, theater-wide, all-domain simulated setting supported by efficient and credible mission analysis. In this context, teams of analysts, technologists and warfighters require a theater level, multi-domain modeling and simulation environment comprised of models that capture knowledge and insights from a multi-disciplinary community covering a broad range of technical and warfighting areas. In this environment, the team conducting the analysis must be able to 1) Identify candidate/appropriate models for a given mission analysis problem, 2) Conduct assessment and classification of assembled assets and 3) Compose and configure assets to address and meet the analytic needs. However, the embodiment of the multi-disciplinary knowledge in models lacks the adequate level of attribution and explanation. This lack of attribution and traceability greatly impacts the ability of users to reuse, transform, and rapidly configure simulation architectures to support concept exploration.

To address this challenge, the Department of Defense and The North Atlantic Treaty Organization (NATO) have taken an important first step by developing a Modeling and Simulation catalogue [1] and proposing a service model to transition towards the notion of Modeling and Simulation as a Service[2]. DARPA is interested in pushing the limits of the service model by developing a "smart" model asset management prototype that 1) enables a multi-disciplinary team with operational, analysis, and technology expertise to rapidly discover, evaluate, modify, and integrate models representing kill-web architectures, platforms, systems, components and 2) allows operational units to conduct mission analysis at theater-level, multi-domain, from space to sea-floor. The proposed approach should be generalizable to support any current model asset type (data, algorithm. model, simulation) and be flexible enough to incorporate and compose future model asset types. The prototype should allow the ingestion of model asset instances and demonstrate the creation of model asset catalogues that support 1) an estimation of the time and level of effort it takes to integrate the assets in the catalogue and 2) an evaluation of the impact of adding, removing and replacing an asset to meet a mission analysis objective. The model asset management prototype, at a minimum, contains information and workflows addressing the following model attributes:

- Security:
    - Asset classification and discovery process needs to account for multiple levels of classification
- Representation:
    - Modeling techniques used in the model are exposed in a manner that is accessible to the user
    - The verification and validation process and outcome are accessible to the user

- Model Correspondence:
    - Linkages to descriptions of the referent are exposed to the user in sufficient detail
- Model Asset Suitability:
    - Asset portfolio goal specification
    - Asset to operation problem mapping
- Integration:
    - Asset integration time and level of effort estimation
- Integration Management
    - Future asset integration process
    - Interoperability and integration impact assessment

**c. Phase I**

Phase I efforts will focus on the development of a knowledge base structure that enables rapid identification of relevant models given an analytical objective. The knowledge base structure should address security, level of representation, model correspondence, suitability, integration and interoperability as well as estimation for integration.

Proposers interested in submitting a Direct to Phase II (DP2) proposal must include detailed description and demonstrated data within their proposal that demonstrates the achievement of all metrics listed in the Phase 1 metrics table.

**Metrics**

Program success will be based on achieving the following metrics:

| Type | Deliverable | Notes |
|---|---|---|
| Knowledge Structure | Documentation, data structures and associated code | Develop a knowledge structure based on the attributes described in paragraph IIb that captures the security, representation, and correspondence aspects of the model. The solution will be evaluated by its ability to represent 100 models of the performer's choosing using the knowledge-base. |
| Model Discovery | Process and workflow for rapid identification of suitable models given analytical objective | Given an analytic objective, demonstrate the ability that the Knowledge structure can be used to discover suitable models, based on the attributes described in paragraph IIb, for various inquiries from a representative repository. Threshold: 100 models within 20 seconds. Goal 1000 models within 20 seconds. |

**Schedule/Milestones/Deliverables**

- Month 1: Kickoff meeting detailing initial approaches.
- Month 3: Initial knowledge structure.

- Month 6: Breadboard demonstration of model discovery.
- Month 9: Use case demonstrating the ability for the Knowledge structure to be used to discover suitable models.

**d. Phase II**

Phase II efforts will focus on the development of a model management framework and process that 1) identifies and classifies different types of assets currently in use within DoD, 2) defines an architecture for managing future types, 3) defines an evaluation framework to identify interoperability and integration gaps and 4) defines a portfolio evaluation framework to identify and estimate the level of effort and time required to create a solution given an analytic question. The final products should be specific and actionable for advanced prototyping.

**Metrics**

Program success will be based on achieving the following metrics:

| Type | Deliverable | Metrics |
|---|---|---|
| Knowledge Structure | Taxonomy/ontology/controlled vocabulary/trained model | Can be a document, a controlled vocabulary or a more formal ontology that incorporates as a threshold the DoD M&S Community of Interest Discovery Metadata Specification (MSC-DMS) with a goal of additional taxonomy as required to enhance performance. |
| Discovery Workflows | Discovery and exploration process | Can be a process, workflow, document or prototype with a threshold of 95% precision in identifying model assets given a search string and a goal of 100%. |
| Management framework | Management process | Provide clear documentation of the framework process. Can be a process, workflow, document or prototype. Demonstrate the ability to successively ingest, classify, store and retrieve 100, 1000, and10,000 assets and provide timing benchmarks. |
| Evaluation Framework | Interoperability and integration assessment framework | Via prototype. Demonstrate the identification of interoperable models for integration purposes at a threshold of 95% precision for a given search string, and goal of 100% correctness. |
| Management Architecture | Portfolio level discovery, evaluation and management process | Via prototype. Demonstrate the discovery of a portfolio for integration purposes at a threshold of 95% precision for a given application, and goal of 100% precision over 10,000 assets. |

**Schedule/Milestones/Deliverables**

- Month 1: Kickoff meeting detailing initial approaches.

- Month 6: Enhancement of current knowledge structure.
- Month 9: Portfolio Management Prototype Architecture.
- Month 12: Demonstration of portfolio management use case with 10,000 unclassified models.
- Month 18: Demonstration of portfolio management use case with additional classified models in scenario-specific use case.
- Month 24: Demonstrate full Model Management Architecture.

**e. Dual Use Applications (Phase III)**

The algorithms developed under the sponsorship of this SBIR topic have potential applications in private industry and defense. Modeling and simulation (M&S) analysis is used by DoD industry partners to assess the performance of products within specific mission areas and environments. Smart model repository tools could be employed within proprietary flight simulator environments and mission-level industry modeling tools. The modeling and simulation aids the development of concepts of employment and also aids identification of performance gaps and/or performance improvements. The smart model repository will enable these simulations to be conducted more rapidly and more cost-effectively. In addition, the Department of Defense has invested heavily in the development of several modeling and simulation environments to include AFSIM, Next Generation Threat System and ITASE. All of these environments require an intensive manual process for the identification, collection and then integration of models and other assets in order to create a mission scenario that can be run within the M&S environment. The Smart Model Repository will create a query-based means of automating the current manual process. It is anticipated that the Smart Model Repository will rapidly provide a collection of model candidates and thereby allow more thorough mission-level analysis.

**f. References**

[1] DOD M&S catalog, last accessed, August 31, 2020
https://www.msco.mil/DoDTools/DoDEnterpriseManagementTools/MSCatalog.aspx

[2] Hannay, J. E., & van den Berg, T. (2017). The NATO MSG-136 reference architecture for M&S as a service. M&S Technologies and Standards for Enabling Alliance Interoperability and Pervasive M&S Applications (STO-MPMSG-149), Lisbon, 20-21.

**g. Keywords**

*Modeling & Simulation Technology, Computing and Software Technology, Autonomy, Decision-making, Information Assurance, Autonomy, Optimization*

## III. SUBMISSION OF QUESTIONS

DARPA intends to use electronic mail for all correspondence regarding this SBO. Questions related to the technical aspect of the research objectives and awards specifically related to this SBO should be emailed to HR001121S0007@darpa.mil. Please reference BAA HR001121S0007-03 in the subject line. All questions must be in English and must include the name, email address, and telephone number of a point of contact.

DARPA will attempt to answer questions in a timely manner; however, questions submitted within seven (7) calendar days of the proposal due date listed herein may not be answered. DARPA will post a consolidated Frequently Asked Questions (FAQ) document. To access the posting, please visit http://www.darpa.mil/work-with-us/opportunities. Under the HR001121S0007-03 summary, there will be a link to the FAQ. The FAQ will be updated on an ongoing basis until one week prior to the proposal due date.

In addition to the FAQ specific to this SBO, proposers should also review the SBIR/STTR General FAQ list at http://www.darpa.mil/work-with-us/opportunities. Under the HR001121S0007 summary, there is a link to the general FAQ.

Technical support for the Defense SBIR/STTR Innovation Portal (DSIP) is available Monday through Friday, 9:00 a.m. – 5:00 p.m. ET. Requests for technical support must be emailed to DoDSBIRSupport@reisystems.com with a copy to HR001121S0007@darpa.mil.