AIR FORCE RESEARCH LABORATORY
ROME, NEW YORK

STATEMENT OF WORK

FOR

POLICY FORMATION AND EXPLANATION USING STORIES AND ANALOGIES
(POLESTAR)

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1.0 OBJECTIVE.

1.1 The objective of this effort is to develop and demonstrate innovative approaches and techniques to enable the development of information systems that support collaborative work by cross-organizational teams of intelligence and policy analysts and operators as they develop models and simulations to aid in understanding the terrorist threat, and generate plausible alternatives/options to deal proactively with the threats.

2.0 SCOPE.

2.1 The scope of this effort is to develop, evaluate, and demonstrate the following technologies for supporting collaborative policy development: 1) A set of Groove-enabled tools for collaborative construction, evaluation, and revision of policy analyses and options, and explicit representations of the argument structures and stories that support them. 2) A scalable corporate memory of stories and arguments that is automatically populated as a side-effect of using these authoring tools, and 3) Flexible workflow management software that tracks dependencies among analysis products.

The anticipated end result is 1) an integrated software system that incorporates the above technologies, suitable for further development and integration under Total Information Awareness (TIA), and 2) evaluations and demonstrations of its application to team-based policy analysis and development.

3.0 BACKGROUND.

3.1 The goal of the TIA Program is to provide significant improvement in the ability to detect asymmetric threats to national security. TIA is an umbrella program aimed at detecting, classifying, linking, tracking, and understanding information gathered from traditional and non-traditional information sources. It is focused on bringing prototype tools and capabilities to the DoD intelligence agencies so that analysts will be better able to identify potential threats to DoD forces and to the nation. Program efforts are intended to provide a series of increasingly powerful leave-behind prototypes with a
limited number of proof-of-concept demonstrations in extremely high risk, high payoff areas. Technology areas include data repositories, collaboration, and prototype systems, as described below:

3.1.1 Data Repositories (TIA/Genisys). In the context of this program, the term repository is intended to convey a new kind of extremely large, omni-media, virtually-centralized, and semantically rich information repository that is not constrained by the limited commercial database products available today. Much of the existing database and repository technology is based on a paradigm defined in the 1980's. Today, computer processors, storage media, and networks are a thousand times more capable. The goal is to reinvent database technology consistent with today's needs and capabilities. To predict, track, and pre-empt attacks requires a full coverage repository containing all information relevant to the tasks of identifying potential terrorists and their supporters, activities, prospective targets, and operational plans. Innovative technologies to architect populate and exploit such a repository for combating terrorism will be developed under this technology area.

3.1.2 Collaboration (TIA/GENOA II). The focus of collaboration is on developing information technology needed by teams of analysts and operations and policy personnel to anticipate and preempt threats to U.S. interests. The goal is to make such teams faster, smarter, and more joint in their day-to-day operations. It will apply automation to team processes so that more information can be exploited, more hypotheses created and examined, more models built and populated with evidence, and overall, more crises dealt with simultaneously. Specific areas include: a) cognitive aids that allow humans and machines to think together in real-time about complicated problems, b) means to overcome the biases and limitations of the human cognitive system, c) cognitive amplifiers that help teams rapidly and fully comprehend complicated and uncertain situations, and d) the means to rapidly and seamlessly cut across and complement existing stove-piped hierarchical organizational structures by creating dynamic, adaptable, peer-to-peer collaborative networks.

3.1.3 Prototype Systems (TIA/TIA Systems). The TIA program will develop and integrate information technologies into fully functional, leave-behind prototypes that are reliable, easy to install, and packaged with documentation and source code (though not necessarily complete in terms of desired features) that will enable potential users to evaluate new technologies through experimentation and rapid transition to operational use. The goal is to create a series of prototype, closed-loop, end-to-end systems. Software products resulting from the two technical areas above as well as other technologies will be integrated to provide these systems.

3.2 This effort addresses the TIA technical area of Collaboration (TIA/GENOA II).
4.0 TECHNICAL REQUIREMENTS.

4.1 The contractor shall develop, evaluate, and demonstrate technology that dramatically enhances the capabilities of analyst teams to collaboratively form well-reasoned intelligence analyses and policy options in uncertain, rapidly evolving situations and participate in program review meetings, workshops, demonstrations, and collaboration.

4.1.1 Develop Basic Argument Structuring Environment.

4.1.1.1 Develop argument representations.

4.1.1.2 Extend Microsoft Word to support construction of arguments, and automatically generate formal representations of argument structure.

4.1.1.3 Provide automatic qualitative evaluation of argument structure.

4.1.1.4 Develop software to graphically display argument structures; display results of argument evaluation, e.g., by coloring nodes in the argument graph.

4.1.1.5 Make graphical visualizations editable, enabling graphical specification and editing of argument structures.

4.1.1.6 Develop abstractions of argument graphs to facilitate rapid navigation of large argument structures and help analysts focus on "active" parts of the overall structure.

4.1.2 Develop Extensions to Support Policy Formation Activities.

4.1.2.1 Semi-automatically generate PowerPoint presentations at user-selected levels of detail.

4.1.3 Develop Repository and Dependency Tracking Services

4.1.3.1 Develop COTS-based persistent repository for argument structures, with version control.
4.1.3.1.1 Monitor dependencies between different parts of an argument or story; alert user.

4.1.3.1.2 Integrate software components using Groove.

4.2 Develop Advanced Argument Structuring Environment.

4.2.1 Develop matrix interface to support individual and collaborative evaluation of arguments via Heuer's Analysis of Competing Hypotheses methodology.

4.2.1.1 Insure semi-automatic quantitative evaluation of arguments by translation into Bayesian networks.

4.2.1.1.1 Insure automatic analysis of argument sensitivity to premises, and provide graphical visualizations of these analyses.

4.2.1.2 Develop tools for exploring the implications of changes in source credibility.

4.2.1.3 Support incorporation of base rate information and correct treatment of missing evidence.

4.2.1.4 Develop a set of standard argumentation templates to support rapid construction of compelling arguments.

4.2.2 Develop Extensions to Support the Use of Analogy and Narrative.

4.2.2.1 Develop story representations.

4.2.2.2 Extend Microsoft Word to support construction of story representations that formally capture temporal and causal relations among story elements.

4.2.2.3 Develop software to graphically display story temporal and causal structure.

4.2.2.4 Extend arguments to include argument by analogy.

4.2.2.5 Develop tools for constructing analogies to stories in the story repository (or to newly constructed stories), in accordance with Neustadt and May's analysis methodologies.
4.2.2.6 Extend qualitative argument evaluation to accommodate argument by analogy.

4.2.3 Develop Collaborative Support Services

4.2.3.1 Develop corporate memory service by extending repository developed in paragraph 4.1.3 to support collaborative use; extend repository schemas to support richer representations of argument and narrative structures.

4.2.3.2 Develop simple workflow and design support tool for representing and tracking steps in the analysis process and the products developed in those steps.

4.3 Extend and Harden Support for Analogy and Narrative

4.3.1 Harden core set of authoring tools.

4.3.1.1 Integrate dialog support developed in paragraph 4.3.1.2 below.

4.3.1.2 Develop argument revision coach for identifying and repairing weaknesses in arguments

4.3.2 Extend and Harden Support for Analogy and Narrative

4.3.2.1 Extend representations and visualizations of stories to include roles, "points", etc.

4.3.2.1.1 Refine and harden representations of analogies, and authoring interfaces.

4.3.3 Develop Advanced Collaborative Support Services.

4.3.3.1 Integrate or replace COTS repository with program-wide or IAO-wide repository.

4.3.3.1.1 Provide profiles for people, organizations, and facilities, including formal representations of changes over time.

4.3.3.1.2 Provide dialog support and capture using instant messaging.

4.3.3.1.3 Extend dependency monitoring to analysis products, and alert collaborators to changes.
4.3.3.1.4 Model the decision-making process, enabling more accurate dependency tracking.

4.4 Extend and Support Integration of Argument Structuring Environment.

4.4.1 Harden and extend technologies developed.

4.4.1.1 Expand and deepen coverage of standard argumentation templates developed in paragraph 4.2.1.4 as necessary.

4.4.1.1.1 Support of argument structuring environment into a full center-edge collaboration environment.

4.4.2 Extend and Support Integration of Argument Structuring Environment.

4.4.2.1 Harden narrative representations.

4.4.2.1.1 Harden analogical representations.

4.4.2.1.2 Support integration of extensions to argument structuring environment into a full center-edge collaboration environment.

4.4.3 Extend and Support Integration of Services.

4.4.3.1 Support integration of services infrastructure into a full center-edge collaboration environment.

4.5 Extend and Support Integration of Argument Structuring Environment.

4.5.1 Harden and extend technologies developed.

4.5.1.1 Support integration of argument structuring environment into a full center-edge collaboration environment.

4.5.2 Extend and Support Integration of Argument Structuring Environment.
4.5.2.1 Harden narrative representations.

4.5.2.1.1 Harden analogical representations.

4.5.2.1.2 Support integration of extensions to argument structuring environment into a full center-edge collaboration environment.

4.5.2.2 Extend and Support Integration of Services.

4.5.2.2.1 Support integration of services infrastructure into a full center-edge collaboration environment.

4.6 Program demonstration, evaluation, and participation:

4.6.1 Demonstration and Evaluation

4.6.1.1 Work with the Genoa II Test & Evaluation contractor to define a generic test suite.

4.6.1.2 Design a tailored test suite for POLESTAR.

4.6.1.3 Conduct annual test & evaluations on the tailored test suite.

4.6.1.4 Develop demonstration scripts, document demonstration objectives and describe functions and capabilities to be demonstrated. Include concise, step-by-step instructions on how to replicate the demonstration, including the target software demonstration environment. (See CDRL, A003)

4.6.1.4.1 Provide technical evaluation of experimental results and report the results to the Genoa II Program. (See CDRL, A004)

4.6.2 Program Participation

4.6.2.1 Participate in program reviews, workshops, demonstrations, annual evaluations, and DARPA Principal Investigator (PI) meetings as specified in the contract schedule.

4.6.2.2 Collaborate and cooperate with other TIA/Genoa II contractors for: a) duplication avoidance, b) ensuring the interoperability of languages, tools, and middleware to avoid
"stovepipe" solutions, and c) ensuring the efficient planning and conduct of demonstrations of developed technology.

4.6.2.3 Conduct oral presentations at program reviews and DARPA PI meetings and workshops. Provide the status of the technical progress made to date in the performance of the contract, and the overall program direction, successes, and significant issues. (See CDRL, A002)

4.7 Deliver all computer software developed, assembled, or acquired in accordance with the contract schedule and the following.

4.7.1 Provide commented software source and executable object code for all developed software. (See CDRL, A005)

4.7.1.1 Provide the executable code to other TIA program participants for testing, evaluation, and potential integration with other components of the TIA system.

4.7.1.2 Package software releases as self-extracting installation executables.

4.7.2 Install the developed software products at Rome Research Site for demonstrating the advanced technology to prospective Air Force customers.

4.7.3 Document installation, user, and maintenance instructions for all developed software components. (See CDRL, A006)

4.7.4 Transfer all purchased and licensed software used during development or as a component for this effort upon completion; include licensing and maintenance agreements and the original media software and documentation. (See CDRL, A007)

4.7.5 Developed software shall be completely maintainable and modifiable with no reliance on any non-delivered computer programs or documentation.

4.8 Reports and Documentation
4.8.1 Continually determine the status of this effort. Provide comprehensive, yet succinct reports documenting progress toward the accomplishment of contract objectives and requirements. (See CDRL, A001)

4.8.2 Supply program documentation, such as, white papers, presentation materials, technical documents, user's instructions, and software developed under this effort to the TIA web portal.

4.8.3 Document all technical work accomplished and information gained during performance of this acquisition to permit full understanding of the techniques and procedures used in evolving technology or processes developed. Include objectives, approach, science involved and concepts employed, significant observations, problems, positive and negative results, and design criteria established. Document procedures followed, processes developed, "lessons learned", and other useful information. If applicable, cross-reference each design, engineering, and process specification delivered. (See CDRL, A008)