AIR FORCE RESEARCH LABORATORY
ROME RESEARCH SITE
ROME NEW YORK

STATEMENT OF WORK
FOR
HUMAN AUGMENTATION OF REASONING THROUGH PATTERNING (HARP)

PR No. T-3-4510

15 OCTOBER 2002

Attachment No. 1
(Contract No. F30602-03-C-0001)
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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 includes the development of: 1) faster, smarter, and more integrated structured argumentation tools that will provide analysts more time for analysis, while improving rigor and introspective thinking about the analytic process, 2) tools for structured policy development for the policy analyst, 3) an open, scalable, distributed, corporate memory of analytic methods, results and objects that capture the "habitat" of people, tools, and data, 4) a "center-edge" collaborative environment with automated process facilitation techniques that work with habitat templates that capture architecture elements of collaborative spaces.

3.0 BACKGROUND.

3.1 The goal of the Total Information Awareness (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 research, design, develop, and enhance a dynamically adaptable, productive environment for human and software collaboration in support of TIA.
4.1.1 Build upon the structured argumentation framework Critical Intent Model (CIM) developed under Genoa. Add capabilities to speed the construction of arguments (analytic results) and templates (analytic methods), improve the quality of arguments and templates through automated critical analysis, provide for the use of more sophisticated fusion methods within arguments, and manage versioning of arguments and templates.

4.1.1.1 Develop conceptual methods and processes to enable the basic suite of Veridian Team Tools to work faster and smarter.

4.1.1.2 Enhance the CIM and Structured Evidential Argumentation System (SEAS) structured argumentation tools to support more complex fusion methods such as, Bayesian, Dempster-Shafer, and fuzzy methods.

4.1.2 Expand upon the Genoa CIM and SEAS Corporate Memory (CMs) unifying them within a federated collection of CMs, making them faster and easier to build and exploit, and more heavily leveraged as a cognitive aid.

4.1.2.1 Expand upon the types of objects included and the publication and situational metadata that tags objects in CM. Add SEAS collections and new objects pertaining to structured policy formation and habitats, metadata pertaining to the temporal, spatial, and organizational aspects of the events to which they pertain. Use automatic extraction techniques to semi-automatically tag objects with this metadata.

4.1.2.2 Based upon the federated index and Genoa tools, develop sophisticated tools for finding semantically similar objects in CM and for browsing based upon the time, space, inferential dependencies, and common references among objects.

4.1.3 Provide structure and transparency for intelligence analysis.

4.1.3.1 Design and implement policy data objects that capture policy thinking and promote transparency based on a new XML-based Policy Markup Language (PML) that is compatible with AML+. The PML objects will be stored in CM and work with standard/custom viewers/Editors.
4.1.4 According to business rules and procedural scripts, build upon technologies from procedural reasoning and workflow to manage team formation, scheduling, modes of collaboration, meetings, briefings, and change detection, in both a goal directed and reactive fashion.

4.1.4.1 Develop subscription-based discovery tools that will be automatically triggered and the resulting virtual collection of results filtered and deposited within relevant analyses according to schedule, and the relevant analysts alerted to any detected changes.

4.1.5 Construct dynamic adaptable collaborative environments or "habitats."

4.1.5.1 Implement the collaborative environment using an open architecture standards implementation. Use Bots to interface Groove shared spaces with center-based server data and services (e.g. intelligent agents to interact with the center to extract useful information and bring it to the edge), along with edge services (i.e. adapters that bring center-based services to the edge) to interface peers with the web based on open standards such as XML, SOAP, UDDI, WSDL and possibly DAML.

4.1.6 Research and develop a transformational methodology for policy and intelligence analysts and decision makers to jointly participate in the development of a full range of contingencies, through rapid scenario formation, in which warning and response actions could be gamed out. The methodology shall be facilitated by the technology developed under paragraphs 4.1.1 through 4.1.5. Define the methodology for strategic policy, then for strategic intelligence, and then unify both into a single comprehensive methodology.

4.1.6.1 Research and develop a new structured methodology for policy analysis and decision making based on the integration of: a) previous work in Genoa applying scenario based planning to national security problems, and b) incorporation of IBM’s Cynefin framework.

4.2 The contractor shall develop templates, indices, and brainstorming tools to facilitate collaboration.

4.2.1 Develop brainstorming tools to aid in the early phases of template development.
4.2.2 Develop template construction facilitation tools that make suggestion for change based on similarities and differences to other templates in CM.

4.2.3 Develop a federated index, across the metadata and free text associated with objects in this heterogeneous CM. The index will be automatically maintained within a peer-to-peer framework.

4.2.4 Develop template-based policy construction tools facilitated through mining of CM.

4.2.5 Build collaborative tools for Brainstorming (including integration of Saffron-power discovery agents with Groove’s directory to identify diverse collaborators coupled with mind-mapping tools), Clustering (some based on technologies that can associate text – latent semantic indexing, Saffron-enabled discovery agents, clustering visualization maps) and Assessment/Voting.

4.2.6 Develop tools to aid in work breakdown, scheduling, and development of scripts. Develop these tools to facilitate structured meetings, inviting new participants, identifying resources, summarizing progress to date, keeping focus on the immediate tasks, and managing the frequency, size, and timing of contributions from all participants. Team formation will be assisted by tools that mine CM suggesting analysts, tools, knowledge, data, and scripts that might play useful roles based on past experience.

4.2.7 Develop an ontology for “habitats” based on an Architecture Definition Language (ADL) developed for Venice composable systems tool that captures the system’s resources and syntactic and semantic connections. Create ADL+ in XML to capture habitat evolution and store it in CM indexed in context.

4.3 The contractor shall develop new, and modify existing tools to support an automated argumentation process.

4.3.1 Develop argument construction aides to enable: a) major portions of these analytic objects to be copied and pasted, b) semi-automated discovery tool creation through the Link Analysis Workbench (LAW), c) integration of discovery tools that capture standing queries
(subscriptions) which are automatically triggered at set intervals, d) automatic filtering of discovery tool results based upon semantic content of its metadata and free text, e) automatic attachment of filtered results to arguments as potential evidence, and f) automatic answering of questions within arguments based upon the attached evidence and the credibility of its sources.

4.3.2 Develop CM export/import capabilities: expand the Argument Markup Language (AML) into AML+, drawing upon StoryML, XMB, DAML+OIL, digital library, and Dublin Core, among others.

4.3.3 Develop policy tools for Scenario Storyboarding, Scenario Story Writing, and Storytelling that leverage narrative techniques, algebraic semiotics, StoryML archetypic indexing of narratives in CM, and the PRS and SWIM process facilitation aids.

4.3.4 Modify CIM to allow sets of priorities (scenarios) to be independently saved and or loaded.

4.3.5 Develop new, or modify existing tools to enable users to search and browse XML-based habitat ontologies. These capabilities will be similar to those used for exploring structured arguments.

4.3.6 Research and develop a new methodology for tasking intelligence analysts to monitor and scan situations of interest identified utilizing the strategic policy methodology developed in paragraph 4.1.6. Provide the ability to better target information acquisition and analysis in service of active strategic policies.

4.4 The contractor shall develop analysis assessment methods and meeting management tools which support distributed collaboration.

4.4.1 Develop template critics to assess the usefulness of template questions/elements based upon their historical significance in CM with respect to current context.

4.4.2 Develop argument critics to spot conflicting interpretations of common bodies of evidence, and, based upon an analysis of the sources of evidence that support arguments, suggest
missing sources, over dependence on a common source, and attributed source credibility that falls outside of historical norms.

4.4.3 Develop a capability for automated object migration across CMs (e.g., across XMB, Groove, SEAS, CIM), based upon expanded import/export capabilities.

4.4.4 Develop tools for policy operations.

4.4.4.1 Enhance CIM with a capability for Quantified Option Assessment (QOA) to allow decision makers to select plans in adversarial situations using the best features of decision theory and game theory. Provide the capabilities to: a) allow modeling of what adversaries may and may not know, b) allow hypotheses of a series of worst case and most likely adversary threat models.

4.4.5 Develop meeting management tools to carry out the policy formation methodology as a distributed meeting where participants are temporally and spatially distributed, and where the mode of collaboration must be constantly adjusted to the prevailing goals and constraints.

4.4.6 Develop tools to view and edit habitats and to facilitate dynamic creation and evolution of habitats to enable the system to find and predictably recruit resources needed to accomplish computational and operational goals and reliably use commercial infrastructure.

4.4.6.1 Access system resource knowledge, business rules, and context metadata enabling predictable horizontal interaction (across stovepipes) and improved coordination within and among cascading habitats with allowable space-to-space interactions.

4.5 The contractor shall develop tools that support visualization of interactions, trend analysis, and modeling for evaluation.

4.5.1 Enhance version management to allow analysts to rapidly understand the relationships among different versions of arguments and templates and include tools for change detection, comparison, and merging.
4.5.2 Develop knowledge discovery techniques to spot trends, discover patterns, and detect anomalies within CM. This includes discovery tools employing perspective lenses based on archetypes and narrative techniques.

4.5.3 Develop a capability to evaluate future results of a strategy making use of models input during vulnerability assessment.

4.5.4 Develop tools, based on the same techniques in paragraph 4.4.5, to support engaged briefings that are dynamically tailored to the audience's apparent level of understanding. Watch list maintenance and out briefs shall be similarly managed.

4.5.5 Add tools and visualizations that enable users to view and manage the social aspects of interaction. Include tracking relationships of colleagues and their value, recalling conversation status, and other interactions. Visible social proxies shall be available to guide the high-level interaction. Visualizations shall expose the structure and evolution of discussions.

4.5.6 Develop a unified methodology for intelligence and policy users that: a) abstracts and identifies common elements of both the strategic policy and intelligence methodologies, and b) integrates the common and unique elements into a unified methodology. As a result, intelligence and policy will mutually drive each other, with each tasking the other based upon changing needs.

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 HARP.

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 middle-ware 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)
Identification and Assertion of Restrictions on the Government's Use, Release, or Disclosure of Technical Data or Computer Software.

The Offeror asserts for itself, or the persons identified below, that the Government's rights to use, release, or disclose the following technical data or computer software should be restricted:

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<th>Name of Person Asserting Restrictions ****</th>
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