Office Of The Secretary Of Defense (OSD)
Deputy Director Of Defense Research & Engineering
Deputy Under Secretary Of Defense (Science & Technology)
Small Business Technology Transfer Research (STTR)
FY 2007 Program Description

Introduction

The Deputy Under Secretary of Defense (Science & Technology) STTR Program is sponsoring a cognitive readiness technology theme and a materials technology theme in this solicitation.

The Army and Navy are participating in the OSD program this year. The service laboratories act as our OSD Agent in the management and execution of the contracts with small businesses. The service laboratories, often referred to as a DoD Component acting on behalf of the OSD, invite small business firms to submit proposals under this Small Business Technology Transfer Research (STTR) Program solicitation. In order to participate in the OSD STTR Program this year, all potential proposers should register on the DoD SBIR/STTR website as soon as you can, and should follow the instruction for electronic submittal of proposals. It is required that all bidders submit their proposal cover sheet, company commercialization report and their firm's technical and cost proposal form electronically through the DoD SBIR/STTR Proposal Submission Website at http://www.dodsbir.net/submission. If you experience problems submitting your proposal, call the help desk (toll free) at 1-866-724-7457. You must include a Company Commercialization Report as part of each proposal you submit; however, it does not count against the proposal page limit. Please note that improper handling of this form may result in the proposal being substantially delayed. Information provided may have a direct impact on the review of the proposal. The DoD SBIR/STTR Proposal Submission Website allows your company to come in any time (prior to the proposal submission deadline) to edit your Cover Sheets, Technical and Cost Proposal and Company Commercialization Report.

We <u>WILL NOT</u> accept any proposals that are not submitted through the on-line submission site. The submission site does not limit the overall file size for each electronic proposal, there is only a page limit. However, file uploads may take a great deal of time depending on your file size and your internet server connection speed. If you wish to upload a very large file, it is highly recommended that you submit prior to the deadline submittal date, as the last day is heavily trafficked. You are responsible for performing a virus check on each technical proposal file to be uploaded electronically. The detection of a virus on any submission may be cause for the rejection of the proposal. We will not accept e-mail submissions.

Firms with strong research and development capabilities in science or engineering in any of the topic areas described in this section and with the ability to commercialize the results are encouraged to participate. Subject to availability of funds, the DUSD(S&T) STTR Program will support high quality research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector. Objectives of the DUSD(S&T) STTR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research and development results. The guidelines presented in the solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD and the private sector.

Description of the OSD STTR Three Phase Program

Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under the STTR Program and will typically be one half-person year effort over a period not to exceed six months, with a dollar value up to $100,000. We plan to fund 3 Phase I contracts, on average, and downselect to one Phase II contract per topic. This is assuming that the proposals are sufficient in quality to fund this many. Proposals should concentrate on that research and development which will significantly contribute to proving the scientific and technical feasibility of the proposed effort, the successful completion of which is a prerequisite for further DoD

support in Phase II. The measure of Phase I success includes technical performance toward the topic objectives and evaluations of the extent to which Phase II results would have the potential to yield a product or process of continuing importance to DoD and the private sector, in accordance with Section 4.3.

Subsequent Phase II awards will be made to firms on the basis of results from the Phase I effort and the scientific and technical merit of the Phase II proposal in addressing the goals and objectives described in the topic. Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). Phase II is the principal research and development effort and is expected to produce a well defined deliverable prototype or process. A more comprehensive proposal will be required for Phase II.

Under Phase III, the DoD may award non-STTR funded follow-on contracts for products or processes, which meet the component mission needs. This solicitation is designed, in part, to encourage the conversion of federally sponsored research and development innovation into private sector applications. The small business is expected to use non-federal capital to pursue private sector applications of the research and development.

This solicitation is for Phase I proposals only. Any proposal submitted under prior STTR solicitations will not be considered under this solicitation; however, offerors who were not awarded a contract in response to a particular topic under prior STTR solicitations are free to update or modify and submit the same or modified proposal if it is responsive to any of the topics listed in this section.

For Phase II, no separate solicitation will be issued and no unsolicited proposals will be accepted. Only those firms that were awarded Phase I contracts, and have successfully completed their Phase I efforts, will be invited to submit a Phase II proposal. Invitations to submit Phase II proposals will be released at or before the end of the Phase I period of performance. The decision to invite a Phase II proposal will be made based upon the success of the Phase I contract to meet the technical goals of the topic, as well as the overall merit based upon the criteria in section 4.3. DoD is not obligated to make any awards under Phase I, II, or III. DoD is not responsible for any money expended by the proposer before award of any contract. For specifics regarding the evaluation and award of Phase I or II contracts, please read the front section of this solicitation very carefully. Every Phase II proposal will be reviewed for overall merit based upon the criteria in section 4.3 of this solicitation, repeated below:

a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c. The potential for commercial (defense and private sector) application and the benefits expected to accrue from this commercialization.

In addition, the OSD STTR Program has a Phase II Plus Program, which provides matching STTR funds to expand an existing Phase II contract that attracts investment funds from a DoD acquisition program, a non-SBIR/non-STTR government program or Private sector investments. Phase II Plus allows for an existing Phase II OSD STTR contract to be extended for up to one year per Phase II Plus application, to perform additional research and development. Phase II Plus matching funds will be provided on a one-for-one basis up to a maximum $500,000 of STTR funds. All Phase II Plus awards are subject to acceptance, review, and selection of candidate projects, are subject to availability of funding, and successful negotiation and award of a Phase II Plus contract modification. The funds provided by the DoD acquisition program or a non-SBIR/non-STTR government program must be obligated on the OSD Phase II contract as a modification prior to or concurrent with the OSD STTR funds. Private sector funds must be deemed an “outside investor” which may include such entities as another company, or an investor. It does not include the owners or family members, or affiliates of the small business (13 CFR 121.103).

The Fast Track provisions in section 4.0 of this solicitation apply as follows. Under the Fast Track policy, STTR projects that attract matching cash from an outside investor for their Phase II effort have an opportunity to receive interim funding between Phases I and II, to be evaluated for Phase II under an expedited process, and to be selected for Phase II award provided they meet or exceed the technical thresholds and have met their Phase I technical goals, as discussed in Section 4.5. Under the Fast Track Program, a company submits a Fast Track application, including statement of work and cost estimate, within 120 to 180 days of the award of a Phase I contract

(see the Fast Track Application Form on www.dodsbir.net/submission). Also submitted at this time is a commitment of third party funding for Phase II. Subsequently, the company must submit its Phase I Final Report and its Phase II proposal no later than 210 days after the effective date of Phase I, and must certify, within 45 days of being selected for Phase II award, that all matching funds have been transferred to the company. For projects that qualify for the Fast Track (as discussed in Section 4.5), DoD will evaluate the Phase II proposals in an expedited manner in accordance with the above criteria, and may select these proposals for Phase II award provided: (1) they meet or exceed selection criteria (a) and (b) above and (2) the project has substantially met its Phase I technical goals (and assuming budgetary and other programmatic factors are met, as discussed in Section 4.1). Fast Track proposals, having attracted matching cash from an outside investor, presumptively meet criterion (c). However, selection and award of a Fast Track proposal is not mandated and DoD retains the discretion not to select or fund any Fast Track proposal.

Follow-On Funding

In addition to supporting scientific and engineering research and development, another important goal of the program is conversion of DoD-supported research and development into commercial products. Proposers are encouraged to obtain a contingent commitment for private follow-on funding prior to Phase II where it is felt that the research and development has commercial potential in the private sector. Proposers who feel that their research and development have the potential to meet private sector market needs, in addition to meeting DoD objectives, are encouraged to obtain non-federal follow-on funding for Phase III to pursue private sector development. The commitment should be obtained during the course of Phase I performance. This commitment may be contingent upon the DoD supported development meeting some specific technical objectives in Phase II which if met, would justify non-federal funding to pursue further development for commercial purposes in Phase III. The recipient will be permitted to obtain commercial rights to any invention made in either Phase I or Phase II, subject to the patent policies stated elsewhere in this solicitation.

Contact with DoD

General informational questions pertaining to proposal instructions contained in this solicitation should be directed to the topic authors and point of contact identified in the topic description section. Proposals should be electronically submitted. Oral communications with DoD personnel regarding the technical content of this solicitation during the pre-solicitation phase are allowed, however, proposal evaluation is conducted only on the written submittal. Oral communications during the pre-solicitation period should be considered informal, and will not be factored into the selection for award of contracts. Oral communications subsequent to the pre-solicitation period, during the Phase I proposal preparation periods are prohibited for reasons of competitive fairness. Refer to the front section of the solicitation for the exact dates.

Proposal Submission

Proposals shall be submitted in response to a specific topic identified in the following topic description sections. The topics listed are the only topics for which proposals will be accepted. Scientific and technical information assistance may be requested by using the SBIR/STTR Interactive Technical Information System (SITIS).

It is required that all bidders submit their proposal cover sheet, company commercialization report and their firm's technical and cost proposal form electronically through the DoD SBIR/STTR Proposal Submission Website at http://www.dodsbir.net/submission. If you experience problems submitting your proposal, call the help desk (toll free) at 866-724-7457. You must include a Company Commercialization Report as part of each proposal you submit; however, it does not count against the proposal page limit. Please note that improper handling of this form may result in the proposal being substantially delayed. Information provided may have a direct impact on the review of the proposal. The proposal submission website allows your company to come in any time (prior to the proposal submission deadline) to edit your Cover Sheets, Technical and Cost Proposal and Company Commercialization Report. We **WILL NOT accept any proposals which are not submitted through the on-line submission site.** The submission site does not limit the overall file size for each electronic proposal, only the number of pages are limited. However, file uploads may take a great deal of time depending on your file size and your internet server connection speed. You are responsible for performing a virus check on each technical proposal

file to be uploaded electronically. The detection of a virus on any submission may be cause for the rejection of the proposal. We will not accept e-mail submissions.

The following is a summary of the technology areas, which are followed by the topics.

Cognitive Readiness Technology Focus Area: Understanding the Social, Cultural, and Political Landscape

The successful accomplishment of U.S. national objectives, not just combat objectives, requires US military planners to plan, prepare and conduct operations across many levels of conflict/warfare. When the military deals directly with another nation, area of regard or international coalition, the overall interaction must be framed in the context of the political, military, economic, social, information, and infrastructure. This context directly influences the U.S. government's options (diplomatic, infrastructure, military or economic (DIME), the military's role, and the interagency/intergovernmental relationships within the chosen option(s). Military operational units and the tools that support military planning and execution must be capable of understanding and modeling the effects of humans and human institutions. Social, cultural and geo-political knowledge and models can help define appropriate subordinate objectives and activities for accomplishing National Security goals. The objectives span military strategic and operations planning, military force design, and the development of effective doctrine, tactics, techniques and procedures for accomplishing those objectives. These models and tools also can enable commanders to explore and develop effective integration of shaping activities with those of the kinetic battlefield.

These topics will develop technologies that can be used to develop relevant models that provide new military-relevant capabilities in understanding the social, cultural, and political landscape and how that landscape shapes the ultimate outcome of our combat and non-combat operations. The challenge is to develop both the understanding and framework necessary to improve our ability to plan and prosecute operations in complex geo-political environments.

The following topics are in the Cognitive Readiness Technology Area:

OSD07-T001	Automation of Strategic Planning Frameworks (Army)
OSD07-T002	Measuring and Mapping Political Will (Army)
OSD07-T003	Development of Systems Architecture for Stake-Holder Asset-based Planning Environment (Army)
OSD07-T004	Training Soldiers to Decode Nonverbal Cues in Cross-Cultural Interactions (Army)
OSD07-T005	Asymmetric Adversaries for Synthetic Training Environments (Navy)

Materials Technology Focus Area: Materials for Energy and Power Security

Improvements in electric power will enable transformational new military capabilities. Power can be freed on ships, aircraft, and other platforms for use in advanced weapon and survivability systems, as well as significant enhancements in system flexibility. Potential life cycle and acquisition savings can be had by reducing fuel requirements, maintenance, personnel, logistics, and inventory. All services can benefit from more efficient power and heating/cooling concepts for fixed and deployable bases from both conventional and renewable energy sources. Technologies that improve fuel efficiency, provide energy from alternate sources and increase platform efficiency provide enhanced energy security through reduced dependence on fossil fuels. OSD is extending its emphasis in this area by focusing in this STTR solicitation on advanced materials research and options for novel fuel cells that can convert hydrocarbon fuels at significantly lower temperatures than traditional solid-oxide fuel cells.

The following topic is in the Materials Technology Area:
OSD07-T006 Advanced Solid-Oxide Fuel Cell Technology (Navy)

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OSD STTR 07 Topic Descriptions

OSD07-T001 TITLE: Automation of Strategic Planning Frameworks

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Provide US military planners and their USG Interagency partners with an automated capability to employ the principles and framework described in the USG Draft Planning Framework for Reconstruction, Stabilization and Conflict Transformation, USJFCOM J7 Pamphlet, version 1.0, 1 December 2005 as well as the Essential Tasks List, April 2005 [1, 2].

DESCRIPTION: The successful accomplishment of US national objectives, not just combat objectives, requires US military planners to plan, prepare and conduct operations across many levels of conflict/warfare. DoD Directive 3000.05 signed 28 November 2005, mandates that: "U.S. military forces shall be prepared to perform all tasks necessary to establish or maintain order when civilians cannot do so." Concerted efforts on the part of USJFCOM and the US Department of State's, Office of the Coordinator for Reconstruction and Stabilization produced two documents of immense value to both US Government and Military Planners - the Draft Planning Framework and the Essential Tasks List. Together these documents provide a comprehensive approach to establish US policy, strategy and to identify tasks that will accomplish the strategy. An automated capability is necessary to provide strategic and operational planners with the systematic approach represented in these documents to rapidly categorize and translate USG objectives into sound, executable strategies and tasks. The development of an automated capability provides a unique opportunity to facilitate planning processes that are geographically and organizationally disparate. The development of such a tool would enable exploration of collaborative work systems that promote organizational interoperability and mobility of the planning process. In addition, the planning framework will benefit from basic software applications, such as macro forms, to improve user-friendliness and to decrease the burden on planning staff.

PHASE I: Develop both the Draft Planning Framework Document and the Essential Task List into an easily understood and useable application/tool for planners to rapidly enter overarching policy goals, establish strategies and develop plans to achieve those goals (Major Mission Elements) and then select individual tasks that define each Major Mission Element in "pull-down" fashion from the Essential Tasks List. Investigate and evaluate methodologies and approaches used by multinational corporations and international organizations, other national governments or other agencies/activities that are geographically and organizationally separated.

PHASE II: Update the application/tool developed during Phase I to incorporate valuable and salient features of other approaches discovered in other approaches, into multiple versions if judicious. Employ both Phase I and Phase II prototype tools in JFCOM sponsored exercises such as the Unified Action series and Multinational Exercise 5 series to provide user feedback and spiral development of the tool.

DUAL USE COMMERCIALIZATION: Has USG-wide and possibly Multination and International application (United Nations, NATO).

REFERENCES:
1. USG Draft Planning Framework for Reconstruction, Stabilization and Conflict Transformation, USJFCOM J7 Pamphlet, version 1.0, 1 December 2005, http://www.dtic.mil/doctrine/jel/other_pubs/jwfcpam_draft.pdf

2. S/CRS Essential Tasks List, April 2005, http://www.state.gov/documents/organization/53464.pdf

KEYWORDS: Strategic planning, Reconstruction, Stabilization, Human, Social, Cultural

OSD07-T002 TITLE: Measuring and Mapping Political Will

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Design, develop and test a dynamic analytical tool for determining the presence, absence and/or degree of political will for reform and collaboration with the USG in democratization, counter-insurgency and counter-terrorism efforts within governments and/or leadership elites of crisis prone states. Develop a web-enabled/deployable training methodology and product to be used by USG policy-makers and DoD operational field leaders to learn how to apply the dynamic analytical tool in specific countries.

DESCRIPTION: In environments that are unstable, the DoD is often at the forefront of USG efforts to stabilize local and regional populations. Operational and tactical military leaders may find themselves to be the primary interface with a country's political leaders. Gauging willingness of those political leaders to collaborate with the USG on counter-insurgency, counter-terrorism and stabilization operations/objectives is critical to U.S. success in these programs. This willingness to collaborate with the USG, specifically in efforts to reform the politico/economic environment, is what is referred to as political will.

The literatures of democratization, counter-insurgency, and counter-terrorism are replete with the centrality of political will to successfully accomplishing our national objectives. It is identified as a threshold variable in determining the relationship between the USG and foreign government counterparts. Political will is derived from the support of the people, and is vital to successful accomplishment of USG objectives and therefore of vital interest to strategic and operational leaders. Moreover, current planning efforts within both the civilian and military agencies of the USG depend on the presence of political will for establishing strategies for dealing with insurgency, terrorism and democratization. For example, current efforts of the OSD ("Ungoverned Areas") and the National Security Council ("Safe Havens Strategy") begin with an initial threshold question, "Does the state have political will?"

Political will is often posed in this way – i.e. as a binary variable; counterpart governments in subject states are assumed to either have, or not have it. It is typically discussed as though the government, or leadership, of the subject state is monolithic. Analyses of political will generally seem to assume that once a determination is made, it can be treated as a constant. However, this over-simplification creates a number of extreme vulnerabilities, and leads to the likelihood of miscalculation in determining the appropriate relationship with a host-government counterpart. The miscalculation of such a key variable can easily result in significant waste of resources, effort and time, and even counterproductive outcomes.

Military and other planners traditionally make instinctive assumptions about the presence or absence of political will based on a variety of subjective factors. Until now no objective framework for determination has been developed or applied. The result is that major decisions regarding collaboration, information sharing, funding and planning are based almost exclusively on individual idiosyncracy, without taking into account historical or collective experience. As defined in JP 1-02, DoD Dictionary of Military Terms, an assumption is: "A supposition on the current situation or a presupposition on the future course of events, either or both assumed to be true in the absence of positive proof, necessary to enable the commander in the process of planning to complete an estimate of the situation and make a decision on the course of action." (e.g. following the conclusion of armed military conflict the population will embrace democratic ideals). Planner's can't actually confirm that is the case without reliable polling data, but through expert opinion and other methods they strongly suspect its validity. Based on an assumption that the environment (political will) will be more benign than contested, the military planner may assign fewer resources at their disposal to population control/security tasks than if the reverse were true. A capability to dynamically assess the impact of political will on national/ military objectives would be of enormous value to USG planners in that it would allow for more efficient/effective allocation of USG resources/efforts.

This research project will de-construct and unpack the concept of political will into its constituent elements. The reduction of political will to a binary variable misses the tremendous array of intermediary positions between the poles of presence or absence. The project will establish a full spectrum of gradients between the two extremes based on the level of intensity of political will. This will enable policy-makers and field leaders to gauge just how much political will their counterparts possess. With respect to the monolithic character of regimes, even the most autocratic regimes are not entirely monolithic – there are always elements within a regime which favor reform. The study will therefore develop a mapping methodology to help determine the universality of political will - which sub-components of host country regime possess political will for reform and collaboration. Finally the project will develop a dynamic component to measure the propensity to variation in political will, or its robustness, based on behavior and fact patterns.

PHASE I: Design the analytic framework for a nuanced determination of critical 'political will' factors within regimes that directly influence stabilization operations and other military-relevant missions and outcomes. Metrics for measuring political will are to be developed, along with the capability to model dynamic changes in the political will dimension that may occur within a given regime.

PHASE II: Develop and refine the framework using empirical validation to clarify relationships between gradients of political will intensity and actual behavior. Use the same historical cases to validate the behavior and fact patterns. Establish overall validity of the dynamic analytic tool through selected testing.

PHASE III: Design and develop modular deployable training program to enable policy-makers and field-based leaders to apply the dynamic analytic tool appropriately and utilize the methodology effectively.

DUAL USE COMMERCIALIZATION: The political will concept could be designed at multiple levels and has potentially wide applicability USG-wide, Multination and International governments and industries.

REFERENCES:
1. Brinkerhoff, Derick W., with assistance from Nicolas P. Kulibaba, "Identifying and Assessing Political Will for Anti-Corruption Efforts," (1999).

2. Blair, Harry and Gary Hanson, "Weighing in on the scales of justice: Strategic approaches for donor-supported rule of law programs," (1994).

3. Turvey, Brent E., "Criminal Profiling: An Introduction to Behavioral Evidence Analysis," (2002).

KEYWORDS: political will, political support, governmental support, political commitment, leadership attitude

OSD07-T003 TITLE: Development of Systems Architecture for Stake-Holder Asset-based Planning Environment

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Development of a systems architecture for operational commanders that incorporates participatory and asset-based community development methodologies for urban areas in support of national/strategic objectives.

DESCRIPTION: The mission of DoD in the Global War on Terror has gone far beyond the traditional warfighting role. The DoD mission areas within Stability Security Transition and Reconstruction (SSTR) requires both strategic and operational understanding all of the factors that influence the actions of friendly and neutral populations in the area of operations. The community development strategists and theorists have advanced methodologies incorporating the "principle that a community can be built only by focusing on the strengths and capacities of the citizens and associations that call the community home." [1] These methodologies could be applied to situations in partner nations of interest to the US government. The asset-based analysis identifies existing resources and assets, indigenous desires and perceptions, enablers – including individuals who can serve in a catalytic role -, existing positive feedback loops and opportunities for future positive feedback loops, and measures of the intended target environment's receptiveness to assistance. Assets are broadly defined and multidimensional, and include financial, human, physical (both man-made and natural), social and political assets. The methodology is inherently participatory [2, 3] and seeks to help communities identify and leverage local assets to create jobs, social capabilities and structures, and sustainable economic markets appropriate for the local environment. Rural areas are the focus of most of the development techniques; however, the move to urban areas in recent history is well documented. The responders will investigate the viability of asset-based development methodologies, translate the salient features to urban environments, design and develop a system architecture that embraces the principles by identifying interacting component software modules, investigate display attributes and data structures, and create a demonstration capability for local applications.

PHASE I: Following completion of an extensive literature review to identify/leverage other on-going related methods/efforts, translate rural techniques/methodologies to urban environments. Design a system architecture that supports the principles and methodologies documented by the asset-based development community for participatory activities. Incorporate social risk management concepts and techniques [4]. Investigate and document interactive display/visualization attributes and data structures. Identify and design the system and component modules for the interactive web-based architecture.

PHASE II: In partnership with the US Army Corps of Engineers and other government participants, develop and demonstrate a capability utilizing open-architecture and enterprise techniques that is web-enabled using industry and government standards for web applications. Adjust the system as required based on customer feedback. Provide training modules and documentation for utilization by those unacquainted with the techniques and methodologies. Demonstrate the capability in a small (<50,000 people) local environment to be identified by the government.

DUAL USE COMMERCIALIZATION: Has non-governmental, municipality, USG-wide and International Organization (World Bank, African Union) application.

REFERENCES:
1. Kretzmann, John P., and John L. McKnight, "A Guide to Evaluating Asset-based Community Development: Lessons, Challenges, and Opportunities," ACTA Publications, Chicago, IL, 1997.

2. Kretzmann, John P., and John L. McKnight, "Building Communities from the Inside Out," ACTA Publications, Chicago, IL, 1993.

3. Hickey, Samuel and Giles Mohan (editors), "Participation – from Tyranny to Transformation?" Zed Books LTD, 2004.

4. Siegel, Paul B. and Jeffery Alwang, "An Asset Based Approach to Social Risk Management," Social Protection Advisory Service, The World Bank. 1999.

KEYWORDS: Development, Reconstruction, Stabilization, Human, Social, Cultural

OSD07-T004 TITLE: Training Soldiers to Decode Nonverbal Cues in Cross-Cultural Interactions

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Develop a computer-based training tool to improve Soldiers' ability to decode nonverbal behavior in cross-cultural interactions.

DESCRIPTION: The course of events in Iraq and Afghanistan has emphasized the role of human rather than technological solutions in influencing the outcome of conflicts, making interpersonal skills an increasingly important set of tools for the warfighter (Scales, 2006). Counterinsurgency, information operations, and stability operations require a high level of interaction with the local population, and in order for these interactions to yield useful intelligence or to facilitate identification of insurgents, Soldiers must have effective communication skills. As a result, greater resources have been allocated to developing proficiency in Middle Eastern languages. However, much of communication occurs through nonverbal channels, especially when language skills are minimal or absent. Recognition and accurate interpretation of others' nonverbal behavior is needed is needed to identify opportunities to influence an individual or situation, such as civil affairs units seeking the cooperation of local leaders, or to discriminate hostile from friendly or neutral intent, such as infantry units operating security checkpoints. The cross-cultural nature of these interactions increases the likelihood of error, due to lower accuracy in cross-cultural emotion recognition (Elfenbein & Ambady, 2002a) and the tendency to apply ethnocentric interpretations of behavior.

The training goal is to prepare Soldiers to interpret and predict behavior more accurately in cross-cultural environments. Training should address the role of culture in nonverbal communication, identifying aspects of nonverbal communication that are universal, such as expression of emotion (Elfenbein & Ambady, 2002b), and aspects of NVC that are culture-specific, such as display rules, emblems, illustrators, and regulators (Ekman &

Friesen, 1969). The culture-specific aspect of training should target a culture in the Middle East. Training should include nonverbal cues in multiple channels (e.g., vocal cues, kinesics) and describe circumstances under which certain channels are more reliable than others. Training should be computer-based and interactive, requiring student response and feedback. Training should not only identify reliable nonverbal cues, but also identify behaviors that may be commonly misinterpreted due to cultural differences. Particular attention should be paid to cues that can be observed from a distance, as observing facial expression may not always be practical when assessing a target for hostile intent and such behaviors are less consciously regulated than facial expressions (Ekman & Friesen, 1974). All training software/systems must be ADL/SCORM compliant.

PHASE I: The objective of Phase I is to develop the concept for the training approach. The contractor should determine which nonverbal behaviors serve as reliable cues and which nonverbal behaviors are likely to elicit misinterpretation. Describe universal and culture-specific nonverbal cues and identify methods for teaching the interpretation of those cues in a specific Middle Eastern culture.

PHASE II: Develop and validate an interactive, computer-based training tool to increase Soldiers' accuracy in decoding nonverbal cues in cross-cultural contexts. Training should include a universal module and a culture-specific module, focused on the culture identified in Phase I. Training must comply with Sharable Content Object Reference Model standards.

PHASE III DUAL USE APPLICATIONS: Modifications to the culture-specific module would result in a training system applicable to a range of cultures. This training could be marketed in a variety of military and civilian contexts in which individuals must routinely engage in cross-cultural interactions. This training could serve as a complement to language training or as stand-alone training for individuals who are not fluent in the language of the local population.

REFERENCES:
1. Ekman, P., & Friesen, W. (1969). The repertoire of nonverbal behavior: Categories, origins, usage, and coding. Semiotica, 1, 49-98.

2. Ekman, P., & Friesen, W. (1974). Detecting deception from the body or face. Journal of Personality and Social Psychology, 29, 288-298.

3. Elfenbein, H. A., & Ambady, N. (2002a). Is there an ingroup advantage in emotion recognition? Psychological Bulletin, 128, 243-249.

4. Elfenbein, H. A., & Ambady, N. (2002b). On the universality and cultural specificity of emotion recognition: A meta-analysis. Psychological Bulletin, 128, 203-235.

5. Scales, R. (July 2006). Clausewitz and World War IV. Armed Forces Journal. http://www.armedforcesjournal.com/2006/07/1866019/

OSD07-T005 TITLE: Asymmetric Adversaries for Synthetic Training Environments

TECHNOLOGY AREAS: Human Systems

ACQUISITION PROGRAM: PEO TRASYS (USMC)

OBJECTIVE: Research, design, implement and evaluate an innovative approach for providing asymmetric tactics and strategies for adversaries in synthetic training environments

DESCRIPTION: Recent events in the Middle East and abroad have clearly illustrated the effectiveness of non-traditional, asymmetric tactics against traditional military forces such as those of the US and her allies. There is little debate as to whether or not this asymmetric threat is viable enough to reexamine the way our military prepares for combat [Cassidy, 2003]. However, even the most recent advances in military simulations continue to place a heavy emphasis on second and third-generation conflict (fought by nation-states, highlighted by conflicts of the 19th

century and the two World Wars). Whereas those conflicts entailed decisive victories and defeats, such closure does not exist in wars of an asymmetric nature – referred to as 'dark war' or 'war in shadows' [Sloan, 2001]. Because of this, these simulations are simply not effective at preparing soldiers for the less-predictable, high-impact tactics and strategies employed by the enemies of today. Opponent models of behavior within these simulations tend to imitate the behaviors of traditional military forces, creating a training environment where exercises emerge as nothing more than war-games of 'blue versus blue' rather than 'red versus blue' [Cruz, 2001].
This research will produce software that can dynamically create asymmetric threat tactics and generate behavior in a simulation-based training environment. This system will enable warfighters to train a particular task (e.g. convoy commander operations) by conducting drills in the environment against dynamic, non-scripted asymmetric adversaries. These adversaries will be capable of generating and implementing tactics and reacting to the actions of the trainee during execution. These tactics must target weaknesses and vulnerabilities of the trainee's forces and tactics. The adversary tactics will adapt to the trainee's forces and tactics over repeated exercises.

PHASE I: Identify a target domain and simulation-based training environment in which to demonstrate asymmetric tactic generation. Research and produce a preliminary design of an asymmetric behavior generation system. Collaboration with subject-matter experts versed in asymmetric behavior is strongly encouraged.

PHASE II: Generate a prototype implementation of the asymmetric behavior generation system, using the domain and training environment identified during Phase I. Demonstrate the capability of the system to produce effective tactics when exercised against a trainee in repeated runs.

PHASE III: In the final phase, the technology will be transitioned to applications in the commercial sector and to the relevant Marine Corps systems (PM TRASYS and TECOM).

PRIVATE SECTOR COMMERCIAL POTENTIAL: The generation of an asymmetric adversary modeling system could be applied to a variety of domains and platforms not only for training, but also for assisting strategy generation and analysis. Commercial war-gaming applications of such a system are also prevalent, as many of today's conflict-related titles center around asymmetric opponent behavior. The ability to dynamically generate such tactics is also directly applicable to the area of homeland security. Our ability to anticipate future terrorist threats could allow governments to more effectively preempt future attacks.

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KEYWORDS: Asymetric adversaries, asymmetric tactics, human behavior modeling, simulation for training

OSD07-T006 TITLE: Advanced Solid-Oxide Fuel Cell Technology

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop and demonstrate materials, processes, and design concepts for portable, moderate-temperature solid-oxide fuel cells.

DESCRIPTION: Traditional solid-oxide fuel cells operate at high temperatures, generally in the range 800-1000 degrees Celsius. At these temperatures the fuel cells can effectively catalyze hydrocarbon fuels and operate at high thermodynamic efficiency through the secondary use of otherwise waste heat. Unfortunately, these high temperatures also place great demands on the fuel cell anodes, cathodes, and all supporting structures, requiring

exotic and expensive high temperature ceramics for active components and supporting structures and generally high temperature alloys and complex protective schemes for other primary and secondary structures. Furthermore, because of these very high internal temperatures and the fragile nature of both active materials and supporting structures, solid-oxide fuel cells have been primarily developed for stationary power generation in which cell life and overall safety can be better ensured.

Low temperature solid-oxide fuel cells operating at or below 550 degrees Celsius are desirable. This may be achieved by using select catalysts, proton-conducting or electron-conducting solid electrolytes, and anode or cathode materials that are capable to operate with fuels that have a range of sulfur and/or carbon dioxide contamination. Understanding mechanisms that control oxidation or reduction reaction rates in electrode materials and ion transport in electrolytes are key to this development. If alternative materials for anodes and cathodes that permit lower temperature operation can be developed and coupled with innovative structural design, then solid-oxide fuel cells would be candidates for portable power in Defense and commercial systems, using a wide variety of hydrocarbon fuels either directly or upon reforming. Defense potential includes power for silent watch, remote sensor systems, more compact secondary power for vehicles and subsystems, and potentially an alternative to diesel or turbine generator sets.

PHASE I: Show feasibility of applying advanced materials and processes in conjunction with innovative design to demonstrate a solid-oxide fuel cell capable of operation at 550 degrees Celsius or less.

PHASE II: Develop and demonstrate a prototype solid-oxide fuel cell capable of producing power for at least 500 hours of continuous operation and 100 cold start cycles.

PHASE III DUAL USE APPLICATIONS: This technology would provide an alternative in efficient portable power to polymer electrolyte membrane fuel cells that could burn complex hydrocarbon fuels more effectively. Such systems would have applications in powering portable electronic devices, isolated sensor systems, transmitters, and emergency power. Lower temperature operation would permit utilization in residential or light commercial applications that currently require costly stationary systems. Phase III options would include scale-up to logistically useful power generation outputs and tailoring for incorporation in specific systems or subsystems.

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KEYWORDS: fuel cell, solid oxide, ceramic, hydrocarbon fuel