U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND SOLDIER CENTER

BROAD AGENCY ANNOUNCEMENT (BAA) FOR BASIC AND APPLIED RESEARCH

Solicitation Number W911QY-20-R-0022

Effective from 28 February 2025 - 27 February 2030

"THE LEADER IN EMPOWERING THE WORLD'S MOST CAPABLE SOLDIERS"

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SECTION I - INTRODUCTION

The mission of the U.S. Army Combat Capabilities Development Command Soldier Center (DEVCOM Soldier Center) is to "provide the Army with innovative science and technology solutions to optimize the performance of our Soldiers". The DEVCOM Soldier Center is the Soldier's research center – ensuring dominance through superior scientific and engineering expertise across the following core competencies:

- Aerial Delivery
- Army Training Technology
- Individual/Collective Protection
- Material Science – Fiber/Textile
- Military Nutrition/Food Service Logistics
- Soldier Performance/Integration

In terms of future capabilities, the Army of 2040 is driven by an evolving threat landscape, which means that Soldier Center's core competencies will adapt in character (based on threat) to demonstrate viable solutions to some of the most challenging problems that will face the Soldier and Small Unit in the Future Operating Environment:

- **Multidomain Concealment – Offsetting Vulnerabilities/Invisible Soldier**
- How does the Army disrupt the adversary's kill chain by delaying and degrading detection by the enemy on a transparent battlefield across the electromagnetic spectrum?
- **Sustaining Distributed Operations - Small Unit Logistics at the Edge**
- How does the Army keep small units resupplied in a distributed and contested environment?
- **Unburden & Enable the Soldier/Squad - Enabled Soldier**
- How does the Army optimally equip and protect Soldiers as an integrated weapon system and the squad as an integrated combat platform?

Advancing critical capabilities in these threat-based problem areas will position the Soldier/small unit to have an advantage in a future conflict against a peer adversary.

To achieve the advances in required capabilities, Soldier Center is particularly interested in efforts along five research focus areas, which were identified and informed by how the Army may operate, organize, and equip in 2040. These are:

- Emergent Materials
- Human Performance and Training
- Machine Learning/Artificial Intelligence
- Robotics and Autonomy
- Synthetic Biology

This Broad Agency Announcement (BAA) is intended to fulfill requirements for scientific study and experimentation directed toward advancing state-of-the-art technologies and/or increasing knowledge and understanding as a means of eliminating current technology barriers. This BAA DOES NOT focus on specific systems or hardware solutions. *This BAA identifies DEVCOM SOLDIER CENTER research/exploratory development areas of interest and provides prospective offerors information on the preparation of proposals along with proposal evaluation factors. The Government may award purchase orders, contracts, grants, cooperative agreements, or other transactions against this BAA.*

Please note that, typically, research resulting from work executed under this BAA leads to an additional requirement for services being provided by the applicable contractor in support of operational experiments to evaluate the measures of merit and performance enhancement capability to the Warfighters. However, it is not possible at the time of release of this announcement, or at the time of contract award, to accurately anticipate if these services will be required, nor is it possible to anticipate the level of effort required. In addition, the technology explored under this BAA typically has application across the various branches of the Department of Defense (DoD). In order to satisfy the unique needs of these different branches and to ensure a proper job is done in the evaluation of the applicable technology, contract modifications that add new Contract Line-Item Numbers (CLINs) and/or expand on current CLINs for services providing flexibility in technology assessment (with technology transition as the ultimate goal) may be executed. In the event that this is required, it shall be considered to be within the scope of this BAA and the resulting contract, and, therefore, will have met the requirements of the Federal Acquisition Regulation (FAR), DoD FAR Supplement (DFARS), and the Competition in Contracting Act. The benefit of this flexibility to the Government and ultimately the taxpayer is a significant increase in the research and development (R&D) return on investment. The flexibility to have multiple users (branches of the military) in the technology evaluation cycle is absolutely critical and allows systems and technologies to be developed in a manner that has broader DoD market applications. These can then be modularly reconfigured to meet goals and objectives for all DoD services.

SECTION II – CONCEPT PAPERS AND PROPOSALS

WHO MAY SUBMIT

The DEVCOM Soldier Center will consider concept papers and proposals based on this BAA from the following organizations and firms interested in conducting scientific research:

- degree-granting colleges and universities,
- nonprofit research institutes,
- foreign organizations, and
- commercial firms (including Large Businesses, Small Businesses, Small Disadvantaged Businesses, Women-Owned Small Businesses, Historically Underutilized Business Zone Small Businesses, Veteran-Owned Small Businesses, and Service-Disabled Veteran-Owned Small Businesses.

Proposals from government facilities and organizations WILL NOT be considered under this program announcement. Offerors are cautioned that only a duly appointed Contracting Officer or Grants Officer acting within the scope and limits of his/her authority may obligate the Government to the expenditure of funds.

Small Businesses (SB), Small Disadvantaged Businesses (SDB), Women-Owned Small Businesses (WOSB), Historically Underutilized Business Zone (HUBZone) Small Businesses, Veteran-Owned Small Businesses (VOSB), Service-Disabled Veteran-Owned Small Businesses (SDVOSB), Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs): Although no portion of this BAA has been set aside for SBs, SDBs, SDVOSBs, HUBZones, HBCUs, or MIs, their participation is highly encouraged. For any topic areas (see Section VI) where sufficient quality proposals are received that demonstrate that a set-aside would be appropriate, DEVCOM Soldier Center will consider doing so and modifying this BAA accordingly. Therefore, all above named business types are encouraged to submit proposals under any topic that they feel they are highly qualified to perform.

The applicable North American Industry Classification System (NAICS) code for the majority of work submitted under this BAA will be either 541713 (Research and Development in Nanotechnology); 541714 (Research and Development in Biotechnology (Except Nanobiotechnology); 541715 (Research and Development in the Physical, Engineering, and Life Sciences (Except Nanotechnology and Biotechnology)) or 541720 (Research and Development in the Social Sciences and Humanities). NAICS 541713, 541714 and 541715 have a small business size standard of 1,000 employees while 541720 has a size standard of $20,500,000 in annual receipts.

To be eligible for award, a prospective recipient must be able to demonstrate sufficient financial and technical resources and must meet certain minimum standards pertaining to financial resources, ability to comply with the performance schedule, prior record of

performance, integrity, organization, experience, operational controls, technical skills, facilities and equipment. (See FAR9.405)

WHEN TO SUBMIT

This BAA shall remain in effect until 27 February 2030 unless superseded, extended or canceled. Concept papers will be accepted until the close of business on 28 February 2025. Proposals may be submitted at any time after the concept paper has been approved and until the BAA closing date of 27 February 2030. Awards against this BAA may be made until 30 June 2030.

The Offeror agrees that if its offer is accepted by the Government, it shall, as specified in the proposal and within ninety (90) calendar days from the date of the proposal, agree to furnish any or all items upon which prices are offered at the price set opposite each item, delivered at the designated point(s), and within the time specified in the proposal schedule. At times, the Government may contact an Offeror after the ninety (90) day period about a proposal it would like to bring to award. This will occur when a shortage of funds exists during the initial ninety (90) day period. If this does occur, the Offeror reserves the right to accept or decline the offer and may also submit a revised proposal with any necessary price/schedule changes, though the technical merit must remain the same.

WHERE TO SUBMIT

Concept papers, proposals and inquires shall be submitted to the electronic or physical mail address indicated under each scientific and technical area of interest cited in Section VI herein. Electronic mail submissions may provide a standard electronic signature or a written signature on the cover page of the submission. Facsimile submission is normally not an authorized means for the delivery of such documents. The contractor MUST receive prior approval from the applicable point of contact (POC) for facsimile submissions.

BAA PROCESS

In an effort to minimize proposal preparation costs, this BAA will utilize a two-step process. Step one will be the offeror's submission of a concept paper. This step will preclude unwarranted effort on the part of an offeror whose proposed technology/capability or product is not of interest to the Government. Those offerors whose concept papers are found to be consistent with the intent of the BAA and which are of interest to the Government will be invited to submit a proposal (step two).Communication with the technical points of contact (POCs) identified in Section VI "Scientific and Technical Areas of Interest" (as well as the POCs listed in Section V – Safety and Human Systems Integration Requirements) is essential in tailoring responses to the specific needs of DEVCOM Soldier Center. This preliminary communication is especially important because once the formal proposal is submitted as instructed in the specific Scientific and Technical Area of Interest listed in Section VI, no further

communication between the proposed contractor and the Government technical POC is allowed.

Requests for or offers of conference or symposium support, consultant services, engineering and/or marketing services, and/or training support will not be considered under this announcement. **Only concepts for research/exploratory development will be considered.**

Offerors should not submit a proposal until selected Government personnel have reviewed the concept paper and the contractor has been invited to submit a formal proposal by Government personnel.

a. Concept Paper Submission: If the Offeror has a novel research approach within an area of interest covered by this BAA, the Offeror should prepare a BAA concept paper. Concept papers should be submitted electronically to the POC listed in each area of interest in Section VI. Concept papers may not exceed 5 single-sided 8 ½ x 11 inch typed pages (including charts, graphs, photographs, etc.) and shall include the following:
    (1) A brief technical explanation of the proposed effort that addresses the major research thrust, the research goals and deliverables, a proposed approach to achieve these goals and deliverables, and military relevancy.
    (2) A brief "management" description outlining key personnel and experience.
    (3) Any past performance the contractor has had with similar research efforts.
    (4) An estimated cost/price and performance schedule for the work.

Concept papers will be evaluated by the Government within ninety (90) days of receipt.

Once an Offeror has been invited to submit a formal proposal by the specified technical POC, the following process MUST be adhered to by the Offeror.

b. Proposal Submission: Informal exchanges should be held with the technical POC listed under each topical area noted in Section VI herein on any proposed research **BEFORE** the submission of a formal proposal, since the BAA is written in such broad terms to cover a wide variety of technical areas.

The Offeror's technical, management, cost/price, past performance, subcontracting (if applicable)/small business participation, and company certification sections of the proposal shall be submitted in severable sections as set forth below. The proposal package must be valid for at least 90 days from the date of submission. All information pertaining to each section shall be confined to the appropriate part. The sections shall be

as brief as possible, consistent with complete submission. Pages should not exceed 8-1/2 inches in width and 11 inches in length; however, fold-out pages depicting such items as sketches, etc., may be used. The proposal will be evaluated in accordance with the process described in Section IV herein. The offeror's proposal package must include the DEVCOM Soldier Center BAA Proposal Cover Sheet which can be found at the SAM.gov link for W911QY20R0022.

PART I - Technical Section - automated and/or one (1) original PART II - Management Section - automated and/or one (1) original PART III – Cost/Price Section - automated and/or one (1)
PART IV - Past Performance Section - automated and/or one (1) original
PART V - Subcontracting (if applicable) & Small Business Participation automated and/or one (1) original
PART VI - Contractor Representations and Certifications - automated and/or one (1) original
PART VII – Contractor Statement of Work –Word Document File

(1) Part I - Technical Section:

The Offeror is responsible for including sufficient details, without reference to cost/price, to permit a complete and accurate evaluation of the proposal from a strictly technical standpoint. The technical proposal shall be formatted as follows to allow for inclusion of all required/applicable information:

(a) A summary of the objective/purpose of proposed research - what scientific "problem" you intend to resolve, advance the state-of-the-art with respect to, or increase the understanding of.
(b) Identification of product(s) or process(es) that you anticipate will result from this effort. Product(s) may simply be technical data, reports on the feasibility of novel concepts, product samples, etc. Also, address any Human Systems Integration (HSI) formerly MANPRINT, and/or safety requirements or state that no such requirements exist. For specific details and guidance on HSI and safety requirements, see Section V herein.
(c) Identification of any potential military and/or civilian applications of the product(s) which may be developed if the work performed under the proposed BAA contract is continued following completion of the proposed contract.
(d) An assessment of the probability for project success.
(e) An explanation of the planned approach, techniques, and/or processes to be used in this effort.
(f) Rationale for the proposed methodology. What, if any, innovative ideas/techniques will be tried? Identify the technical risks in completing this project and the approach taken to overcome these risks. For studies

involving human subjects, describe recruitment plan and access to populations. The proposal/application should describe a plan for data access. (Access to subjects and data is the sole responsibility of the investigator.) As relevant, describe plans for addressing issues unique to working with military populations. If human and/or animal subjects are included in the research, proposals/applications may be submitted without human and/or animal use protocols and institutional approvals. However, protocols with required institutional approvals must be submitted no later than 60 days after award to demonstrate continued progress and ensure continuation of payment. The Contracting or Grants Officer may make exceptions in situations where human and/or animal use is not expected to begin until after the first year of the research project. In such cases, a timeframe for submission of the appropriate protocols and institutional approvals will be established prior to award. PIs and collaborating organizations may not use, employ, or subcontract for the use of any human participants, including the use of human anatomical substances, human data, and/or human cadavers, or laboratory animals until applicable regulatory documents are approved by the Army Human Research Protections Office (AHRPO) to ensure that DoD regulations have been met. Allow at least 2 to 3 months for regulatory review and approval.

(g) Any planned interactions with DEVCOM Soldier Center (to include a request for a post-award conference if the contractor so desires) required during the performance of proposed contract.

(h) Any planned collaborative arrangements with other parties (including subcontractors and/or consultants) for the effort. Identify the responsibilities and contributions of these parties in completing the intended deliverables. If the Offeror is an academic institution, provide details of planned interactions with industry (if applicable) and letters from the industries in which they commit themselves to support the effort.

(i) A detailed list and description of all deliverables, including data the Offeror proposes to provide to the Government, the schedule for delivery, and acceptance criteria. Proposals must include a severable, self-standing, detailed list and description of all deliverables without any proprietary restrictions that can be used to make an award.

(j) A schedule containing milestones for the performance of the proposed effort.

(k) Detailed Risk Mitigation Plan: Discuss in detail the technical, cost and schedule risks involved with the project and how each risk will be mitigated by the Offeror.

(2) Part II - Management Section:

The management section of the proposal shall include the following for the Offeror and any collaborators identified in Part I:

(a) Resumes (or some portion of such) of technical personnel detailing education, experience, and technical expertise proposed for this effort and the percentage of time expected to be devoted to this project.
Note: Resumes should reflect and emphasize the qualifications and experience as related to the execution of the proposed tasks.
(b) Organization of the Offeror's firm.
(c) Facilities and equipment available for the proposed effort.
(d) Project management systems and controls to be utilized by the Offeror. Include tools, systems and procedures that will be used during execution of the proposed tasks. (i.e. task tracking, management tools, etc.)

(3) Part III - Cost/Price Section:

The Cost Proposal Spreadsheet can be found by following SAM.gov Solicitation Link at W(11QY20R0022.Click on the "proposal spreadsheet" link and save a copy of the spreadsheet. Instructions for completion have been embedded into the spreadsheet. Any proposed options that are identified in the Technical Proposal but are not fully priced out in the Cost Proposal Spreadsheet will not be included in any resulting contract or other transaction. If proposing options, they **must** be separately priced and separate spreadsheets should be provided for the base period and each option period. In addition to providing summary by period of performance (base and any options), the Contractor is also responsible for providing a breakdown of cost for each task identified in the Statement of Work. The sum of all costs by task worksheets MUST equal the total cost summary.

For proposed subcontracts over $250,000, Offerors must provide a separate, fully completed Cost Proposal Spreadsheet in support of the proposed costs. This spreadsheet, along with supporting documentation, must be provided either in a sealed envelope with the prime's proposal or via email directly to DEVCOM Soldier Center as instructed in the specific Scientific and Technical Area of Interest listed in Section VI at the same time the prime proposal is submitted. The email shall identify the proposal title, the Prime Offeror, and the attached proposal. The Prime Offeror should include a description of the effort to be performed by the subcontractor.

Offerers should also familiarize themselves with the new subcontract reporting requirements set forth in Federal Acquisition Regulations (FAR) clause 52.204-10, Reporting Executive Compensation and First-Tier Subcontract Awards. The pertinent

requirements can be found in Section III, Additional Information about Proposal Submissions.

The secure pdf-compatible format is intended to prevent unauthorized editing of the proposal prior to any award. A password should not be required for opening the proposal document, but the government must have the ability to print and copy text, images, and other content. The electronic submission of the Excel spreadsheet should be in a "useable condition" to aid the Government with its evaluation. The term "useable condition" indicates that the spreadsheet should visibly include and separately identify within each appropriate cell any and all inputs, formulas, calculations, etc. The Offeror should not provide "value only spreadsheets" similar to a hard copy.

(4) Part IV - Past Performance Section:

(a) Information should be submitted for all proposed first-tier subcontractors with whom the Offeror is teaming, as well as for the Offeror itself.

(b) The Offeror should submit past performance information on any contracts (as a prime or subcontractor) it worked on during the previous three (3) years which are relevant to the efforts required by this solicitation. In addition, any and all contracts terminated in whole or part during the previous five (5) years, including those currently in the process of such termination, are considered relevant and the Offeror shall provide past performance information for those contracts. The following information should be included:

- Role as prime or subcontractor
- If from past Government contract, the contracting activity name; address; and the contracting officer's name, telephone number and email address
- Contract type
- Awarded cost/price
- Final, or projected final, cost/price
- Original delivery schedule
- Final, or projected final, delivery schedule

(c) For each of the contracts described in the past performance section of the Offeror's proposal, a description of the objectives achieved, detailing how the effort is similar to the requirements of this solicitation, shall be included. For any contracts that did not/do not meet the original requirements with regard to original cost/price, schedule, or technical performance, the Offeror should provide a brief explanation of the reason(s) for such shortcomings and any demonstrated corrective actions taken to avoid recurrence. For any terminated contracts, the Offeror shall indicate the termination type and reasons.

(5) Part V – Subcontracting & Small Business Participation

(a) Subcontracting Plans (if applicable)

The US Army DEVCOM Soldier Center is strongly committed to providing meaningful subcontracting opportunities for Small Businesses (SB), Small Disadvantaged Businesses (SDB), Women-Owned Small Businesses (WOSB), Historically Underutilized Business Zone (HUBZone) Small Businesses, Veteran-Owned Small Businesses (VOSB), Service Disabled Veteran-Owned Small Businesses (SDVOSB), Historically Black Colleges and Universities/Minority Institutions (HBCU/MI), and other socioeconomic considerations through its awards.

Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. 631(a)), it is the policy of the Government to enable SB, SDB, WOSB, HUBZone, VOSB, and SDVOSB concerns to be considered fairly as subcontractors to contractors performing work under Government contracts and to ensure that prime contractors and subcontractors carry out this policy. Offerors, other than small businesses, seeking an award of greater than $700,000, are required to submit a subcontracting plan IAW FAR 19.702, 19.703, and 19.704 as part of their proposal. The plan format is outlined in FAR 19.704. A sample Small Business Subcontracting Plan template is provided at the SAM.gov link for W911QY20R0022.

Subcontracting plans will be reviewed for adherence to applicable public laws and regulations cited in FAR Part 19 and its supplements. An offeror's refusal to submit an acceptable subcontracting plan is grounds for the Government to not negotiate award of that offeror's BAA proposal.

(b) Small Business Participation Plan

Separate from the Subcontracting Plan, ALL prime offerors, regardless of size, shall submit a Small Business Participation Plan in accordance with DFARS 215.304. All offerors shall provide a statement of the extent of the offeror’s commitment to small business participation through its awards and must agree that SB, SDB, WOSB, HUBZone, VOSB, and SDVOSB concerns will have the maximum practicable opportunity to participate in contract performance consistent with its efficient performance. A Small Business Participation Template found at the SAM.gov link for W911QY20R0022.

NOTE: Small Business offerors may meet the requirement using work they perform themselves. This assertion will be reviewed to ensure that it supports this policy by providing meaningful subcontracting

opportunities.

(6) Part VI - Contractor Representations and Certifications:

Offerors are required to complete the annual representations and certificates in the System for Award Management (SAM) SAM.gov and should note in Part VI of their proposal what their Dun and Bradstreet Data Universal Numbering System (DUNS) number is and the fact that they are in SAM.

Note: The applicable North American Industry Classification System (NAICS) code for the majority of work submitted under this BAA will be either 541713 (Research and Development in Nanotechnology); 541714 (Research and Development in Biotechnology (Except Nanobiotechnology); 541715 (Research and Development in the Physical, Engineering, and Life Sciences (Except Nanotechnology and Biotechnology)) or 541720 (Research and Development in the Social Sciences and Humanities). NAICS 541713, 541714 and 541715 have a small business size standard of 1,000 employees while 541720 has a size standard of $20,500,000 in annual receipts. DFARS Representations and Certifications for Grants and Agreements are provided at the SAM.gov link for W911QY20R022.

(7) Part VII - Contractor Statement of Work

The offeror shall provide a stand-alone Statement of Work (SOW) that outlines the specific work to be performed that is supported by the other parts of the offeror's proposal and which will become the contractually binding SOW in the resulting contract. The SOW shall begin with the following language:

"Independently, and not as an agent of the Government, the Contractor shall furnish all necessary services; qualified professional, technical and administrative personnel; material, equipment and facilities not otherwise explicitly described as provided by the Government under the terms of this contract as set forth below."

The SOW should follow the format described below, although the format described herein is only meant to be a guide and is not necessarily all-inclusive. As such, contents should be tailored to the specific requirement being proposed. As applicable, the various SOW sections should address the following:

(a) **Background:** Identified as the "Introduction", this section provides information needed to acquaint the reader with the basic acquisition situation. The background information may:
- Identify the requirement in very general terms;
- Describe why the project is being pursued and how it relates to other projects;

- Summarize any statutory authority or regulations affecting the overall requirement; and
- Identify any background materials attached to the SOW.

(b) **Objectives:** This section should provide a concise overview of:
- The contract effort goals and objectives; and
- How the results or end products will be used.

(c) **Scope:** Provide a brief statement of what the Government expects to accomplish under the contract-the breadth and limitations of the contract effort. It should not include specific work tasks or a description of deliverable products.

(d) **Tasks:** Sometimes identified as "Requirements" or "Work Requirements", this section defines the SPECIFIC TASKS that the Contractor must complete during contract performance and should describe requirements in terms of results required rather than the methods for completing the work. The specific tasks must provide the specific performance attributes that define success, such as minimum performance thresholds, form/fit/function characteristics, quality control requirements and/or other OBJECTIVE measurements defining successful task performance. Other items to consider include but are not limited to:
- Specify requirements clearly so that all readers can understand them.
- Reference only the absolute minimum applicable specifications and standards needed.
- Tailor specifications and other documents.
- Separate general information from direction.
- Include specific titles and task descriptions for all tasks for required performance.
- Use a Work Breakdown Structure (WBS) format and WBS Dictionary
- Include milestones that are to be accomplished as applicable and as identified on the milestone schedule. Milestones can include such things as preliminary reports or data submittals, attendance at meetings, etc.

(e) **Period of Performance**: Provide period of performance in either months or years; if applicable, include options and spell out what is optional vs. what is not; provide any restrictions (e.g., NTE 100 hours a month, etc.)

(f) **Place of Performance**: Insert the place of performance for this work (e.g., DEVCOM Soldier Center, contractor's facility (include location), etc.

(g) **Delivery:** This section should clearly state:
- What the Contractor must deliver, including specific quantities for

each deliverable. If different tasks have different delivery requirements, they must be clearly identified.

- When the Contractor must deliver. This may be stated using actual dates, days after contract award, or using some other method that clearly marks the required delivery date.
- Delivery address/location. This may be stated as a location, an organization, a person identified by position (e.g., Contracting Officer's Representative, a person identified by name or using some other description.)
- What documentation (if any) the Contractor must obtain from the Government to verify Government receipt of the delivery.
- Other items to consider: Deliverables are different than task completion milestones. Milestones may not require a specific deliverable or data submittal. Include a schedule for when final products such as data, reports or other items are required to be furnished to the Government.

(h) **Government-Furnished Property, Material, Equipment, or Information (GFP, GFM, GFE, or GFI):** This section should identify any Government-furnished property required to be provided by the Government to the Contractor. This includes all Government-furnished property, such as Government-furnished material, equipment, or information. If the list of property is extensive, this section should identify where that list can be found.

(i) **Security:** This section should identify any unique security requirements associated with contract performance, such as secure facilities, DD-254 requirements, etc.

(j) **Travel:** Describe any travel requirements that are to be encountered in the performance of the service(s).

(k) **Special Material Requirements:** Describe requirements for any special materials that are to be encountered in the performance of the service(s).

(l) **Other Unique Requirements:** Discuss any other unique requirements or considerations required for successful contract performance.

THIS ANNOUNCMENT <u>IS NOT</u> FOR THE ACQUISITION OF TECHNICAL, ENGINEERING AND OTHER TYPES OF SUPPORT SERVICES.

SECTION III – ADDITIONAL INFORMATION ABOUT PROPOSAL SUBMISSIONS

1. CONTRACTOR MANPOWER REPORTING

(a) To support the requirements of title 10, U.S.C., Sections 235 and 2330a, the DoD transitioned from the former DoD Enterprise Contractor Manpower Reporting Application (ECMRA) to the System for Award Management (SAM.gov) to allow industry to report all manpower data into a single Federal-wide portal, removing duplicative requirements: one for DoD and another for the rest of the Federal Government, which requires the same data elements to be reported for services contracts performed for both DoD and Federal civilian agencies that essentially perform the same function. Title 10, U.S.C., Sections 235 and 2330a establishes the requirement to report on manpower functions and costs under services contracts. The DFARS 204.1703 provides direction on reporting and identifies SAM as the government-wide required reporting site. SAM also implements the recommendation of the advisory panel under the National Defense Authorization Act (NDAA) of FY2016 (Public Law 114-92), Section 809, to develop a replacement approach to the inventory of contracted services.

(b) The Contractor shall report annually, by October 31, at https://www.sam.gov, on the services performed under this contract or order, including any first-tier subcontracts, during the preceding Government fiscal year (October 1 - September 30). The Contractor shall report the following information for the contract or order: the total dollar amount invoiced for services performed during the preceding Government fiscal year under the contract or order, and the number of Contractor direct labor hours, to include first-tier subcontractor direct labor hours, as applicable, expended on the services performed under the contract or order during the previous Government fiscal year. The Government will review the Contractor's reported information for reasonableness and consistency with available contract information. In the event the Government believes that revisions to the Contractor's reported information are warranted, the Government will notify the Contractor. Upon notification, the Contractor shall revise the reported information or provide the Government with a supporting rationale for the information.

2. EXECUTIVE COMPENSATION AND FIRST-TIER SUBCONTRACT REPORTING (APPLIES ONLY TO CONTRACTS)

Section 2(d) of the Federal Funding Accountability and Transparency Act of 2006 (Pub.L. No. 109-282), as amended by section 6202 of the Government Funding Transparency Act of 2008 (Pub. L. 110-252), requires the Contractor to report information on subcontract awards. The law requires all reported information be made public; therefore, the Contractor is responsible for notifying its subcontractors that the required information will be made public.

Unless otherwise directed by the Contracting Officer, by the end of the month following the month of award of a first-tier subcontract with a value of $25,000 or more (and any modifications to these subcontracts that change previously reported data) the Contractor shall report the following information at https://www.fsrs.gov/ for each first-tier subcontract:

(a) Unique identifier (DUNS Number) for the subcontractor receiving the award and for the subcontractor's parent company, if the subcontractor has one.
(b) Name of the subcontractor.
(c) Amount of the subcontract award.
(d) Date of the subcontract award.
(e) A description of the products or services (including construction) being provided under the subcontract including the overall purpose and expected outcomes or results of the subcontract.
(f) Subcontract number (the subcontract number assigned by the Contractor).
(g) Subcontractor's physical address, including street address, city, state, and country. Also include the nine-digit ZIP code and congressional district.
(h) Subcontractor's primary performance location, including street address, city, state, and country. Also include the nine-digit ZIP code and congressional district.
(i) The prime contract number (and order number if applicable).
(j) Awarding agency name and code.
(k) Funding agency name and code.
(l) Government contracting office code.
(m) Treasury Account Symbol (TAS) as reported in FPDS.
(n) The applicable North American Industry Classification System (NAICS) code.

By the end of the month following the month of a contract award, and annually thereafter, the Contractor shall report the names and total compensation of each of the five most highly compensated executives for the Contractor's preceding completed fiscal year at https://www.fsrs.gov/ if:

(a) In the Contractor's preceding fiscal year, the Contractor received:
  (i) 80 percent or more of its annual gross revenues from Federal contracts (and subcontracts), loans, grants (and sub-grants) and cooperative agreements; and
  (ii) $25,000,000 or more in annual gross revenues from Federal contracts (and subcontracts), loans, grants (and sub-grants) and cooperative agreements; and
(b) The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of

the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at http://www.sec.gov/answers/execomp.htm).

Unless otherwise directed by the Contracting Officer, by the end of the month following the month of a first-tier subcontract with a value of $25,000 or more, and annually thereafter, the Contractor shall report the names and total compensation of each of the five most highly compensated executives for each first-tier subcontractor for the subcontractor's preceding completed fiscal year at https://www.fsrs.gov/ if:

(a) In the subcontractor's preceding fiscal year, the subcontractor received:
(i) 80 percent or more of its annual gross revenues from Federal contracts (and subcontracts), loans, grants (and sub-grants), and cooperative agreements; and
(ii) $25,000,000 or more in annual gross revenues from Federal contracts (and subcontracts), loans, grants (and sub-grants), and cooperative agreements; and

(b) The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at http://www.sec.gov/answers/execomp.htm).

If the Contractor in the previous tax year had gross income from all sources under $300,000, the Contractor is exempt from the requirement to report subcontractor awards. Likewise, if a subcontractor in the previous tax year had gross income from all sources under $300,000, the Contractor does not need to report awards to that subcontractor.

3. GOVERNMENT FURNISHED PROPERTY (GFP)

Government Furnished Property (GFP), as defined in FAR Part 45, may be available for contractor use during the performance of a given contract awarded against this BAA.

The offeror should clearly request in its proposal what, if anything, it desires as GFP for the given project. It is recommended that a section in the technical or management proposal be set aside to summarize the GFP requirements.

The offeror may request for incorporation in the contract a GFP delivery schedule NOT based specifically on the date of contract award.

Any property furnished to and accepted by the Government under a resultant contract and subsequently returned to the contractor for any reason shall be regarded as GFP.

Any facilities, including rooms, desks, etc., to be provided to a contractor by the Government for the performance of any portion of a contract, is considered to be GFP, and if needed should be specifically requested for the applicable time frames in the offeror's proposal.

4. TYPE OF INSTRUMENT

The Natick Contracting Division has the authority to award procurement contracts, cooperative agreements, and grants, and reserves the right to use the type of instrument most appropriate for the effort proposed. Offerors should familiarize themselves with these instruments and the applicable regulations before submitting a proposal. Following are brief descriptions of the possible award instruments. Offerors shall provide rationale to support their suggested award instrument. Further information may be found in FAR Part 16.

Procurement Contract - A legal instrument which, consistent with 31 U.S.C. 6303, reflects a relationship between the Federal Government and a State, a local government, or other recipient when the principal purpose of the instrument is to acquire property or services for the direct benefit or use of the Federal Government. Procurement contracts resulting from this BAA will generally fall into two broad categories:

(a) Firm Fixed Price (FFP) contracts (see FAR 16.2.) FFP contracts are generally utilized when performance risks are low, and the delivery requirements are very well defined and can be readily priced and scheduled. However, a FFP contract may be necessary for business entities that do not possess a Defense Contract Audit Agency (DCAA) approved accounting system (which is a requirement for award of a cost reimbursement contract). FFP contracts are structured in one of two methods that dictate how a contractor is reimbursed for work performed, and offerors proposing a FFP contract are strongly encouraged to carefully consider their cash flow requirements when formulating their proposals:

(i) FFP contracts may be structured to reimburse the contractor upon delivery of the work. Contract Line Item Numbers (CLINs) specify a particular piece of work and the delivery terms, and the contractor invoices the Government upon delivery.

(ii) An alternative structure is a milestone payment structure based on discrete incremental milestones that are achieved as progress is being made against a longer-term contract deliverable. The use of milestone payments will only be considered by the Government when the milestones are clearly defined in terms of specific

activity-based events AND performance measurement attributes that define milestone achievement, AND a discrete price for the milestone.

(b) Cost Reimbursement contracts (See FAR 16.3). Cost reimbursement contracts are generally utilized when there is technical risk that may impede successful performance such that it is difficult to accurately predict the final cost. In order to receive a cost reimbursement contract, the contractor must possess a DCAA approved accounting system.

The contract type may vary according to the degree and timing of the risk responsibility assumed by the contractor for the cost of performance and the amount and nature of the profit incentive offered to the contractor for achieving or exceeding specific standards and goals. See FAR Subpart 16.101(a). Offerors shall identify the type(s) of contract (FAR Part 16) they feel is (are) best suited to the proposed effort. The offeror shall note that, in accordance with FAR Subpart 16.301-3, in order to receive a COST type contract, its accounting system must be adequate for determining costs on a Government contract. This is determined by the DCAA office assigned to the offeror's business location and may take thirty (30) to forty (40) days for completion. An Offeror's suggestion regarding suitable contract type does not obligate the Government to employ the suggested contract type.

Offerors may propose profit or fee to both FFP and cost reimbursement type contracts. The Government will employ a weighted guidelines approach to establishing profit or fee, and offerors are strongly encouraged to use this method when establishing their proposed profit or fee. The weighted guidelines method is described in DFARS 215.404-71, and a weighted guidelines calculation template is at DD Form 1547.

The selection of the contract type and any fee or profit is subject to negotiation.

Grant - A legal instrument that, typically utilized with academic institutions, consistent with 31 U.S.C. 6304, is used to enter into a relationship:

a. The principal purpose of which is to transfer a thing of value to the recipient to carry out a public purpose of support or stimulation authorized by a law of the United States, rather than to acquire property or services for the DOD's direct benefit or use.
b. In which substantial involvement is not expected between the DOD and the recipient when carrying out the activity contemplated by the grant.
c. In which no fee or profit is allowed.

Cooperative Agreement - A legal instrument, also typically utilized with academic institutions, which, consistent with 31 U.S.C. 6305, is used to enter into the same kind of relationship as a grant (see definition "grant"), except that substantial involvement is

expected between the DOD and the recipient when carrying out the activity contemplated by the cooperative agreement. The term does not include "cooperative research and development agreements" as defined in 15 U.S.C. 3710a. No fee or profit is allowed.

Grants and cooperative agreements are governed by the following regulations:

a. OMB Circular A-21, "Cost Principles for Educational Institutions"
b. OMB Circular A-87, "Cost Principles for State, Local and Indian Tribal Governments"
c. OMB Circular A-102, "Grants and Cooperative Agreements with State and Local Governments"
d. OMB Circular A-110, "Uniform Administrative Requirements for Grants and Agreements with Institutions of Higher Education, Hospitals, and Other Non-Profit Organizations"
e. OMB Circular A-122, "Cost Principles for Non-Profit Organizations"
f. OMB Circular A-133, "Audits of States, Local Governments, and Non- Profit Organizations"
g. DOD Grant and Agreement Regulations (DODGARs), DOD 3210.6-R http://www.dtic.mil/whs/directives/corres/html/321006r.html

Copies of OMB regulations may be obtained from:

Executive Office of the President
Telephone: (202) 395-7332
Publications Service
FAX Requests: (202) 395-9068
New Executive Office Building
http://www.whitehouse.gov/OMB/
725 17th Street, N.W., Room 2200
Washington, DC 20503

http://www.whitehouse.gov/omb/circulars_a021_2004/

NOTE: In accordance with DoD Directive 3210.6, http://www.dtic.mil/whs/directives/corres/html/321006r.html, the DODGARs may include rules that apply to other non-procurement instruments, when specifically required in order to implement a statute, Executive Order, or Government-wide rule that applies to other non-procurement instruments, as well as to grants and cooperative agreements.

5. PREPARATION COSTS

It must be clearly understood that the receipt and review of concept papers and proposals as described in this BAA by the Government is entirely for the purpose of technical

evaluation and in no way constitutes an agreement to enter into contractual or other relationships. It must be further understood that the submission of such documents is voluntary and must be done solely at the offeror's expense. The Government will in no way be held liable for, nor reimburse, an offeror for any expenses (direct or indirect) incurred in the process of formulating or submitting such documents.

6. AVAILABILITY OF FUNDS

It must be clearly understood that, as of the date of release of this BAA, there are no funds committed for any project. Until such time as funds are released to the Contracting Officer, no contract can, or will, be made for an otherwise acceptable proposal.

7. FAR INFORMATION/REFERENCES

All FAR information/references plus other related acquisition information may be found on the Internet at either of the following addresses: https://www.acquisition.gov/

8. SYSTEM FOR AWARD MANAGEMENT (SAM) REGISTRATION

By submission of an offer, the Offeror acknowledges the requirement that prospective awardees MUST be registered in the System for Award Management (SAM) database in order to be eligible to receive an award, and subsequently prior to submitting an invoice and through final payment of any contract resulting from this BAA Solicitation.

Offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation. To remain registered in the SAM database after the initial registration, the Offeror is required to review and update on an annual basis from the date of initial registration (or subsequent updates) its information in the SAM database to ensure it is current, accurate and complete.

9. INVOICING AND PAYMENTS

All payments by the Government under contracts awarded from this BAA shall be made by electronic funds transfer (EFT) or the Government purchase card. If not paid by purchase card, then invoices shall be submitted electronically in accordance with DFARS 252.232- 7003, which will be included in any resulting contract from this BAA. The automated method being used at DEVCOM Soldier Center is the Wide Area Workflow (WAWF) system found at https://wawf.eb.mil/.

Contractors are encouraged to view this website and familiarize themselves with the invoicing process. More specific instructions on WAWF will be provided in any BAA award document.

10. REPORTING AND TECHNICAL DATA/SOFTWARE DELIVERABLES

The following are samples of data deliverables that are typically required under a research effort:

Monthly Progress Reports; test results, data, and analyses; technical data covering technology; source and object code for software; presentation materials; Final Technical Report; Safety Assessment Report

Separate Contract Data Requirement Line items (CDRLs) are included in a contract to cover each of the above items. Each CDRL includes a data item description and possibly a military standard to provide, e.g. guidance in the format of the data delivered.

The following minimum data deliverables will be required under traditional procurement contracts awarded under this BAA:

Monthly Progress Report: These reports must describe the previous calendar month's activity, technical progress achieved against goals, difficulties encountered, recovery plans (if needed), explicit plans for the next calendar month, and financial expenditures (including expenditures during the past calendar month period plus cumulative expenditures and projected expenditures for the coming calendar month.)

Final Technical Report: For a final report, each selected Offeror must provide a final technical report of work performed during the period of performance delivered no later than the prescribed time. The final report must be a cumulative, standalone document that describes the work of the entire research effort. It must include any technical data gathered. The final technical report must include a summary of all performance goals versus performance achieved during the program (either measured or otherwise substantiated). The final technical report must discuss all variances from the performance goals including reasons or theories for variances. If applicable, provide a discussion of how the Offeror might meet any unmet performance goals under a future effort. This final technical report must also include "lessons learned" from the effort as well as recommendations for future research, development, or testing that would lead to success in meeting the performance goals. The final report must provide a comprehensive and detailed account of all funds expended.

11. RESTRICTED DATA ON PROPOSALS

As stated in FAR 52.215-1(c) "Instructions to Offerors - Competitive Acquisition", the following guidance is provided for contractors desiring to restrict any information in their concept papers or proposals:

Offerors that include in their proposals data that they do not want disclosed to the public

for any purpose, or used by the Government except for evaluation purposes, shall –

(1) Mark the title page with the following legend:

> "This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed -- in whole or in part -- for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this offeror as a result of – or in connection with -- the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in sheets [*insert numbers or other identification of sheets*];" and

(2) Mark each sheet of data it wishes to restrict with the following legend:

> "Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal."

12. INTELLECTUAL PROPERTY

a. Noncommercial Items (Technical Data and Computer Software)
Offerors responding to this BAA requesting a procurement contract, grant, or cooperative agreement to be issued under the FAR/DFARS shall identify all noncommercial technical data and noncommercial computer software that they plan to deliver under any proposed award instrument in which the Government will acquire less than unlimited rights, and to assert specific restrictions on those deliverables on a list. Offerors shall follow the format for the list under DFARS 252.227-7017 for this stated purpose. In the event that Offerors do not submit the list, the Government will assume that it automatically has "unlimited rights" to all noncommercial technical data and noncommercial computer software delivered under any award instrument, unless it is substantiated that development of the noncommercial technical data and noncommercial computer software occurred with private or mixed funding. If private or mixed funding occurred in the development of noncommercial technical data and noncommercial computer software delivered under any award instrument, then Offerors should identify the data and software in question as subject to Limited Rights, Restricted Rights or Government Purpose Rights. In accordance with DFARS 252.227-7013 "Rights in Technical Data- Noncommercial Items", and

DFARS 252.227-7014 "Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation", the Government will automatically assume that any such Government Purpose Rights restriction is limited to a period of five years in accordance with the applicable DFARS clauses, after which time the Government will acquire "unlimited rights" unless the parties agree otherwise. Offerors are admonished that the Government will use the list during the source selection evaluation process to evaluate the impact of any identified restrictions and may request additional information from the Offeror, as may be necessary, to evaluate the Offeror's assertions. Once an Offeror's assertions are confirmed and a contract is to be awarded, a clause confirming the scope of these identified restrictions may be prepared for incorporation into the contract. If no restrictions are intended, then the Offeror should state "NONE" on the list. A sample list for complying with this request is as follows:

NONCOMMERCIAL			
Technical Data or Computer Software to be Furnished with Restrictions	Basis for Assertions	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(LIST)	(LIST)	(LIST)

b. Commercial Items (Technical Data and Computer Software)
Offerors responding to this BAA requesting a procurement contract, grant, or cooperative agreement to be issued under the FAR/DFARS, shall identify all commercial technical data, and commercial computer software that may be embedded in any noncommercial deliverable technical data and/or computer software contemplated under the research effort on the list. The Government may use the list during the source selection evaluation process to evaluate the impact of any identified commercial data/software restrictions, and may request additional information from the Offeror, as may be necessary, to evaluate the Offeror's assertions. If no deliverable commercial technical data/software is intended, then the Offeror should state "NONE" on the list.

A sample list for complying with this request is as follows:

COMMERCIAL	
Technical Data or Computer Software to be Furnished with Restrictions	Basis for Assertions
(LIST)	(LIST)

c. All Proposers – Patents
Offerors responding to this BAA shall include documentation proving ownership of inventions or possession of appropriate licensing rights to all inventions (including patented or those inventions for which a patent application has been filed) that will be utilized under the proposal being submitted. If a patent application, provisional or non-provisional, has been filed for an invention that the proposal utilizes, but the application has not yet been made publicly available, the serial number, inventor name(s), assignee names (if any), filing date, and a summary of the invention title may be provided together with either: 1) a representation of ownership of the invention, or 2) proof of possession of appropriate licensing rights in the invention.

d. All Offerors – Intellectual Property Representations
Offerors shall provide a good faith representation that they either own or possess appropriate licensing rights to all other intellectual property (IP) that will be utilized under the proposal being submitted. Additionally, Offerors shall provide a short summary for each such IP in which an Offeror asserts the Government will be restricted that describes the nature of the restriction and the intended use of the intellectual property in the conduct of the proposed research.

13. PROTECTION OF HUMAN SUBJECTS

The DEVCOM Soldier Center Human Research Protections Office ensures that research conducted or supported by the DEVCOM Soldier Center and involving human subjects, human anatomical substances, human data, human cadavers, and animals is conducted in accordance with federal, DoD, Army, and international regulatory requirements.

Principal Investigators (PIs) and applicant organizations **may not commence performance** of research involving the above, **or expend funding** on such efforts, until and unless regulatory documents are submitted to and approved by the DEVCOM Soldier Center (SC) Human Research Protection Official (HRPO) to ensure compliance with DoD human subjects research (HSR) requirements. All expectations described below are consistent with Department of Defense Instruction (DoDI) 3216.02, "Protection of

Human Subjects and Adherence to Ethical Standards in DoD-Supported Research," as issued on April 15. 2020, and available at https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/321602p.pdf.

A timeframe for submission of the appropriate protocols and required approvals will be established during negotiations.

Specific requirements for research involving human subjects or human anatomical substances include but may not be limited to:

a. **Assurance of Compliance:** Each institution engaged in non-exempt HSR must have a current Department of Health and Human Services Office for Human Research Protection (OHRP) Federal Wide Assurance (FWA) or DoD Assurance. The Institution's IRB office or the HRPO can assist in determining if engaged institutions have active assurances and obtaining an assurance is required.

b. **Training:** Personnel involved in HSR must have appropriate instruction in the protection of human subjects. Documentation confirming completion of appropriate instruction may be required during the regulatory review process.

c. **Informed Consent Form:** The following must appear in the consent form:
   - A statement that the DoD is providing funding for the study.
   - A statement that representatives of the DoD are authorized to review research records. In the event that a Health Insurance Portability and Accountability Act (HIPAA) authorization is required, the DoD must be listed as one of the parties to whom private health information may be disclosed.

d. **Intent to Benefit:** The requirements of Title 10 United States Code Section 980 (10 USC 980), which are applicable to DoD-sponsored research, must be considered. 10 USC 980 requires that "Funds appropriated to the Department of Defense may not be used for research involving a human being as an *experimental subject* unless (1) the informed consent of the subject is obtained ***in advance***; or (2) in the case of research intended to be beneficial to the subject, the informed consent may be obtained from a legal representative of the subject."

   An individual not legally competent to provide informed consent (e.g., incapacitated individuals, cognitively impaired, minors) may not be enrolled as an ***experimental subject*** in a DoD-supported study unless the research is intended to benefit each subject enrolled in the study, to include subjects enrolled in study placebo arms. Studies designed in a manner that permits all subjects to potentially benefit directly from medical treatment or enhanced surveillance beyond the standard of care

can meet the 10 USC 980 requirements. Note that the definition of ***experimental subject*** as defined in the DoDI 3216.02 has a much narrower definition than ***human subject***. Research with experimental subjects must involve an intervention or interaction where the primary purpose of the research is to collect data regarding the effects of the intervention or interaction.

10 USC 980 is only applicable to certain intervention studies. It does not apply to retrospective studies, observational studies, studies that involve only blood draws, and tissue collections.
Contact the DEVCOM Soldier Center HRPPO at (usarmy.natick.devcom-sc.mbx.nati-amsrd-nsc-d@army.mil) ***if further clarification regarding applicability of 10 USC 980 to the proposed research project is required.***

NOTE: All contracts with organizations conducting human research will include DFARS clause 252.235-7004 Protection of Human Subjects word for word and the following local clause:

CONTRACT CLAUSE FOR USE OF HUMAN SUBJECTS

The substance of the DFARS Clause 252.235-7004. must be included in all subcontracts that may include research involving human subjects in accordance with 32 CFR Part 219, DoD Directive 3216.02, and 10 U.S.C. 980, including research that meets exemption criteria under 32 CFR 219.101(b). This clause does not apply to subcontracts that involve only the use of cadaver materials.

Research at funded institutions using human subjects may not begin until the Human Research Protection Official (HRPO) approves the project. Written approval to begin research for the use of human subjects under the applicable protocol proposed for this award will be issued from the DEVCOM SC HRPO Principal Investigator (PI). **A copy of this approval will be maintained by the DEVCOM SC HRPO as part of the official file.**

Noncompliance with any provision of this clause may result in withholding of funds and or termination of the award. The Contractor shall comply with the requirements of Department of Defense Instruction (DODI) 3216.02 and 32 CFR 219 and FDA regulations, when applicable.

END CLAUSE

The following procedures will be employed to ensure compliance with the above contract clause:

- The contractor will coordinate with the DEVCOM Soldier Center HRPP Office usarmy.natick.devcom-sc.mbx.nati-amsrd-nsc-d@army.mil for HRPO submission requests.
- The contractor will submit the submission documents to the email address: usarmy.natick.devcom-sc.mbx.nati-amsrd-nsc-d@army.mil

14. ANIMAL USE

PIs and applicant organizations may not commence performance of research involving the above, or expend funding on such efforts, until and unless regulatory documents are submitted to and approved by the U.S. Army Medical Research and Materiel Command (USAMRMC) Office of Research Protections (ORP) Animal Care and Use Review Office (ACURO). All expectations described below are consistent with DoDI 3216.01, "Use of Animals in DoD Programs," as issued September 13, 2010, available at http://www.dtic.mil/whs/directives/corres/pdf/321601p.pdf.

Specific documents relating to the use of animals in the proposed research will be requested if the application is selected for funding. The ACURO must review and approve all animal use prior to the start of working with animals. PIs must submit the institutional animal use protocol, IACUC approval of that protocol, and a version of the animal use appendix titled "Research Involving Animals." For guidance on which version of the appendix to use, as well as links to both, visit the ACURO website at: https://mrmc.amedd.army.mil/index.cfm?pageid=research_protections.acuro_Animalappendix ***Allow at least 2 to 3 months for regulatory review and approval processes for animal studies.***

For additional information, send questions via email to ACURO at usarmy.detrick.medcom- usamrmc.other.acuro@mail.mil.

NOTE: All contracts with organizations conducting animal research will include DFARS clause 252.235-7002 Animal Welfare and the following local clause:

CONTRACT CLAUSE FOR USE OF ANIMAL SUBJECTS

Research, development testing, evaluation and training at funded institutions using animal subjects may not begin until the US Army DEVCOM Soldier Center Human Protections Director (HPD) reviews the project and approval is granted from the Animal Care and Use Review Office (ACURO). Written approval to begin research for the use of animal subjects under the applicable protocol proposed for this award will be issued from

either the ACURO or the HPD and provided to the Principal Investigator (PI). A copy of this approval will be retained by the HPD for the official file. Noncompliance with any provision of this clause may result in withholding of funds and or termination of the award. The Contractor and any Subcontractor shall comply with the requirements of AR 40-33, Department of Defense Instruction (DoDI) 3216.01.

END CLAUSE

15. USE OF HUMAN CADAVERS OR HUMAN ANATOMICAL SUBSTANCES OBTAINED FROM HUMAN CADAVERS

Research, development, test and evaluation (RDT&E), education, or training activities involving human cadavers shall not begin until approval is granted in accordance with the Army Policy for Use of Human Cadavers for RDT&E, Education, or Training, 20 April 2012 (https://mrmc.amedd.army.mil/assets/docs/orp/army-policy-for-use-of-human-cadavers_042012.pdf). The USAMRDC ORP is responsible for administrative review, approval, and oversight of research involving sensitive uses of human cadavers or human anatomical substances obtained from human cadavers. Award recipients must coordinate with the DEVCOM Soldier Center to ensure that proper approvals are obtained. Written approvals to begin the activity will be issued under separate notification to the recipient. Questions regarding submission of cadaver research for USAMRDC ORP review and approval should be directed to the DEVCOM Soldier Center HPD via email at usarmy.natick.nsrdec.mbx.nati-human-protection-administrator**.**

16. MILITARY RECRUITING

Military Personnel Volunteers: The following is important information for research projects proposing to include military personnel as volunteers.

- **Recruitment of Military Personnel:** Civilian investigators attempting to access military volunteer pools are advised to seek collaboration with a military investigator familiar with service-specific requirements.

  A letter of support from Commanders of military units in which recruitment will occur or the study will be conducted will be requested by the HRPO, and is necessary by the reviewing IRB. Some military sites may also require that each volunteer seek written permission from their supervisor prior to participation in research studies.

  Special consideration must be given to the recruitment process for military personnel. The Chain of Command must not be involved in the recruitment of military personnel and cannot encourage or order service members to

participate in a research study. For greater than minimal risk research, an ombudsperson must be employed when conducting group briefings with active-duty personnel to ensure that volunteers understand that participation is voluntary; this ombudsperson may be recommended in other situations as well, especially when young enlisted service members, who by virtue of their age and enlistment status are trained to follow orders, are being recruited. Service members are trained to act as a unit, so peer pressure should also be considered and minimized, if possible.

- **Payment to Federal Employees and Military Personnel:** Under 24 USC 30, payment to federal employees and active-duty military personnel for participation in research while on duty is limited to blood donation and may not exceed $50 per blood draw. These individuals may not receive any other payment or non-monetary compensation for participation in a research study unless they are off duty or on leave during the time they are participating in the protocol.

- **Confidentiality for Military Personnel:** Confidentiality risk assessment for military personnel requires serious consideration of the potential to affect the military career. Medical and psychological diagnoses can lead to limitation of duties and/or discharge from active duty. Information regarding alcohol or drug abuse, drunk driving, and sexual or spousal abuse can lead to actions under the Uniform Code of Military Justice, including incarceration and dishonorable discharge.

17. INTERNATIONAL TRAFFIC IN ARMS REGULATION (ITAR)

The offerors and their subcontractors shall comply with the ITAR, 22 CFR Parts 120 through 130. Information regarding ITAR is available at http://pmddtc.state.gov/regulations_laws/itar_official.html. Information pertaining to the Export Administration Regulation (EAR) is available at http://www.bis.doc.gov/index.php/regulations. Please consult with the Department of State (https://www.pmddtc.state.gov/ddtc_public) regarding any questions relating to compliance with the ITAR and consult with the Department of Commerce (https://www.bis.doc.gov/) regarding any questions relating to compliance with the EAR.

18. ORGANIZATIONAL CONFLICTS OF INTEREST

All Offerors and proposed subcontractors must affirm whether they are providing scientific, engineering, and technical assistance (SETA) or similar support to any DEVCOM Soldier Center technical office(s) through an active contract or subcontract. All affirmations must state which office(s) the Offeror supports and identify the prime contract numbers. Affirmations shall be furnished at the time of proposal submission. All

facts relevant to the existence or potential existence of organizational conflicts of interest (FAR 9.5) must be disclosed. The disclosure shall include a description of the action the Offeror has taken or proposes to take to avoid, neutralize, or mitigate such conflict. In accordance with FAR 9.503 and without prior approval, a contractor cannot simultaneously be a SETA and a research and development performer. Proposals that fail to fully disclose potential conflicts of interests will be rejected without technical evaluation and withdrawn from further consideration for award. If a prospective Offeror believes that any conflict of interest exists or may exist (whether organizational or otherwise), the offeror should promptly raise the issue with DEVCOM Soldier Center by sending his/her contact information and a summary of the potential conflict by e-mail to the Administrative Point of Contact identified in each topic under Section VI, before expending time and effort in preparing a proposal and mitigation plan.

If, in the sole opinion of the Contracting Officer after full consideration of the circumstances, any conflict situation cannot be effectively avoided, the proposal may be rejected without technical evaluation and withdrawn from further consideration for award under this BAA.

SECTION IV – EVALUATION PROCESS

1. EVALUATION APPROACH FOR CONCEPT PAPERS

Concept papers will be evaluated by technical/scientific personnel who are knowledgeable within the particular topical area/specific interest area to determine if the paper presented is consistent with the intent of the BAA and of interest to the Government. Concept papers will be evaluated on the scientific/technical merit, the management approach, the importance to agency programs, and the proposed cost/price. Based on these evaluation criteria, the highest rated concept papers will show considerable potential to develop into highly qualified proposals that could likely lead to an award. Concept papers will be evaluated within ninety (90) days of receipt.

2. EVALUATION APPROACH FOR PROPOSALS

Proposals submitted in response to this solicitation will be given a scientific/peer review evaluation by DEVCOM Soldier Center technical personnel in accordance with the evaluation criteria below. Each proposal will be evaluated based on the merit and relevance of the specific proposal as it relates to DEVCOM Soldier Center program requirements/needs, rather than against other proposals. Once a proposal has been submitted to DEVCOM Soldier Center as instructed in the specific Scientific and Technical Area of Interest listed in Section VI, the Offeror is to HAVE NO FURTHER CONTACT with the technical POC until the time a contract award exists. Inquiries regarding status of the evaluation may be submitted to the DEVCOM Soldier Center office that received the formal proposal (see the specific Scientific and Technical Area of Interest listed in Section VI.

Offerors whose proposals are considered not to have sufficient merit, which are not relevant to an Army need, or which are in areas where funds are not expected to be available will be notified as soon as possible after completion of evaluation that their proposal will not be further considered for a contract award.

Offerors who submit formal proposals via the guidance provided in the specific Scientific and Technical Area of Interest listed in Section VI will receive an initial notice of receipt, along with a summary of the next steps for evaluation of the proposal, when funding is expected to be available, and an estimated timeline for processing. The offeror is cautioned that the availability of funds as of the date of such notice is no guarantee that funds will be available at any given later date.

3. BASIS FOR AWARD

Offers will be selected based upon the outcome of proposal evaluation in accordance with the evaluation criteria cited below plus the availability and source of funds. Not all highly rated proposals will result in a contract award. The Government may elect not to award a

contract for every highly rated proposal for each topical area/specific interest area. The Government may award more than one contract in a given topical area/specific interest area or the Government may not award a contract at all in a given topical area/specific interest area.

4. FACTORS AND SUBFACTORS TO BE EVALUATED

Evaluation will be broken down into five (5) factors: technical, management, cost/price, past performance, and subcontracting plan/small business participation plan. The technical factor is the most important followed by management, cost/price, and finally, past performance. The technical factor has at least two (2) and up to three (3) sub-factors and cost/price has two (2) sub-factors, each of equal importance. Technical sub-factors A and B are of equal importance and technical sub-factor C is also equal when it is an applicable sub-factor.

Technical personnel will assign an adjectival and risk rating for the technical and cost/price factor and sub-factors, as well as the management factor of each proposal. Past performance areas will receive only a performance risk rating.

5. EVALUATION CRITERIA

a. **FACTOR I -Technical:** Each sub-factor in this factor will be evaluated and receive an individual rating. This factor will receive an overall rating based on the ratings of all the technical sub-factors combined.

(1) Sub-factor A: Technical Merit: The proposal will be evaluated on the relevance of the proposed effort in response to the topical area/specific interest area and the overall technical feasibility of the technology, capability, the product and/or the technology proposed.

(2) Sub-factor B: Technology Advancement/Warfighting Capability: The proposal will be evaluated on the potential to increase the combat effectiveness of the Army and the potential for exploiting a capability not likely to be executed elsewhere.

(3) Sub-factor C: Safety and HSI Requirements (when applicable): The proposal will be evaluated to assure that it has properly addressed safety/HSI requirements (see section V herein) by including the following information:

(a) The offeror's understanding of safety/HSI and how it applies to the proposed work.

(b) The methods/techniques the Offeror will use to ensure that safety/HSI will be incorporated into the program so as to ensure that the items/products delivered to the Government are safe and effective for use by personnel.

(c) The qualification/knowledge of the individual responsible for the offeror's safety/HSI requirements.

b. **FACTOR II - Management:** The proposal will be evaluated on the quality of the personnel, equipment, facilities, project management systems, controls (i.e., the overall organization), and the milestone schedule being proposed. The overall management plan will be evaluated.

c. **FACTOR III - Cost/Price:** Each sub-factor in this factor will be evaluated and receive an individual rating. This factor will receive an overall rating based on the ratings of both cost/price sub-factors combined.

(1) Sub-factor A: Cost/Price Benefit: The proposals will be evaluated to determine the overall benefit to the Government. Considerations will include industry contribution and fiscal feasibility. Fiscal feasibility includes the ability to accomplish the proposed project within Government fiscal constraints; the requirement for the use of other Government contractors to assist in the execution of proposed effort; and the use of Government furnished equipment, information, facilities, and other assets. The proposals will be evaluated to determine the extent to which the overall cost/price to the Government is reasonable.

(2) Sub-factor B: Cost/Price Realism: The proposals will be evaluated for cost realism to assess the likelihood that the technical and management approaches can be accomplished at the cost/price proposed.

d. **FACTOR IV - Past Performance:** The Offeror's and first tier subcontractor's past performance with Government and industry in the specific interest area or similar and/or related areas will be evaluated to assess the relative risks associated with the Offeror's likelihood of success in meeting the requirements stated in this BAA. Specific areas of past experience and performance examined will include demonstrated technical and schedule performance, cost control, general responsiveness to contract requirements, customer satisfaction, and customer focus. Emphasis will be on recent, relevant experience (see past performance area under Section II of this BAA).

e. **FACTOR V –Subcontracting Plan/Small Business Participation Plan**

(1) Small Business Subcontracting Plan (if applicable): Subcontracting plans will be reviewed for adherence to applicable public laws and regulations cited in FAR Part 19 and its supplements. Subcontracting plans will be rated as acceptable or unacceptable. An Offeror's refusal to submit an acceptable Subcontracting Plan is grounds for the Government to not negotiate award of that offeror's BAA proposal.

(2) Small Business Participation Plan: Small Business Participation

Plans will be evaluated against the evaluation criteria below and will be given an adjectival rating (see Section IV Evaluation Process, Part 6 Rating Method (b)). A Participation Plan templates provided at the beta.SAM link for W911QY20R0022.

1. The extent of participation of SB, SDB, WOSB, HUBZone, VOSB, and SDVOSB firms in terms of total contract value.
2. The extent to which such firms are specifically identified in proposals.
3. The extent of commitment to use such firms (for example, enforceable commitments are to be weighted more heavily than non-enforceable ones).
4. The complexity and variety of the work small firms are to perform.
5. Past performance of the offerors in complying with requirements of the clauses at FAR 52.219-8, Utilization of Small Business Concerns, and 52.219-9, Small Business Subcontracting Plan.
6. Provide a statement of the extent of the offeror's commitment to small business participation through its awards and must agree that SB, SDB, WOSB, HUBZone, VOSB, and SDVOSB concerns will have the maximum practicable opportunity to participate in contract performance consistent with its efficient performance.

6. ***RATING METHOD***

a. Under the technical portion in the HSI/safety evaluation only, the following method shall be used: the offer will be given a pass/marginal/fail in the evaluation areas cited; however, should a fail or marginal be given, the Government may be able to work with the offeror in order to assure HSI/safety requirements are correctly addressed.

b. Adjectival Ratings: The adjectival ratings that will be utilized for evaluating individual technical, management, cost/price factors and sub-factors, and small business participation are defined as follows:

(1) Excellent: Evaluation of the factor/sub-factor indicates the Offeror's proposal meets or exceeds all stated criteria by demonstrating a firm grasp of the requirements and translating the requirements into a well-defined and preferred approach. Innovative approaches that push the state of the art are present. The proposal exhibits strengths and does not contain any weaknesses or deficiencies.

(2) Very Good: Evaluation of the factor/sub-factor indicates the Offeror's proposal meets or exceeds all stated criteria by demonstrating an understanding of the requirements and translating the requirements into a well-defined and feasible approach. Innovative approaches that are, at a minimum, state of the art are present. The proposal exhibits some strengths and might contain one or more weaknesses but does not contain any deficiencies.

(3) Acceptable: Evaluation of the factor/sub-factor indicates the Offeror's proposal meets all stated criteria by demonstrating an understanding of the requirements and translating the requirements into a feasible approach. Limited innovation beyond the norm is present. The proposal may exhibit some strengths and might contain some weaknesses but does not contain any deficiencies.

(4) Marginal: Evaluation of the factor/sub-factor indicates the Offeror's proposal meets the majority of the stated criteria but either demonstrates a limited understanding of the requirements or translates the requirements into an approach that may not be feasible. The proposal may exhibit some strengths and might contain several weaknesses but does not contain any deficiencies.

(5) Unacceptable: Evaluation of the factor/sub-factor indicates the Offeror's proposal does not meet the stated criteria or contains one or more deficiencies that indicate a lack of understanding of the requirements. The stated criteria can only be met with major changes to the proposal.

c. Risk Assessment:

(1) The proposal risk assessment ratings for technical, management, and cost/price factors and sub-factors are defined as follows:

(a) High: Likely to cause serious disruption of contract effort or increase in cost/price of performance even with special contractor emphasis and Government monitoring.

(b) Moderate: Has some potential to cause minor disruption of contract effort or increase in cost/price of performance. Normal Government monitoring will probably be able to overcome most difficulties.

(c) Low: Has very little potential to cause disruption of contract effort or increase in cost/price of performance. Minimal Government monitoring will probably be able to overcome difficulties.

(2) The performance risk assessment ratings for past performance are defined as follows:

(a) High: Based on the Offeror's performance record, substantial doubt exists that the offeror will successfully perform the required effort.
(b) Moderate: Based on the Offeror's performance record, some doubt exists that the Offeror will successfully perform the required effort.
(c) Low: Based on the Offeror's performance record, little doubt exists that the Offeror will successfully perform the required effort.
(d) Unknown: No performance record identifiable. This is essentially a neutral rating, which will neither directly benefit nor negatively impact the offeror.

d. Definitions:

(1) Strength: An aspect of a proposal that appreciably decreases the risk of unsuccessful contract performance or that represents a significant benefit to the Government.

(2) Weakness: A flaw in the proposal that increases the risk of unsuccessful contract performance. A "significant weakness" in the proposal is a flaw that appreciably increases the risk of unsuccessful contract performance.

(3) Deficiency: A material failure of a proposal to meet a Government requirement or a combination of significant weaknesses in a proposal that increases the risk of unsuccessful contract performance to an unacceptable level.

SECTION V–SAFETY AND HUMAN SYSTEMS INTEGRATION REQUIREMENTS

In addition to the technical portion of your proposal, there are specific requirements for Safety and HSI (Manpower and Personnel Integration)/Human Systems Integration (HSI) that are governed by regulation that must be included, ***if applicable***, in any acceptable proposal.

Contractors who develop an item, equipment or system for use by U.S. Army personnel shall include the following system safety/health hazards and HSI requirements:

1. SYSTEM SAFETY/HEALTH HAZARD

Contractors who propose development of early technology or prototype materiel shall ensure an aspect of their effort is to identify potential mishap risks and that those risks are eliminated or controlled to an acceptable level. The objective of this effort is to preclude injury, illness, or death to the user or maintainer, or damage to the materiel developed. To ensure this objective, the contractor should describe its planned actions, may be required to conduct specific hazard analyzes, and should provide a safety assessment that:

a) identifies safety design standards (statutory, regulatory, industry consensus, etc.) utilized in the design;
b) identifies safety features, controls, devices, etc., incorporated into the materiel design;
c) includes Material Safety Data Sheets for potentially hazardous materials used in the manufacture or operation of the materiel;
d) residual risks associated with the use of the materiel; and
e) specific safety recommendations or precautions required to ensure the safety of personnel and property.

Acceptable levels of residual risk and combined hazard severity-probability (Risk Assessment Code) are provided below for the convenience of potential offerors. These "excerpts" were taken from MIL-STD-882D, Standard Practice for System Safety, which, if desired, may be seen in full text at the following web site: http://www.geia.org/sstc/G48/882d.pdf.

a. Risk Assessment: Decisions regarding resolution of identified hazards shall be based upon assessment of the residual risk involved. To aid the achievement of the objectives of system safety, hazards shall be characterized as to hazard severity categories and hazard probability levels whenever possible. A risk assessment procedure considering only hazard severity will generally suffice during the early design phase to minimize risk. When hazards are not eliminated during the early design phase, a risk assessment procedure based upon hazard probability hazard, hazard severity, as well as risk impact shall be used to establish priorities for corrective action of identified hazards or formal acceptance of residual risks.

Table 1 Risk Assessment Codes (RACs)

			PROBABILITY				
			Frequent A	Probable B	Occasional C	Remote D	Improbable E
SEVERITY	Catastrophic	I	IA	IB	IC	ID	IE
	Marginal	III	IIIA	IIIB	IIIC	IIID	IIIE
	Negligible	IV	IVA	IVB	IVC	IVD	IVE

Table 2 Risk Levels Indicated by RACs

HAZARD RAC	RISK LEVEL
IA-ID, IIA-IIC, IIIA	**HIGH** – Unacceptable
IE, IID, IIIB-IIIC, IVA	**MEDIUM** – Unacceptable
IIE, IIID-IIIE, IVB-IVE	**LOW** - Acceptable upon review & approval of System Safety PM/Project Officer & Supporting Engineer

b. Hazard Severity: Hazard severity categories are defined to provide a qualitative measure of the worst credible mishap resulting from personnel error; environmental conditions; design inadequacies; procedural deficiencies; or system, subsystem, or component failure or malfunction.

Table 3 Hazard Severity Definitions

DESCRIPTION	CATEGORY	DEFINITION
Catastrophic	I	Death or system loss
Critical	II	Severe injury, severe occupational illness, or major system damage
Marginal	III	Minor injury, minor occupational illness, or minor system damage
Negligible	IV	Less than minor injury, occupational illness or minor system

c. Hazard Probability: The probability that a hazard will be created during the planned life expectancy of the system can be described in potential occurrences per unit of time, events, population, items, or activity. Assigning a quantitative hazard probability to a potential design or procedural hazard is generally not possible early in the design process. A qualitative hazard probability may be derived from research, analysis, and evaluation of historical safety data from

similar systems. Supporting rationale for assigning a hazard probability shall be documented in hazard analysis reports. An example of a qualitative hazard probability ranking is:

Table 4 Hazard Probability Definitions

DESCRIPTION*	LEVEL	SPECIFIED INDIVIDUAL ITEM	FLEET OR INVENTORY**
Frequent	A	Likely to occur frequently	Continuously experienced
Probable	B	Will occur several times in the life of an item	Will occur frequently
Occasional	C	Likely to occur sometime in the life of an item	Will occur several times
Remote	D	Unlikely, but possible to occur in the life on an item	Unlikely, but can be reasonably expected to occur
Improbable	E	So unlikely, it can be assumed occurrence may not be experienced	Unlikely to occur, but possible

*Definitions of the descriptive words may have to be modified based upon quantity involved.
** The size of the fleet or inventory should be defined.

2. HUMAN SYSTEMS INTEGRATION

HSI is a comprehensive management and technical process designed to improve total system (user, hardware and software) performance through continuous integration of manpower, personnel, training, human factors, system safety, health hazards, and soldier survivability considerations throughout the materiel design, development, and acquisition process. HSI concerns that must be addressed during the performance of tasks are focused primarily on optimizing user/maintainer performance while minimizing error and simplifying maintenance tasks without introducing any new safety risks or health hazards. To ensure that this objective is met, if applicable, all developmental efforts shall include HSI/Human Factors Engineering analyses, which identify and evaluate operability and maintainability deficiencies.

Early discussions with appropriate POCs will identify whether or not HSI requirements apply to a particular effort. Typically, HSI applies to the design, development, and acquisition of all items, equipment, or systems intended for personnel use or that will require personnel interaction for the proper use, maintenance, repair, etc. These items include, but are not limited to, typical soldier products under the purview of DEVCOM

Soldier Center such as: personal protective clothing/equipment, food and food service equipment, tents/shelters and airdrop equipment. For efforts focused on research, HSI considerations, particularly those associated with safety and health hazards, shall apply when the product of a research effort will be utilized in the development of items, equipment, or systems.

Specifically, contractors shall consider the potential safety and health hazard implications that the products of their research efforts will have when/if those products are integrated into items. When HSI is required, it shall be addressed in the contractor's proposal under the technical section and will be evaluated under the technical section as outlined in Section IV, Factor I of this BAA.

For efforts requiring HSI considerations, the contractor shall provide documentation that should include, as appropriate to the proposal (but is not limited to), an explanation that describes how each HSI domain was (or will be) taken into consideration when designing/developing the item. Include a discussion relating to the trade-offs that were made, if any, and the rationale associated with those trade-offs and/or how trade-offs associated with the HSI domains will be addressed and handled. Specifically, the contractor shall address each domain regarding the proper use/operation, maintenance, inspection and repair of their product, as follows:

(1) Manpower/Personnel & Training: Address the numbers of personnel, their skill qualifications and training (either in the form of formal training, embedded training, training materials, etc.) that is or will be required.
(2) Human Factors Engineering:
    (a) Describe how sound Human Factors Engineering principles and practices were (or will be) applied to the design and development of the product.
    (b) The contractor shall utilize the data for design-critical human body dimensions as contained in the 2012 Anthropometric Survey of U.S. Army Personnel: Methods and Summary Statistics. Address what design-critical human body dimensions were (or will be) taken into consideration when designing the product (e.g., for proper fit of items or acceptable reach/accessibility, etc.).
    (c) When deemed appropriate, provide the following Human Factors Engineering analysis or the intention to provide this information:

        An explanation that documents and describes human performance errors and/or difficulties that may be encountered during operation, maintenance, and repair of the item, equipment, or system. For each error, include the estimated frequency of occurrence, the cause of the error/difficulty in terms of the conditions that may have contributed to it, the consequence of the error/difficulty on system operation, and

a brief explanation of the reason for the error/difficulty by the user.

An explanation that describes how human performance may impact system goals by including a narrative explanation of how human error associated with operations and the length of time required to perform operations may affect system reliability and effectiveness.

A description of potential incompatibilities among human performance capabilities and equipment to document both the aspects of performance that may be adversely affected and the associated equipment configurations/characteristics. The contractor shall identify the controls or displays that may be needed but are not present on the equipment.

Recommended solutions to these incompatibilities shall also be included and stated in terms of redesign, alteration of tasks, and/or training.

(d) Provide any instructions necessary for proper use/operation/ maintenance/repair of the equipment or a discussion of what instructions will be developed or will be necessary. The instructions shall include the proper method of interface with any other standard item that will typically be used/worn with their product.

(3) System Safety and Health Hazards: See paragraph 1 of this Section.

(4) Soldier Survivability: Soldier Survivability pertains to the characteristics of a system that can reduce fratricide, detectability and probability of being attacked, as well as minimize system damage, soldier injury, and cognitive and physical fatigue. Describe any impacts the product has on Soldier Survivability and/or how Soldier Survivability issues were (or will be) considered in the design/development of the product.

All contractor questions/concerns about proposal requirements for system safety engineering and HSI requirements may be discussed with the following appropriate POCs:

SAFETY: Ms. Jan Knowlton, TEL: 508-206-3500, janice.a.knowlton.civ@army.mil

HSI: Ms. Blake Mitchell, TEL: 508-206-3902, Katherine.b.mitchell.civ@army.mil

SECTION VI – SCIENTIFIC AND TECHNICAL AREAS OF INTEREST

A. COMBAT FEEDING

COMBAT FEEDING EQUIPMENT AND SYSTEMS

Combat Food Service Equipment for Individual and Group Feeding.

Ideas, concepts, and technologies applicable to sustaining troops on the battlefield are needed for four general mission areas: consolidated large groups (550 troops), companies (150 troops), squads/small combat units (~12 troops), and individual warfighters. Responsive proposals are directed towards minimizing the expenditure of energy, manpower, and other resources and materiel, and yet provide maximum flexibility and effectiveness in responding to the total food service requirements of troops operating under all battlefield threats, in all climatic and terrain conditions, and at all levels of commitment. Generally, the requirements are for systems and components that can be rapidly deployed/employed; are easily transported, included options for autonomous delivery offer quick response times; are highly efficient (i.e., require least manpower, fuel, maintenance, water, etc.); support all types of rations and menus; and can be readily adapted to any battlefield scenario. As such, equipment must be compact, lightweight, versatile (e.g., modular, multi-functional, multi-fuel capability, etc.), energy efficient, reliable, and easily operated and maintained. In addition, effective field sanitation and waste handling/disposal concepts are needed.

Field feeding equipment and systems can be classified according to the following specific interest areas:

(A) Individual
- (1) Ration and beverage heating
- (2) Ration and beverage chilling
- (3) Acquisition and treatment of water from the native environment

(B) Group
- (1) Heat and Serve
- (2) Storage of perishable fresh and frozen foods
- (3) Preparation of meals
- (4) Transportation, distribution, and service
- (5) Waste management, reduction, recycling, and conversion
- (6) Water Management, reduction and recycling
- (7) Surface sanitization and Foodservice sanitation
- (8) Refrigeration and ice making

Scientific and Technical Areas of Interest:

A comparison of current and emerging capabilities versus known and projected requirements of the Military Services indicates an interest in the following technical areas:

a. Diesel/JP8 combustion technologies including vaporization, atomization, and gasification (catalytic or otherwise) that are efficient, clean, reliable, and maintainable.
b. Exothermic and endothermic chemical technologies and thermoelectric technologies for heating and chilling rations/beverages that are safe, efficient, compact, and/or reusable.
c. Heat transfer technologies that will safely utilize all forms of generated/cogenerated energy (e.g., chemical, electrical, fuel combustion, etc.) for cooking, heating, and cooling rations and water.
d. Refrigeration technologies, ice making or other methods for safely storing perishable foods, that operate with minimum expenditure of energy and limited weight/space demands for all modes of transport, storage, and distribution of perishable subsistence in the field.
e. Refrigeration and ice-making technologies to enable mobile, military, containerized cold storage that uses refrigerants with high efficiency, reliability and a low GWP (global warming potential).
f. Equipment technologies for safely thawing cases and pallets of frozen foods.
g. Field amenable methods and equipment to improve the sensitivity and selectivity for detection and identification of microbiological or chemical contamination in foods.
h. Material technologies for new structural and insulation materials appropriate for food service equipment that provide improved durability, strength, energy efficiency, and cost.
i. Material technologies for new structural and heat transfer, heat retention, recovery, and/or thermal control materials appropriate for individual and group ration heating that provide improved ration component heating time and energy efficiency while reducing bulk, weight, and cost.
j. Equipment and systems technologies to reduce, recycle, and/or extract energy out of food service waste in an efficient, safe waste handling, and disposal in an environmentally acceptable manner.
k. Food equipment sanitation technology that reduces the logistics of cleaning and sanitizing cookware by reducing water, reducing fuel required to heat water, treating and recycling the water, novel disinfectants and sanitizers, or other forms and processes for waterless sanitation.
l. Methods and equipment for the decontamination of fresh fruits and vegetables in a field feeding environment.
m. Equipment technologies to ensure the sanitary protection of food and

beverages during assembly, preparation, service, and distribution in the field, and systems concepts for efficient and effective cleaning and sanitation of field feeding equipment.

n. Novel power supplies for efficiently and effectively producing/storing and/or providing electric power to operate field feeding equipment including consideration of such factors as size, weight, cost, reliability, safety, maintainability, useful life, and environmental factors.
o. Equipment technologies, novel methods, and devices for heating food and chilling water on aircraft in vehicles, or otherwise while on the move.
p. Equipment technologies that offer improvements in baking, roasting, steaming, boiling, simmering, and grilling.
q. Equipment and technologies to reduce cooking, cleaning, and maintenance labor in Navy ship galleys and sculleries.
r. Automated Information Systems, Radio Frequency Identification, and sensors for food service equipment and systems to include wireless systems that support more efficient and effective food service operations to include inventory management, rotation, shelf-life measures, and waste management.
s. Equipment technologies integrated with the food service equipment or systems to automatically reduce the power consumption for electric food service equipment items and/or automatically manage the available electric power more efficiently to increase cooking throughput without increasing the weight, volume, manpower, and cost.
t. Equipment and technologies and systems that reduce labor by automatically tracking and storing subsistence items aboard Navy ships.
u. Equipment and technologies for acquisition of water from the native environment by squads and/or individual warfighters such as atmospheric water harvesting, desalination, ice/snow melting, extraction from plants, etc. to reduce logistical burden.
v. Equipment and technologies for treatment of water acquired from the native environment by squads and/or individual Soldiers to minimize exposure risk to chemical and biological contaminants.
w. Technologies to enhance capabilities of shelter materials used in field feeding environments including heat reduction technologies such as reflective coatings, anti-microbial and/or anti-mold materials, energy harvesting, weight reduction, ballistics protection, and/or insulation for arctic environments to reduce logistical burden.
x. Equipment and technologies to utilize advanced manufacturing including but not limited to bioreactors to produce food ingredients and products in austere environments.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:

Michael Wiederoder, TEL: (508) 206-3366, michael.s.wiederoder.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Combat Capabilities Development Command Soldier Center
Combat Feeding Division, Soldier Sustainment Directorate
ATTN: FCDD-SCP (Ms. Donna Glowka/Ms. Jean Trumpis)
15 General Greene Avenue Natick, MA 01760-5018
TEL: 508-206-3397/508-206-3398
Donna.m.glowka.civ@army.mil
Jean.m.trumpis.civ@army.mil

COMBAT RATION RESEARCH AND DEVELOPMENT

Shelf-stable prepared combat rations are essential for enabling the individual warfighter to perform assigned missions and to survive battlefield threats. The requirements for compactness, storage stability, protection, modularity, enhanced nutrition, warfighter acceptance, convenience, and producibility have become even more stringent in anticipation of supporting highly mobile, widely dispersed warfighters in climatic extremes.

Combat ration functionality goals can be divided into the following specific interest areas:

- Storage stability with maximum quality and nutrient retention
- Production and distribution efficiency
- Consumption/acceptance enhancement
- Nutritional interventions for human performance optimization/enhancement
- Validated ex vivo/in vitro model systems for assessing nutrition interventions to optimize/enhance human performance and countermeasures against military relevant stressors
- Improved, enhanced, and more effective protective packaging systems
- Collection and consolidation of quality assurance and environmental data
- Food protection from incidental or intentional contamination
- Novel, non- or low-thermal food processing methods and technologies
- Novel manufacturing technologies, including additive manufacturing, that enable food production at point of need that can be tailored to warfighter needs.
- Food preservation and hurdle technologies that enable ‘clean label’ formulations.
- Environmentally preferable “green” food processing methods and

sustainable high barrier food packaging materials
- Footprint reduction technologies to reduce weight and volume of operational rations
- Nutrient densification technologies to ensure adequate nutrition in portable ration components
- Alternative ration delivery and distribution mechanism for emergency resupply of rations, and to unburden Class 1 logistics
- Efficient artificial intelligence (AI) to ease and enhance the delivery, distribution, and storage of operational rations

Scientific and Technical Areas of Interest:

A comparison of current capabilities versus future battlefield requirements indicates the need to explore key emerging areas of scientific knowledge and technological capabilities. These Scientific and Technical (S&T) Areas of Interest are in direct support of several operational/capability requirements serving the needs of the Armed Services in the near, mid, and longer-range timeframe and on the future battlefield (Future Force). The S&T Areas of Interest also support the following major thrusts: enhanced performance; energy and nutrient intake; nutrient stability and bioavailability; improved consumption rates; tailored nutrition; and reduced ration weight and volume, source material, and waste. In addition, each S&T area is linked to Defense Strategic Goals, Force Transformation, the Joint Operational Concepts, and the Services visionary documents to provide the total spectrum of joint service support to sustain the warfighter on the battlefield through technological advantage, thereby ensuring focused logistics, improved responsiveness, deploy-ability, agility, versatility, survivability, and improved combat readiness and effectiveness. The spectrum of likely operations describes a need for land forces in joint, combined, and multinational formations for a variety of missions extending from humanitarian assistance and disaster relief to peacekeeping and peacemaking to major theater wars.

Advanced, multi-functional, effective, and efficient protective packaging systems are crucial to the preservation of Army material in any climatic and/or hazardous environment. Material requirements for protective packaging systems relate to both food and food service equipment.

In order for the individual warfighter to perform the assigned mission and/or survive battlefield threats, mission essential items must arrive at the right time at the right place and provide the expected functionality and utility. Technological advances in high barrier polymer films and coatings, active and intelligent packaging are needed to meet the increasingly stringent and sometimes conflicting requirements of compactness, sustainability, storage stability, recyclability, protection, modularity, durability, convenience, degradability, and producibility. Packaging functionality includes (as applicable) protection from the following events: temperature extremes, insect/rodent

infestations, moisture permeation, oxygen permeation, light penetration, microbial penetration, tampering events, loss of integrity, and transportation hazards (including rough handling and air drop). Advanced systems for tracking and monitoring quality of ration unit loads are required for flexible logistic systems for the future battlefield.

The key areas of science and technology include:

a. Scientific information and advanced processing/manufacturing technologies are needed to ensure that nutrients required for optimum performance under stress are provided and are physiologically available for utilization.
b. Improved technology is needed to produce a greater variety of ready-to-eat, lightweight, low-volume, nutrient/calorie-dense ration components that are palatable, cost effective, and producible by the ration industry.
c. Innovative food processing technologies and systems are needed to provide for cost-effective, high-volume production of shelf stable, wet, intermediate moisture, or dry foods with maximum retention of quality factors and nutrition.
d. Scientific information is needed about the influence of food constituents and processing (traditional and novel advanced methods) on the physical structure, chemical reactivity, nutrient preservation, package integrity, and microbiological safety of ration components to ensure their stability under extreme storage conditions (with special interest in dairy products, eggs, and other high-protein foods).
e. Scientific information and unique advanced manufacturing technologies (e.g., 3D Printing, synthetic biology, precision fermentation) are needed to produce customized meals on demand on or near the battlefield that meet individual warfighter nutritional needs.
f. Scientific information and innovative technologies/methodologies are needed about maximizing quality/nutrient retention and extending shelf life/storage stability of fresh fruits and vegetables as well as cost effective logistical support mechanisms or implementation strategies suggested for viable technologies.
g. Programming and database development is needed for exploiting a ration item optimization model to guide the selection of ration components or off-the-shelf items intended for diverse missions based on energy requirements, nutritional content, battlefield operational conditions, personal preferences, weight, volume, and cost of items or components.
h. Validated scientific information is needed to determine the basis for and extent to which specific food constituents incorporated into the food: 1) delay fatigue, 2) optimize physical strength and endurance, 3) accelerate recovery from strenuous exertion and musculoskeletal injury, 4) heighten alertness or enhance cognitive abilities, 5) increase feelings of satiety of

warfighters engaged in physically or mentally demanding tasks, or 6) promote warfighter health protection and fitness, prevent injury and illness, conserve the mental and physical well-being of warfighters, and maintain personal readiness.

i. Biotechnology-based solutions are needed for integration and simulation of human in vitro/ex vivo organ systems in order to develop more physiologically relevant model systems for evaluating nutritional interventions that protect, alleviate, mitigate, or reverse detrimental effects of warfighter relevant stressors on host (human) physiology and performance.
j. Scientific concepts and data are required for increasing the speed and sensitivity of detection technologies (sensors) for food, water, and ice safety determination to include novel approaches in preparation of samples from complex food and water matrices, high throughput screening capabilities, improved transducer technologies, and capture efficiencies. In addition, field-portable objective and quantitative technologies are required for determination/estimation of ration quality status or presence of food- and water-borne pathogens and chemical contaminants.
k. Scientific information is needed for the development and implementation of strategies for the application of novel pathogen reduction technologies for fresh fruits and vegetables and for food preparation and eating surfaces.
l. Scientific information is needed for the development and implementation of methods or technologies for rapid detection of food quality deterioration and lipid oxidation in shelf stable foods during storage.
m. Scientific information is needed for the development and elaboration of food safety risk analysis decision-making tools such as in comprehensive food processing and environmental risk assessments as well as predictive models of pathogen behavior in specific food matrices.
n. Scientific information is required for novel strategies in the development of a universal enrichment media for the growth and detection of foodborne pathogens with rapid diagnostic technologies.
o. Packaging technology based on non-foil, high barrier polymeric material is needed to ensure protection against oxygen, moisture vapor, microbial, and insect penetration to maintain integrity throughout the military logistics system, and to provide rations with a minimum three-year shelf life.
p. Active/smart packaging materials/films/coatings and in-packaging adjuvants are needed that possess inherent properties for scavenging or eliminating moisture, oxygen, off odors (e.g., aldehydes), carbon dioxide,

and/or ethylene (as appropriate) as well as repelling insects and rodents. Technology is also needed for packaging materials/systems (e.g., microencapsulation, bioactive packaging) containing anti-microbial or biocidal agents, physiological inhibitors for fresh produce and other methodologies to control or modify the atmosphere within a package for extension of shelf life.

q. Technology is needed to develop advanced materials/films/coatings for flexible, semi-rigid, and rigid polymeric containers that provide physical and chemical protection comparable to traditional aluminum foil-based high barrier polymeric materials. Determine compatibility of non-foil high barrier polymeric material for both thermo-processing and novel thermal/nonthermal processing (e.g., microwave or high-pressure processing).
r. Technology is needed to develop a model that will predict the barrier performance of film structures incorporating multiple high barrier technologies, while taking into account environmental variables such as temperature and relative humidity, packaging configuration, headspace composition, interaction between product and package, and process-induced stresses in packaging materials.
s. Technology is needed to advance packaging to reduce weight and volume and to make it more sustainable, recoverable, recyclable, compostable, biobased, degradable, and capable of being decontaminated. Technology should be innovative, high-performance, manufacturable, for incorporation into ration primary and secondary packaging systems to enhance ration container and unit load performance during long-term storage and rough handling conditions. Multi-functional coatings and/or additives may also enhance the utility of secondary packaging. Enhanced systems must adequately protect military rations and must ensure sufficient burst strength and compression/stacking strength properties. [see related “w” previous section]
t. Low cost, intelligent packaging technologies including enhanced bar code labels, printed electronic sensor devices/labels with displays, energy harvesting materials and smart indicators for reconstitution water fill lines and food serving target temperatures are needed to enhance primary, secondary, and/or pallet-level ration packaging systems to improve strategic handling, product storage/rotation/inspection, assembly, mobility, deploy-ability, transportability (including unmanned aerial delivery), security, logistics and distribution supply chain tracking and retrieval, and to ensure reliable operation of components in all scenarios.
u. Technology is needed to automate and centralize manufacturing (traceability) and inspection data and to provide real-time asset visibility and tracking of environmental storage/history data to accurately predict the

remaining shelf life of operational rations, and to facilitate improved process efficiency and management of the ration supply chain throughout the lifecycle.

v. Technology is needed to develop cost effective convenience and portable packaging features/designs, including easy-to-open, eat-on-the-move, and reclose able functional packages for dispensing both conventional and unconventional solid and reconstituted liquid ration components.

w. Technology is needed to develop flexible, semi-rigid and/or rigid high barrier materials that are: compatible with Horizontal/Form/Fill/Seal machinery; capable of withstanding classical thermos processing, microwave or high-pressure sterilization, as well as aseptic packaging; and capable of providing products with a three-year shelf life.

x. Technology is needed to develop and produce lighter weight, shelf-stable, highly appealing, and verifiably nutritious individual and group operational ration systems having a smaller footprint or modular subsystems that require little or no preparation and are adaptable for Joint Service applications in global deployments and all operations ashore and afloat. Nutritious and novel sustainment systems must support the future Modular Force and Joint Operational Environment under all battlefield threats and climatic conditions enabling an agile and adaptive military response for 'prompt' and 'sustained' operations.

y. Technology is needed to develop biodegradable or edible ration packaging systems to reduce battlefield waste/signature in multidomain operations.

z. Technology for high thermal conductivity packaging materials to reduce energy required for heating ration components.

aa. Advanced technologies, innovation, and concepts to devise novel systems, capabilities, and/or methodologies to enhance distribution-based combat ration sustainment to deliver the right rations, to the right place, at the right time, over extended distances supporting global deployments. Logistics and sustainment delivery concepts must optimize operational efficiency and cost effectiveness, ensure warfighter acceptability and nutrition, and achieve strategic responsiveness for highly mobile, rapidly deployed forces involved in extended operations requiring Class 1 resupply. Innovative sustainment concepts should emphasize speed, precision, accuracy, visibility, and reduce or eliminate traditional supply chain management problems including product identification and location, stock rotation and management issues, product spoilage losses, and menu fatigue.

bb. Technology is needed to develop imaging and spectroscopy methods to assess combat ration safety, quality, and composition using discrete metrics ensuring warfighter acceptability and nutrition standards. Such

technologies may be combined with image processing, algorithm development, and/or machine learning to minimize variations in formulation, detect and identify adulterants, verify quality standards (spoilage, oxidation, browning, etc.), and identify chemical and/or biological hazards in combat rations.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:

Michael Wiederoder TEL: 508-206-3366, michael.s.wiederoder.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
Combat Capabilities Development Command Soldier Center
Combat Feeding Division, Soldier Sustainment Directorate
ATTN: FCDD-SCP (Ms. Donna Glowka / Ms. Jean Trumpis)
15 General Greene Avenue Natick, MA 01760-5018
TEL: 508-206-3397 / 508-206-3398
donna.m.glowka.civ@army.mil / jean.m.trumpis.civ@army.mil

B. SOLDIER PROTECTION AND SURVIVABILITY

WARFIGHTER SYSTEMS TECHNOLOGIES

1. Integrated Protective Headborne Equipment and Injury Diagnostic/Assessment Tools.

Head borne protection for the individual combatant involves protection of the head (to include the eyes, neck and throat) against ballistic and blast threats such as the following:

a. Blast over pressure
b. Blast fragments
c. Blunt Trauma (blast induced, ballistic induced, or low velocity impact)
d. Small arms threats (handgun and rifle rounds)

New materials, material processing techniques, designs, modeling and simulation tools, survivability models, treatments, and diagnosis technologies are required to meet this broad range of threats while also providing in-depth consideration of the appropriate ergonomics, comfort, hearing, mission requirements, thermal/vapor management, and other cognitive functions necessary for the combatant to fully execute his/her operational duties without extensive physical or mental impairments.

<u>Scientific and Technical Areas of Interest:</u>

A comparison of current capabilities versus future battlefield requirements dictates interest in the following major areas of scientific knowledge and technological capabilities.

Technology is needed for:

a. New and improved polymers for fiber reinforced composites which can provide increased ballistic protection and lighter weight.
b. New fibers and materials for energy absorption and moisture vapor permeability/cooling management.
c. New material processing techniques focused on uniform performance or increased performance particularly using additive manufacturing.
d. New and improved transparent materials for enhanced eye protection without compromising optical clarity, stretch resistance, anti-fog, multi-hit capability, and light transmittance.
e. Improved lightweight integrated communications devices.
f. Engineering designs that incorporate enhancements to the protective head borne equipment system including power and data architecture, area of coverage, field of view, modular attachment points, speech recognition, and compatibility/interoperability with other equipment.

g. Predictive modeling and simulation tools for blunt impact suspension systems using any type of 3D printed engineered structure.
h. Modeling and simulation survivability design tools including biomechanics and injury prevention/diagnosis models.

A need also exists for:

i. Novel modular designs and integration concepts to identify the best technical approach to provide head protection to the individual combatant against multiple ballistic and non-ballistic threats. Such concepts should identify ballistic protection capabilities for each component and area of the head to be protected. Upon identification of critical design elements, further efforts should establish the feasibility of systematically combining those modular components into a lightweight head-borne system of approximately 3.5 pounds, providing a high level of protection against the identified threats and a high level of user comfort.
j. Unique and novel design approaches that utilize the currently fielded equipment and developmental items as a base platform for incorporating modular components for improved ballistic/blast protection and which would offer the user the ability to tailor the level of protection to the current threat by adding or removing modular integrated components (i.e. face shield, eye protection, and neck protection).
k. Ergonomic and human factor studies to identify key parameters for user acceptability. The identified design(s) include studies, laboratory data, and human evaluations for heat stress retention, stability, ability to fire weapon systems, maneuverability, and general form, fit, and function of proposed design.
l. Modeling and simulation design and material evaluation tools that provide engineers and medical personnel the appropriate human interface information necessary to mitigate injuries from a variety of threats encountered on the modern battlefield.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Mr. Benjamin Fasel, TEL: 508.206.3783, benjamin.p.fasel.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Mr. Benjamin Fasel)

General Greene Avenue
Natick, MA 01760-5019
TEL: 508.206.3783
Email: usarmy.natick.devcom-sc.mbx.osi-spsd@army.mil and
benjamin.p.fasel.civ@army.mil

2. Modular Personal Protection Equipment (MPPE) and Injury Diagnostic/Assessment Tools.

The US Army is seeking innovative solutions to develop advanced body armor systems that provide enhanced protection against a range of threats, including ballistic, fragmentation, and blast debris. The goal is to create systems that are not only effective but also lightweight, flexible, and modular, allowing for scalable protection tailored to specific mission requirements and threat scenarios. Additionally, new diagnostic and assessment tools/methods that medically evaluate the effectiveness of armor and the individual combatant as well as modeling and simulation design tools, survivability models, treatments, and diagnosis technologies are needed in order to more fully characterize specific warrior threats and populations at risk, requiring further clinical intervention. In order to support this requirement, new diagnostic and assessment methods and tools for behind armor and penetrating wounds are required. In addition, research data needs to be collected in a systematic manner for the various services, compiled, and analyzed in order to develop a baseline for a requirements document. The injury data is a key element in developing treatment and diagnosis tools and new protection/survivability models so that troops may be better protected in future engagements and injuries treated at the front lines.

a. Developing armor systems that conform to individual body contours, ensuring a secure and ergonomic fit for soldiers of all shapes and sizes. This could involve using advanced materials or innovative mechanisms to create conforming or conformal designs that provide a close fit with minimal bulk. Key considerations include enhancing mobility, comfort, and range of motion for the wearer, as well as integrating with load carriage and operational gear without compromising functionality.
b. Creating novel hard armor plate materials and designs that reduce weight while maintaining or exceeding ballistic performance standards. This could involve exploring advanced ceramics, hybrid material systems, ultra-high-pressure consolidation, and additive manufacturing techniques such as 3D printing to achieve lighter, more flexible plate systems. Scalability and modularity are essential considerations to ensure that protection can be tailored to specific threat levels.
c. Designing next-generation soft armor systems using advanced materials such as nanofibers, shear-thickening fluids, or new nonwoven textiles. The focus should be on improving protection against fragmentation, blast debris, and

unconventional ballistic threats while reducing weight and increasing comfort and flexibility for extended wear in diverse operational environments.

d. Developing technologies to protect against battlefield threats including but not limited to small arms, high-velocity fragmentation threats, blast debris and effects, secondary projectiles, and other hazards. Research should address materials, system architectures, multi-layered systems, and/or energy-dissipating technologies that can integrate seamlessly with existing and future body armor systems without compromising mobility or comfort. Novel design approaches are desired to enhance protection against these threats while minimizing weight and bulk.
e. Designing modular body armor systems that can be customized to meet specific mission requirements and threat scenarios. Systems should integrate multiple components into a cohesive, lightweight design that provides tailored coverage, from full-body protection to lighter configurations for high-mobility missions. Compatibility with existing load carriage and operational gear is essential.
f. Developing new test protocols, tools, and standards to evaluate body armor performance under realistic conditions. Testing should address multi-threat environments, including ballistic fragmentation, environmental and blast effects, and incorporate parameters such as durability, thermal comfort, mobility, and blunt trauma mitigation. In-field assessment tools for real-time diagnostics and performance evaluation are also of interest.
g. Exploring the application of advanced materials and manufacturing methods, such as nanomaterials, advanced composites, and additive manufacturing, to improve body armor systems. Proposals should aim to create lighter, more durable, and more flexible systems that provide enhanced protection across a range of operational conditions.
h. Modeling and simulation design and material evaluation tools that provide engineers and medical personnel the appropriate human interface information necessary to mitigate injuries from a variety of threats encountered on the modern battlefield.
i. There is a need for research programs with specific goals and end-points for health related issues relevant to military personnel and veterans. These research programs are generally concerned with topics relating but not limited to healthcare delivery, detection, diagnosis, treatment and control or eradication of specified chronic diseases, conditions, or syndromes, or to other initiatives relevant to health needs.
j. Studies of blast effects to include overpressure and behind armor effects on the individual and materials/systems to mitigate effects.
k. Additional concepts may include transparent armor, smart materials for armor and other functionalities, and nanotechnology approaches to new materials. Novel concepts which may include active armor are of interest.
l. Ergonomic and human factor studies to identify key parameters for user

acceptability. The identified design(s) include studies, laboratory data, and human evaluations for heat stress retention, stability, ability to fire weapon systems, maneuverability, and general form, fit, and function of the proposed design.

Technical POC:
Dr. David Otterson, TEL: 703.828.4254, david.m.otterson.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Dr. David Otterson)
General Greene Avenue
Natick, MA 01760-5019
TEL: 703.828.4254
Email: usarmy.natick.devcom-sc.mbx.osi-spsd@army.mil and david.m.otterson.civ@army.mil

3. Chemical/Biological Protection for Individuals.

The protection of the Warfighter from exposure to hazardous chemicals, such as chemical warfare agents, is essential to mission accomplishment on today's battlefield and that of the future. This protection is currently accomplished through the use of an activated carbon system, the use of semi- or selectively- permeable material systems, and the use of impermeable barrier materials. The activated carbon system is used in protective overgarments and affords protection by adsorbing hazardous chemicals. The impermeable barrier materials consist of rubber, coated, and multilayer laminate fabrics found in gloves, boots and special purpose (e.g. depot storage/demolition/explosive ordnance disposal ensembles), which afford protection by acting as a physical barrier to chemicals.

Future needs for chemical protective uniforms require that they protect against multiple threats including toxic aerosols and biological agents, be self-decontaminating, and be reusable. These uniforms must also be comfortable in all climates and not impair the mobility or performance of the Warfighter. The materials for these uniforms should be lightweight; retain protection post-laundering; have improved protection for resistance to liquid, vapor, and aerosol CB agent penetration; lessen the propensity for heat stress; have increased durability and shelf life; be resistant to petroleum, oils, and lubricants (POLs) and other battlefield contaminants, and be reusable through the use of reactive and biocidal materials that will detoxify the chemical warfare (CW) agents without adverse reaction with the skin. There is a need for the development of methods for measuring adsorption of agents and agent surrogates within protective materials

(particularly liquid challenge/liquid penetration) and for determining the reaction products (quantitative and qualitative) that originate from detoxification chemistry taking place in catalytic and reactive materials.

With impending regulations and increased ligations with Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), supply chains for these compounds are dwindling. Therefore, any novel materials and solutions need to be free of PFAS materials moving forward. Solutions should also consider any potential regrettable substitutions to avoid similar challenges in the future.

A need exists to alleviate the effects of extreme environmental loads through the use of microclimate conditioning. In particular, there is a need to mitigate the effects of heat stress induced by personal protective clothing. Microclimate Cooling Systems (MCS) are effective in removing excess stored body heat, resulting in reduced body core temperature rise and reduced skin temperature. Operationally, MCS can significantly increase users' mission duration, improve mental acuity, reduce hydration needs, and enhance thermal comfort. However, the size, weight, and power consumption of these systems have precluded their use for many users. Thus, there is a need to minimize these parameters to improve the acceptance of MCS for the military and First Responder communities.

A comparison of current capabilities versus future battlefield requirements dictates interest in the following major areas of scientific knowledge and technological capabilities:

a. Novel materials and concepts that could provide protection against highly toxic compounds, including toxic industrial chemicals (TIC) and military offensive chemical agents (blister, nerve, etc.) in gross contamination amounts for extended periods (greater than four hours), and biological agents. We are also interested in related exploratory development proposals such that feasibility can be established for the development of improved CB agent/TIC protective and biological agent protective suits, garments, gloves, and socks. Proposals that emphasize lighter weight, improved protection, improved decontamination (through the use of self-decontaminating or biocidal materials or materials that can be regenerated in the field), improved durability and launderability, reduced heat stress, and other human factor concerns are of particular interest. Intelligent textiles and polymers are of interest. These may include materials with controllable, variable permeability. For gloves, novel technologies that improve tactility, durability, and moisture vapor transport are desired. All novel materials and solutions should be not using any intentionally added PFAS and take into consideration any regrettable substitutions.
b. Swatch and system test methodologies for evaluating the effectiveness of emerging CB material technologies to provide protection against hazardous

chemicals.

c. Low cost service life indicators that can be worn or stored inside a chemical protective garment package to visibly display or provide some reading as to the degree of protection remaining in the garment are of interest as are applications of novel polymers and smart materials.
d. Reduce/minimize the need for live agent testing to verify the chemical protection of current carbon-based sorptive systems.
e. Advanced material technologies such as elastomeric, polymeric, semi-permeable, or selectively permeable membrane technology that allows selective permeation of moisture while preventing penetration of chemical and biological warfare agents in the forms of liquid, vapor, and aerosol, without the use of intentionally added PFAS.
f. Garment design and novel closure systems for CB protective clothing systems. We are interested in ensemble designs that enhance protection and reduce thermal burden. We are also interested in elastic/stretchable polymeric materials such as thermoplastic elastomers for development of closure systems that provide and maintain chemical/biological agent protection in normal and in stretched states.
g. Mechanisms and garment treatments that capture and possibly react with aerosolized (<5micron) threat particles. Key to this work would be to demonstrate that such treatments could remain effective during the normal use and service life of the protective garment.
h. Improved and multi-functional outer shell materials for CB protective garments. We are interested in materials with novel surface modification to either their fibers or the fabric that improve comfort and protection of the garment. Some areas include comfort, durability, air permeability, water solvency, and oil repellency (i.e. omni phobic or superhydrophobic and super oleophobic) of the materials, without the use of PFAS, for the life of the garment.
i. Development of self-healing polymers for CB protective clothing applications.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POCs:
Ms. Molly Richards, TEL: 508.206.3945, molly.n.richards2.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Ms. Molly Richards)
General Greene Avenue

Natick, MA 01760-5020
TEL: 508.206.3939
Email: usarmy.devcom-sc.mbx.osi-spsd@army.mil and
molly.n.richards2.civ@army.mil

4. Countersurveillance.

Survivability is fundamental to the conduct of warfare. The countersurveillance mission is to enhance the survivability of the Warfighter on the battlefield by providing textiles for uniforms, individual equipment (to include carried equipment), and paints/textiles for exposed skin that reduce detectability by various sensors. These sensor threats include the eye, near infrared image intensifiers, short-wave infrared devices, thermal imagers, radar, and multi-spectral sensors. Sensor threats may be operated solely by a human observer, or in conjunction with a computer observer, e.g. Automatic Target Recognition (ART) and Aided Target Recognition (AiTR) algorithms. ATR/AiTR defeat includes reduction of the effectiveness of these tools by degrading their ability to detect, recognize, and identify the Warfighter.

Signature suppression with textile and skin camouflage materials usually takes the form of dyes/pigments, additives, and coatings. New novel and innovative solutions are encouraged. Thermal countermeasures must not degrade existing countermeasures for visual and near infrared (NIR) protection. They should be passive, hypo-allergenic and not increase the bulk or heat stress over levels currently imposed by existing clothing systems.

Scientific and Technical Areas of Interest:

Analysis of user requirements and current capabilities indicates the need for:

a. Near and far term research proposals related to novel concepts and materials that:
   - Defeat the threat of short-wave infrared (SWIR) devices.
   - Defeat the threat of mid-wave infrared (MWIR) thermal sensor detection.
   - Defeat the threat of long-wave infrared (LWIR) thermal sensor detection.
   - Defeat the threat of radar detection.
   - Defeat multispectral threat sensors.
   - Defeat hyperspectral threat sensors.
   - Defeat ATR/AiTR algorithms.
   - Provide novel camouflage solutions to current and future sensor threats by exploring the applicability of a wide variety of technical approaches without compromising visual and NIR performance.
   - Provide NIR and SWIR protection and maintain shade after laundering and exposure to various environmental conditions.

- Provide protection to exposed hands and facial areas to defeat multispectral sensor detection.
- Provide protection by concealment of carried equipment to defeat multispectral sensor detection.
- Provide materials and/or coatings/paints capable of temporarily adjusting visual/NIR/SWIR/MWIR/LWIR camouflage in the field for uniforms and personnel protective equipment (PPE) for enhanced concealment in specific areas of conflict/interest.
- Provide new manufacturing technologies for the scale-up of printing and fabrication of textile uniforms and equipment to facilitate a quick turnover of novel camouflaged final products to the Warfighter.
- Provide materials and systems worn or carried by the Soldier to be used for identification of friend or foe. The materials and system should be covert (not a signature offender) and compatible with current and future night vision systems.

b. Exploratory development proposals related to the above areas under which the feasibility of such proposals may be demonstrated.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POCs:

Ms. Anabela Dugas, TEL: 508.206.3959, Anabela.dugas.civ@army.mil
Mr. Michael Manser, TEL: 508.206.3138, michael.j.manser.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Mr. Axel Rodriguez)
General Greene Avenue
Natick, MA 01760-5020
TEL: 508.206.3169
Email: usarmy.devcom-sc.mbx.osi-spsd@army.mil and axel.e.rodriguez-negron.civ@army.mil

5. Body Worn Interactive Materials.

Electronic subsystems, devices, and sensors are being miniaturized for personal use. Novel materials, technologies, and manufacturing methods are needed to integrate these electronics into textiles, protective clothing, or combat field equipment. There is an interest in the development of textile-based conductive materials and integration of these materials and electronics into textile clothing and individual equipment to provide

multiple performance enhancements.

Desired materials and products shall be safe to wear, lightweight, flexible, launderable, resistant to corrosion and water contamination, and durable to wear and tear. In addition, novel materials providing sense and respond, or actuation capabilities, power generation, or radio frequency tagging are of interest.

Scientific and Technical Areas of Interest:

A comparison of current capabilities versus future battlefield requirements dictates interest in the following major areas of scientific knowledge and technological capabilities.

Technology is needed for:

a. New fiber forming polymers that provide conductive, radiative, or optical performance. Conductivities of conductive fibers should approach that of metals for power/data transmission applications.
b. Responsive fibers and fabrics that can sense and respond to a particular stimulus.
c. Novel manufacturing processes to integrate electro-optic fibers, yarns, films, and materials into fabrics. These processes should be capable of large-scale production of the materials.
d. Techniques to integrate or mount battery powered wireless or wired sensors or other miniature electronic devices into or onto fabrics or other individual equipment.
e. Development of ergonomic connector technologies to attach/detach electronics and sensors to/from network.
f. Methods to translate standard cabling such as USB 2.0, Firewire (IEEE 1394), and coaxial cables into flat, lightweight, flexible, wearable textile-based conductors.
g. Integration methods of textile-based body-worn antennas into protective clothing and equipment.
h. Novel wearable power generation technologies to provide minute battery charging capabilities or to provide for direct power of low consumption miniature electronic devices.
i. Lightweight Electromagnetic Interference/Radio Frequency (EMI/RF) shielding capabilities for wearable electronic components and conductive networks.
j. Radio Frequency tagging for technical applications such as local positioning within a building and for inconspicuous data storage and collection.
k. Development of ergonomic computer input devices for hardware of other clothing items.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Paola D'Angelo, TEL: 508.206.3972, paola.a.dangelo.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Paola D'Angelo)
General Greene Avenue
Natick, MA 01760-5020
TEL: 508.206.3972
Email: usarmy.devcom-sc.mbx.osi-spsd@army.mil and
paula.a.dangelo.civ@army.mil

6. Materials Nanotechnology.

Nanotechnology, the understanding and manipulation of matter at the nanometer scale, offers opportunities to create materials with new or significantly improved properties relative to known materials. Metamaterials and metasurfaces are examples of artificial materials, designed for unusual properties that don't usually occur in Nature, with structures (nanostructures for visible wavelengths) having periodicities smaller than the wavelength of interest. In some cases, properties are observed in materials with controlled nanometer-scale structures that have not been realized in more conventional material structures. Examples include the use of nanostructures to enhance optical effects like photon scattering and increased or otherwise tailored absorption, use of plasmonic effects to greatly increase Raman sensitivity for highly sensitive and selective sensing of molecules, enabling of new smart materials, and improvement of energy-harvesting efficiency in photovoltaic, thermoelectric, and other energy- and power-harvesting materials and early-stage devices.

Periodic structures with nano-scale features are known to interact strongly with electromagnetic radiation having wavelengths on the order of the feature size or larger wavelengths (metamaterials and metasurfaces). These effects can be used to create new types of resonant structures for enhanced optical performance, for instance: the photonic crystal behavior exhibited by materials with controlled structural features on the nanometer scale. Plasmonic field enhancement from nanostructures and/or nanoparticles has enabled the exquisitely sensitive Surface-Enhanced Raman Spectroscopy response and improved absorption and "photon management" in both inorganic and organic solar cells. Nanoscale periodic structures are also used to create non-conventional optical

components that can be tuned to operate in specific wavelength regions.

Scientific and Technical Areas of Interest:

There is a need for research and development of materials incorporating nanometer-size architectures and demonstrating enhanced or novel properties relative to existing materials in the area of physical properties, including mechanical properties; thermal properties; diffusion barrier properties; plasmonic, nanoelectronics, electromagnetic, and optical properties; novel or enhanced chemical functionality; and unanticipated combinations of properties. Composites of polymers with nanometer-scale reinforcements of various forms may offer enhanced mechanical properties, allowing equipment to be fabricated with less weight and bulk than current designs and possibly at lower cost. The creation of composites comprised of plasmonic nanoparticles and 'smart materials' (i.e. materials that respond to an external stimulus) is an area where there has been limited research. The coupling of those two fields to produce smart materials that respond to changing plasmonic fields of metallic nanoparticles is an area of research that could result in materials that could find use in optical switching, photovoltaic, and filtration applications. The creation of interpenetrating networks of various compositions with domain sizes on the nanometer scale may offer access to unprecedented material properties. Fiber or textiles with controlled nanometer-scale architectures may have application to the development of high strength, high durability, or multifunctional textiles.

Plasmonic, semiconducting, and even dielectric nanoparticles and nanostructures exhibit novel optoelectronic and optical properties such as enhanced quantum yields, hot carrier effects, ultrafast rectification, photonic up conversion, nonlinear absorption, etc. These novel effects can be exploited to unburden the Soldier by enabling more battery recharging in the field and less use of disposable batteries with their associated logistical train; energy-harvesting materials could also be used to reduce the logistical burden of the individual Warfighter, the squad, and/or small camps and outposts. Novel optoelectronic effects will also empower new, highly sensitive detection of explosives and chemical threats as well as other novel sensing functionality. Nonlinear optical effects are very important for quantum sensing, which promises more selective and sensitive sensing of molecules in the presence of interferents, and nonlinear optical effects can be greatly enhanced with nanostructures, adding plasmonic materials and/or metasurfaces. Metasurfaces can exhibit large nonlinear optical effects due to nano- and micro-patterning even if their bulk constituent material does not have an intrinsic atonic-scale nonlinearity. Purely optical effects arising from nanomaterials may be used for Soldier vision protection and advanced imaging in a variety of scenarios. To harvest a useful amount of energy, metasurfaces must be scalable to and fabric table over large areas, yet allow simple packaging and transport.

Design and development of nanotechnology-based novel, stable, lightweight, and highly

efficient Organic or Organic-Inorganic hybrid solar cells such as perovskites (stable) and other tandem solar cells that can be solution processed into thin films at low-temperature, capable of roll-to-roll production at low-cost, and compatible to be integrated into existing Army textiles.

Particular areas of application for the materials of interest include personnel armor, clothing, airdrop systems, shelters and load carriage systems, generation of entangled photons for quantum sensing, packaging materials, sensitive and selective detection of molecules including those with health or environmental concerns, textile-integrated electronic systems, chemical and biological reactive materials, permselective materials, tactical optics, and vision systems.

In addition to the discovery and development of new materials, research efforts may be needed to understand the nano-scale origins of bulk properties observed in nanocomposite or nano-structured materials that could aid in the design optimization of material structures for particular applications.

New techniques that will enable the creation of periodic and a-periodic structures with decreased feature size are of interest, and the ability to control the geometry of nano-scale elements and their periodic configuration is also of interest.

Research to develop economically viable processes for the creation of nano-structured materials on a commercial scale may be of interest.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POCs:

Dr. Richard Osgood, TEL: 508.206.3139, richard.m.osgood.civ@army.mil
Dr. Francisco Aranda, TEL: 508.206.3142, francisco.j.aranda4.civ@army.mil
Dr. Ravi Mosurkal, TEL: 508.206.3845, Ravi.Mosurkal.civ@army.mil

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Nicholas Dugan)
General Greene Avenue
Natick, MA 01760-5020
TEL: 508.206.3952
Email: usarmy.natick.devcom-sc.mbx.osi-spsd@army.mil and nicholas.p.dugan2.civ@army.mil

7. Advanced Protection, Integration Technologies/Systems and Assessment Methods.

The Army is seeking a revolutionary approach to system design and integration using emerging technologies and technology trends. New and emerging technologies and design concepts must be explored to provide the warrior with combat overmatch through significant advances in survivability, mobility, and cognitive/physical warrior performance. An advanced combat uniform system will emerge as the foundation for the human interface, load carriage, and protection for the future warrior systems. System weight and bulk reduction are key goals of this effort. Significant mission benefits to the soldier include: longer mission time (endurance) in hot/cold environments; improved warrior performance in all mission environments; reduced heat stress casualties; reduced water intake requirements; enhanced cold weather protection; and enhanced mobility due to reduced bulk.

Scientific and Technical Areas of Interest:

a. Research proposals to develop combat uniform and modular, integrated system design concepts and breadboard prototypes to include integration of multiple technologies into fewer textile-based structures and/or system components. Unique and novel design approaches for protective systems should be scalable and tailorable to meet regional threat and mission scenarios.
b. Research proposals to decrease the size, weight and bulk associated with protective clothing and equipment, while maintaining or enhancing the current level of protection.
c. Research proposals for novel design approaches and technologies to provide enhanced ventilation and/or heating and cooling concepts suited for dismounted Warfighter applications.
d. Technologies to deliver potable drinking water to the individual Soldier from an indigenous source, as well as to identify threats in the water source prior to use and monitor purification system performance.
e. Research proposals to develop and implement measures, assessment tools, and methods. Specifically, development of standardized test methods and devices that measure key performance parameters and user acceptability of protective systems is needed.
f. Test methods and standards that need to be developed include, but are not limited to, “other than mosquito” vector protection efficacy, physical comfort under various climactic conditions, thermal comfort, environmentally appropriate/correlated abradants, and methods that apply to knits and wovens for comparative purposes.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:

Dr. Shaun Filocamo, TEL: 508.206.3939, shaun.f.filocamo.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Dr. Shaun Filocamo)
General Greene Avenue
Natick, MA 01760
TEL: 508.206.3939
Email: usarmy.natick.devcom-sc.mbx.osi-spsd@army.mil and shaun.f.filocamo.civ@army.mil

8. Integrated Sound, Light and Blast Management for the Ears and Eyes.

The goal of this effort is to protect vital senses and preserve physical and neurological performance essential to deployment readiness and mission effectiveness with primary focus on the eyes and ears.

Scientific and Technical Areas of Interest:

Manage sound, light, and pressure wave effects on the Soldier in military environments.

A need exists for:

a. Innovative materials and technologies, or unique combinations of technologies, to protect the Soldier's senses from temporary or permanent impairment by incident energies such as physical impact, blast, light, and sound. Areas of interest include, but are not limited to, enhanced ballistic fragmentation eye protection, hearing protection, and directed energy protection (to include lasers). Hearing protection solutions should preserve auditory situational awareness, allow for good sound localization, and preserve ability to communicate verbally face to face while protection is in place. Vision protection solutions should preserve visual situational awareness, accommodate both daytime and nighttime outdoor lighting conditions, and be capable of accommodating users requiring prescription correction while protection is in place. Solutions may be passive and/or active in nature. Active solutions should give consideration to energy efficiency and/or self-sufficiency (such as energy harvesting) to conserve power.
b. Novel approaches to improve situation awareness by removing impediments and enhancing input to the senses in various operational environments/conditions, while simultaneously providing protection. Areas of interest include, but are not limited to, vision enhancement, hearing

enhancement, unique approaches to mitigating lens fogging, improved lens scratch/abrasion resistance, and technologies that assist with transition between low and bright lighting conditions. Enhancement technologies should not cause undue burden on cognitive load or adversely affect perception and attention. Solutions may be passive and/or active in nature. Active solutions should give consideration to energy efficiency and/or self-sufficiency (such as energy harvesting) to conserve power.

c. Integrated sensory protection solutions that offer increased multifunctional capability for improved protection and situational awareness in a single platform. Solutions may be a combination of active and/or passive technologies to mitigate threads and hazards while maximizing situational awareness in various environments and operating conditions. Solutions may be stand-alone and/or designed to interface with other products (such as for supplemental power, information/data/communication, or other needs). Enhancement technologies may be used to improve situational awareness. Active solutions should give consideration to energy efficiency, self-sufficiency (such as energy harvesting), and/or other means to manage and conserve power, particularly for solutions involving multiple electronically driven technologies.
d. Other new/novel sensory protection and enhancement concepts that will improve operational effectiveness.

A need also exists for:

Modeling and testing methodologies for characterizing and conducting trade-off studies of various technological concepts/approaches and/or prototypes to include, but not limited to:

a. Protection against sound.
b. Protection against directed energy.
c. Protection against blast effects on eyes, ears, brain, and/or protective system itself.
d. Concept and/or prototype performance as compared to currently fielded systems and/or to no protection at all.
e. Concepts and/or prototypes designed for exposure monitoring and/or alerts.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:

Ms. Michelle Markey, TEL: 508.206.3196, michelle.l.markey.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Mr. Benjamin Fasel)
General Greene Avenue
Natick, MA 01760
TEL: 506.206.3783
Email: usarmy.natick.devcom-sc.mbx.osi-spsd@army.mil and benjamin.p.fasel.civ@army.mil

TEXTILE TECHNOLOGIES

1. Multi-Functional Materials.

Individual Warfighter protection against battlefield threats such as ballistics, enemy detection, and environmental and manmade hazards is essential to the continued effectiveness of the fighting force. At the same time, protective materials (clothing/armor, etc.) must also be effective and ensure survival under extremes (temperature and humidity) without significant sacrifices in Warfighter comfort. Current textile technologies require multiple components to be added to the Warfighter uniform in order to meet these threats. Development of novel multifunctional materials would have significant impact on Warfighter load, increasing survivability and sustainability in the field. The following is a summary list of textile technologies of interest to the DEVCOM Soldier Center:

a. Novel polymer synthesis that produces materials, including coatings, fibers, yarns, or fabrics, with unique chemical/physical/mechanical property characteristics (e.g. high strength/tenacity, sense/response capabilities, tailorable protection, multi-component constructs, and smart materials)
b. Surface modification to existing materials that enhances existing properties and/or provides a multi-functional platform.
c. Yarn and fabric manufacturing, fabric preparation, and finishing processes to provide enhanced protection and various functionalities, without negatively impacting Soldier comfort or performance, including but not limited to: moisture management, thermal management, flame and thermal protection, chemical and biological protection, water resistance/repellency, durability to wear and environmental exposure, reactive behaviors, impact protection, and electrostatic properties.
d. New scale-up technologies for creating conventional and novel fibers and fabrics that would also facilitate a quick turnover of final products to Soldiers.
e. New technologies for the characterization of textile systems properties (e.g. electrostatic; electromagnetic; durability; and flame, thermal, and ballistic resistance).
f. Modeling the chemical/physical/mechanical properties of new materials and/or surface modifications to existing materials, and the effects of these materials

on Warfighter comfort (e.g. air and water permeation, flexibility, wear and tear).

g. Exploration of the effects of combining functionalities into a single material on their efficacy.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POCs:

Paola D'Angelo, TEL: 508.206.3972, paola.a.dangelo.civ@army.mil
Dr. Ravi Mosurkal, TEL: 508-206-3845, ravi.mosurkal.civ@army.mil
Ms. Melynda Perry (for Yarn and Fabric Manufacturing), TEL: 508.206.3150, melynda.perry.civ@army.mil

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCP (Paola D'Angelo)
General Greene Avenue
Natick, MA 01760-5020
TEL: 508.206.3939,
Email: usarmy.natick.devcom-sc.mbx.osi-spsd@army.mil and paola.a.dangelo.civ@army.mil

C. SOLDIER EFFECTIVNESS

1. Body-Worn Systems, Hand-Held Devices, Smart-Lightweight Electronic Components, and Information processing to Increase Soldier Maneuverability and Protection through on-Soldier Sensing, Remote Sensing, and Knowledge Management

The head-worn and body-worn, weapon-mounted, and remote sensing electronic systems, components, and smart sensors for future individual and small combat unit Warfighter systems will require both integrated communications and knowledge management for the next generation of Soldiers, NBC protection, tactile/visual/audible information displays, micro display integration, weapon sighting/fire control functions, and directed energy weapons (DEW) protection on the Warfighter. These will maximize the Warfighters maneuverability, survivability, and situational understanding on the battlefield. Advanced technology for the Soldier is needed for the integration of miniature lightweight, durable, reliable, low-power displays, sensors, optics, remote threat detectors, personal area network systems, and knowledge management. This includes wireless and wearable smart electronic components/modules/materials that might be integrated into textiles or

on the Soldier for disseminating power and data in a manner which the small combat unit can process. The knowledge management includes both Artificial Intelligence and Machine Learning (AI/ML) for processing sensor data into operationally relevant information, advanced visualization technologies, and decision tools.

Scientific and Technical Areas of Interest:

Future technology integration efforts focused on needs of Soldiers that increase force effectiveness by optimizing and integrating sensing, sensor data processing, information portrayal, and decision tool capabilities to improve the Soldier's maneuverability and survivability have revealed the following areas of interest:

a. Research proposals related to advancing the human integration and current technology for lightweight, integrated wearable systems; Soldier integrated displays and body-worn systems that enhance the Soldier survivability and situational awareness on the battlefield. Special interest areas include unique human systems integration of data and power systems, miniaturization, increased durability and reliability, and components having low power as well as new power solutions that meet Soldier-portable system requirements for survivability and situational understanding. Specific examples of body-worn system capabilities include: data devices, integrated electronic modules, inter-connections in fabrics, wearable battery technologies, combat identification, tactical engagement simulation capability, system voice control, State-of-the-Art unique interfaces, haptics, neuro-physiological, and physiological/medical sensors and data management, Soldier integration of individual/team weapon system sensors and controls.
b. Research proposals for various lightweight, low power, body-mounted displays; threat detecting sensors; indirect weapon sighting systems; communication and information management capabilities and devices to enhance performance and protect Warfighters' biosensors against the varied threats expected in the intense battlefield environment of the future (e.g., chemical/biological toxins, unexploded ordnance, RF, seismic, acoustic); and smart electronic modules that think, sense and communicate to the Warfighter; interfaces that allow Warfighters to manipulate miniature robotics and robotically controlled sensors to enhance visualization and situational and decision awareness.
c. Research proposals for low weight, low power, high efficiency man portable/wearable systems and components (e.g., antennae, power and/or data bus, sensors, displays) that can be integrated into textiles and other protective structures.
d. Research proposals that integrate Soldier portable IR and daylight readable display technologies using minimal energy output levels with deicing and defogging capability, meeting performance requirements across all

environments.

e. Research proposals for body-worn components, sensors and systems, and system components using innovative display and sensor technologies capable of innovative human integration. Critical areas of interest include some or all of the following display attributes:
    - Displayed Information
    - Reduced bulk and weight
    - Integration of multifunctional displays, modules, and sensors
    - Increased bandwidth, resolution color displays and sensors
    - Reduced power requirements
    - Electronic components that may be integrated into textiles
    - Components that use AI/ML to turn sensor data into operational information for the Warfighter
    - Cognition enhancement capabilities
    - E-Textile technologies that conduct energy
    - Energy harvesting technologies
    - Integrated Data and Power technologies that support Soldier SA and other devices
    - Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:

Mr Josh Buller, TEL: (508) 206-3878, joshua.l.buller.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

2. Biomechanics

Biomechanical tools, data, and knowledge products are currently being developed to guide the design of boots, individual body armor, and load carriage gear that reduce injuries, delay fatigue, and enhance dismounted Warfighter agility, mobility, and operationally relevant performance.

There is a need for detailed information on the forces acting on the Soldiers'

musculoskeletal system as well as how their gait, range of motion, rates of movement, energy expenditure, stamina, and ability to detect and react to threats are affected by their load and its distribution on the body, the terrain and grade of the environment, and obstacles presented by the environment.

Scientific and Technical Areas of Interest:

A review of the existing data and models has revealed the following areas of continuing scientific and technical interest:

a. Anatomy/Imaging: Development of innovative and fundamental metrics to quantify and assess the relation of joint morphologies of the loaded lumbar spine or lower limb during dynamic Soldier-specific tasks with biomechanical profiles associated with reduced performance and increased injury risk of the dismounted Warfighter.
b. Fatigue: Determining explicit biomechanical tools and measures to assess and predict declines in physical performance across a range of Soldier relevant tasks, scenarios, and environments. Integration of biomechanically based predictive physical fatigue algorithms into real-time monitoring of systems of Warfighter physical performance.
c. Determination of biomechanical measures of fatigue to predict performance failure of critical Warfighter task outcomes.
d. Head/Neck, Helmet: Investigation of the effects of acute and chronic head-borne weight and moment of inertia on Warfighter performance, fatigue, and the incidence of injuries. Determination of physical and mass property boundaries of head-borne mass for the dismounted and mounted Soldier based on performance, fatigue, and injury.
e. Biomechanics in the field: Validated, reliable, and accurate methods for acquisition and analysis of marker-less kinematic (and kinetic) data during Soldier-specific tasks performed in a variety of environments that are suitable for integration into real-time monitoring of Warfighter performance injury risk. Technological capability must be able to integrate seamlessly with a wide variety of Warfighter clothing and individual equipment worn and carried on the body.
f. Modeling & Simulation: Development of modeling and simulation tools, as well as virtual prototyping tools to allow for the assessment of the effects of Soldier-borne equipment on the performance of military relevant tasks (i.e. human locomotion over various types of terrain and other Soldier-specific maneuvers). Within the tool the ability to model typical Soldier loads, as well as the ability to model other wearable devices (e.g. human augmentation devices) is desirable to assess their effects on Soldier performance.
g. Novel Pressure/Force Measure: Capability that advances the current state of technology to measure the pressure and/or force applied to the shoulders/upper

back/lower back region of Soldiers while fully encumbered with military equipment.

h. Obstacle Course and Agility: Tools and measures that tie lab-based scientific measures to Warfighter relevant obstacle course performance as well as establishment of valid and reliable tools and measures sensitive to Soldier-borne equipment effects.
i. Soldier Load: Determination of the biomechanical effects of varied mass, volume, and location of loads on the range of Warfighter performance and Warfighter tasks; development of prototypical devices that facilitate enhancing the understanding of load (re-) distribution on the body; and research that addresses optimizing load distribution and its benefit on marksmanship, agility maneuvers, climbing, sprinting, and other military relevant environs.
j. Soldier Performance Augmentation: Fundamental research that advances knowledge on scientific issues surrounding efficacy of prototypical devices designed to augment Soldier performance. Development of wearable devices designed to augment Soldier performance (e.g., reduce metabolic cost of load carriage, enhance mobility, increase strength, etc.).

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Mr. John Ramsay TEL: (508) 206-3888, john.w.ramsay4.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

3. Anthropometry

The DEVCOM Soldier Center has traditionally maintained an extensive anthropometric database on U.S. Army and other military personnel. Anthropometric data are used to facilitate the design and sizing of personal protective clothing and equipment systems. These data are also required for the design and layout of general-purpose workstations and combat vehicle crew stations. Virtually all military system development requires access to accurate body size data at some point in the design process. U.S. Army

anthropometric data are also used by military contractors, other government agencies, and industry. The U.S. Army is currently executing a major anthropometric survey of its personnel to collect current body size information for use in the applications defined above.

Scientific and Technical Areas of Interest:

a. Develop software tools for extracting traditional anthropometric data and other human engineering related measurements of the human body such as volume, surface area, and curvatures from 3D whole body, head/face, hand, and foot images. These tools may include applications for measurement of the human body as well as for summarization of body size and shape using 3D and 4D anthropometric data. These tools shall be implemented on 3D/4D human body surface images and integrated with hardware and software systems currently in use by US Army anthropologists and human engineers.
b. Develop and/or integrate human body modeling software into an analytical computer-based system that allows clothing and equipment designers to visualize, compare, and evaluate the effects of single and multi-layer clothing/equipment systems on the physical performance of human users. The resulting tolls will be used by anthropologists and human engineers to assess the impact of clothing/equipment systems (body armor, helmets, NBC, and thermal protective clothing) on key performance parameters such as mobility, movement, and overall area of coverage of the human body.
c. Obtain clothed and encumbered anthropometric measurement data on a representative set of US Army personnel in order to identify the dimensional changes in body size that occur as single and multi-layer clothing and equipment systems worn by Warfighters. At a minimum, identify and quantify the body size changes that occur under current and next generation clothing and equipment systems that impact Warfighter body size for typical Infantry, Aviation, and Ground Vehicle Warfighters. Data collection procedures may include a combination of traditional anthropometric tolls and/or 3D whole body and body segment scanning of study participants depending upon the specific nature of the clothing and equipment systems being investigated. Close coordination between the government and offeror on such matters as the final dimension list, body land marking requirements, quality control implementation, and data cleaning shall be required throughout the duration of this data collection effort.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:

Blake Mitchell, Katherine.b.mitchell.civ@army.mil; (508) 206-3504

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

4. Warrior Performance

Warrior Performance is the degree to which a Warfighter's skills and abilities are implemented for a particular task or set of tasks. It is specific to the military operational environment. There are on-going efforts to generate data in the area of human science as it relates to Warrior Performance; however, most of these efforts relate to the physical aspects of performance.
Though significant work is being done through these efforts, more work remains in order to gain a complete picture of the complex relationship of the warrior to his/her environment.

Concentration on the cognitive aspects of individual warrior performance is lagging. Significant work still remains to be done in this area as well as the interaction between warrior cognitive and physical performance. The objective of this area of study is to generate methodologies, relevant data, and models that will advance the ability to measure, predict, and enhance warrior performance in training and mission contexts. Outputs can be applied directly to the development of emerging warrior systems with equal emphasis on physical and cognitive performance. The warrior performance target audience includes male and female: Dismounted Infantry, Mounted Infantry, Engineers, SOF, Medics, Army Aircrew, and Military Police.

Scientific and Technical Areas of Interest:

Development and validation of quantitative measures and criteria as well as methodologies for evaluating these areas is a key element of any proposed effort.

a. Research to understand and predict the performance of individuals and small units with respect to their Situational Awareness, memory, and decision-making in relevant Soldier environments. Understanding what is important to measure and how to measure in soldier context is of value. Influencing factors for investigation should include understanding the relationship of individual knowledge skills and abilities on cognitive and/or physical performance in

mission context. Studies may also include the impact of mission (e.g., complexity, type, intensity), mission environment (e.g., MOUT, Jungle) training proficiency, and unit dispersion on the performance of individuals and small units. Studies on the impact of different technology types on situational awareness, decision-making, and measures of performance are also of interest.

b. Studies on the effect of fatigue on warriors to include, but not be limited to, the influence of mission on physical and cognitive fatigue and/or workload, quantification of the physical/cognitive relationship of fatigue, quantification of different types of fatigue (e.g., muscle, cognitive, systemic) and their impact on warrior performance, determining mitigating factors of fatigue and/or cognitive workload, and determining whether levels/degrees of fatigue and/or workload can be predicted based on personal characteristics and/or physiological measures.
c. Research aimed at identifying, characterizing, and validating novel warrior performance optimization or enhancement techniques. Techniques can be focused on cognitive and/or physical performance in training and mission contexts.
d. Taxonomy – Develop taxonomy of measures and associated criteria of physical and cognitive warrior performance.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Dr. Caroline Mahoney, TEL: (508) 206-3833, caroline.r.mahoney.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

5. Soldier Power Sources, Power & Data Distribution and Management

In the future Multi-Domain Operational Environment, dismounted Warfighter capabilities will continually be modernized with advanced sensors, networking, and processing technologies, all of which require power. While many of these new capabilities will possess advanced low-power electronics and power-management features, the need for innovative and safe power source solutions for the Warfighter and small combat unit will remain an essential aspect of the Army's Soldier modernization

program.

Emerging operational concepts dictate the need for technology to support extended missions without the benefit of re-supply for 72 hours or longer.

The Army's Soldier Modernization program includes viewing the Soldier as a System. From this perspective, hybrid power architectures that combine centralized and distributed power sources are being investigated. Implementation of this architecture necessitates exploration of both wired and wireless power and data distribution. Incorporation of power management features that reduce power consumption without impacting mission effectiveness is also being explored.

Scientific and Technical Areas of Interest:

- Power source solutions that can demonstrate through objective analysis substantial reductions in life cycle cost and logistics burden are of primary interest to the Army.
- Battery technologies and concepts that provide improvements in energy density, ergonomics, "ease of use", and safety to facilitate human factors and Soldier-centric integration are of interest.
- Technologies that enable battery charging on the Soldier while on the move are of interest. Small power-dense and efficient fuel cells are of specific interest.
- Technologies that efficiently and effectively distribute and manage power on the Soldier are of interest. Cables and connectors are of specific interest.
- Providing individual Soldiers with accurate and reliable power status data, which is a key enabler to the Army's Operational Energy campaign, is of interest.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Mr. Noel Soto. TEL: (508) 206-3864, noel.soto2.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803(Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

6. Future Warrior Technology Integration.

As the Army transforms to a lighter, more agile, and lethal force, a revolutionary approach to system design and integration is needed, consisting of open system architectures to provide lightweight, system-engineered, integrated modular protective combat ensembles employing plug and play components. New technologies and design concepts must be explored to provide the warrior with combat overmatch through revolutionary advances in survivability, mobility, networked communications, collaborative situational awareness, power sources, and networked lethality/fire control while enabling extended combat missions with reduced loss in physical capabilities from fatigue, stress, and hardship.

Scientific and Technical Areas of Interest:

a. Proposals are needed to integrate, mature, and demonstrate innovative ballistic and blast protection solutions to provide increased protection against evolving bullet, fragmentation, and blast threats through an architecture that integrates weight reduction, anthropometry, modularity, and tactical gear packaging to increase mobility and reduce stress. Examples include: develop multiple impact survivability concepts for torso and improved protection for head, face, and extremity; mature and integrate advanced fiber, polymer, ceramics, nano, and/or composite material technologies for ballistic and blast protection.
b. Proposals are needed to integrate and demonstrate innovative integrated solutions in the areas of: tactical concealment and multispectral signature reduction; and protection against flame, lasers, chemical, biological, and toxic industrial chemicals and materials. Technology options include selectively permeable membranes, flame resistant fibers, fabrics and treatments, and nanotechnology-based materials.
c. Proposals are needed to integrate and demonstrate novel design approaches and technologies to provide body-worn enhanced passive, active, and hybrid thermal management (optimized for weight and power reduction). Examples include: body worn ventilation and filtration systems, incorporating active microclimate cooling with Body armor and Chemical-Biological protective suits, incorporating active ventilation with headgear protection, and semi-permeable and moisture wicking membranes/fabrics for improved temperature and moisture management.
d. Proposals are needed to mature, integrate, and demonstrate Soldier mobility and load assistance solutions to include physical augmentation/exoskeleton, lower extremity load assistance devices, and advanced systems for load assistance applications for able-bodied operators. These systems must provide improvements in physical performance while maintaining user safety and reducing muscular and metabolic fatigue during load carriage activities.

e. Proposals are needed to mature and integrate Warfighter and Small Combat Unit (SCU) networking technologies with Soldier information awareness systems and emerging tactical networks. The goal is to maintain compatibility and interoperability of unique platoon, squad, and Warfighter information requirements with company and higher Command and Control (C2), and Situational Awareness (SA) infrastructures. Technology solutions include reliable jam-proof wireless technologies and advanced cabling and connectors to include e-textiles and micro/nano connectors to enhance personal area networking between head, body, and weapon systems.
f. Proposals are needed to integrate, mature, and demonstrate innovative Warfighter power and energy solutions to Soldier System. The goal is to provide higher power and energy density sources for ground and mounted Warfighters. Examples include: direct and reformed methanol fuel cell, conformal low-profile rechargeable battery, enhanced zinc-air battery, and platoon/squad level generator/charger.
g. Proposals are needed to mature, evaluate, and integrate Small Combat Unit (SCU) lethality concepts and technologies to include small unit cooperative engagement for more accurate firing solutions, common net-centric SOSCOE compliant Fire Control and body-worn gunfire detection solutions.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POCs:

Mr. David Audet, TEL: (508) 206-3870,david.j.audet2.civ@army.mil
Mr. Michael Samuel (for Soldier thermal management, human augmentation and power and energy mobility and load carriages technologies), TEL: 508) 206-3860,Michael.n.samuel.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

7. Technology Assessment and Simulation Tools.

As the Army transforms to a lighter, more agile and lethal force, a revolutionary approach to system integration, assessment, and simulation of Warfighter systems architectures

encompassing all aspects of dismounted maneuverability to include protection, networked communications, collaborative situational awareness, power sources, and networked lethality/fire control is needed.

Scientific and Technical Areas of Interest:

The following technical areas warrant research and development efforts.

a. Proposals are needed to develop engineering assessment and simulation tools for the DEVCOM Soldier Center dismounted Soldier systems labs and associated distributed labs. The lab objectives are to develop effective tools to expedite the integration and the assessment of dismounted soldier component technology prior to field experimentation.
b. Proposals are needed to expand the current simulation capability into the realm of performance metrics associated with dismounted Soldier use of component technologies. The expected simulation capabilities performance metrics include:
    - Development of simulation and architecture capabilities, Artificial Intelligence and Machine Learning (AI/ML) Efficacy, Information Portrayal Efficacy, Cognitive Loading, Squad Situational Awareness during planning, movement, execution, reconsolidation, and after action reviews.
    - Displays, reporting efficacy, unstructured communications, voice, white boarding, structured communications, Squad computer input devices, and lethality component performance: accuracy and latency.
    - Small, combat unit net centric performance for information dissemination and portrayal, asset control, sensor data dissemination, and sensor data consumption, including unmanned aerial vehicle (UAV), unmanned ground sensor (UGS), unmanned ground vehicle (UGV), Chem/Bio, soldier worn gunfire detection (SWGD), and Mobility.

Communication with the Technical POC prior to the submission of concept papers or formal proposals is required.

Technical POC:
Mr Josh Buller, TEL: (508)206-3878, Josh.l.Buller.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)

General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

8. Ecological Approach to Warfighter Survivability; Perception-Action-Cognition

The degree to which physically coupled load, coupled environmental information, and cognitive requirements interact in regulating of emergent properties of Warfighter performance is unknown. Consequences on perception-action (P-A) coupling are suggested to have significant impact on Warfighter survival and performance, given the extreme loads, cognitive tasks, and environmental constraints of combat and training. This thrust area within DEVCOM Soldier Center offers the potential for significant progress in understanding the impact of load, equipment, cognition, and environment on Warfighter survival and performance.

Research is required at the Applied and Basic levels in order to ascertain and link operational performance metrics, coordinative and intentional dynamics, and underlying system dynamics to survivability and performance in combat. The 'Enterprise for the Ecological Study of Warfighter Load' seeks to integrate various aspects of Ecological theory and Dynamic Systems approaches to understand the nested dynamics involved in specific operational tasks (dynamic marksmanship, threat identification during locomotion, situational awareness, etc.). Impacts of physically coupled load on information pick up and intentional task dynamics under fatigue/stress conditions are an unexamined but necessary area of research into Survivability.

The Enterprise seeks to build a collaborative group within Government and Academia who support "best practices" data collection and analysis approaches in order to best serve the Warfighters' needs while expanding the applicability of the ecological approach to understanding the "Human Dimension'.

<u>Scientific and Technical Areas of Interest</u>:

The following are some of the fundamental questions necessary in understanding the overall consequences of Warfighter load, necessary subordinate relations to task performance, and the modeling necessary to further our understanding. While marksmanship is initially of primary interest due to the potential consequences of load on P-A/survivability; there certainly exist other equally relevant areas of investigation using the ecological approach in understanding the problems of technology overload. Thus, the list below should not be considered exclusive.

<u>Applied Research Questions:</u>

1. What are the consequences of Warfighter load on Perception-Action coupling necessary for Survival in combat?
    a. How does load affect establishment of marksmanship postures and the necessary postural affordances for perception of the environment?
    b. How does load affect the coordination dynamics during dynamic marksmanship in different "work-spaces" within the environment?
    c. What are the consequences of segmental loading on the speed-accuracy trade-off during marksmanship; what are the basic metrics that provide insights into local and global dynamics?
    d. Can Hybrid Oscillator Models be developed for Fitts Law Tasks using Speed and Load Parameterization for Marksmanship tasks?
2. What fundamental impacts does segmental loading have on the perceptual capabilities of the Human System during movement through the environment?
    a. How does segmental loading and speed affect the ability to successfully identify and discriminate (e.g. Friend v Foe) targets in the environment during straight-line locomotion?
    b. How does segmental loading and speed affect the ability to successfully identify and discriminate (e.g. Friend v Foe) targets in the environment during different locomotive styles (e.g. straight line, side to side, around obstacles, over rough terrain, etc.)?
3. What are the effects of terrain complexity and load on visual perception/Dynamic Visual Acuity (DVA)?
    a. How does load and speed parameterization affect DVA during locomotion when terrain becomes increasingly complex?
    b. How do Warfighters navigate differential terrain under different loads, speeds, and terrestrial complexity in the short range (e.g. 5-20m), mid-range (20-50m), and long-range (50+m) in order to achieve maximal efficiency of movement?
4. How does Perceptual Encapsulation of the Warfighter affect information pick-up and action under load (e.g. reduced field of view, aural localization)?
    a. How do area of protection trade-offs (e.g. greater visual & aural encapsulation) affect threat pick-up, and to what degree is the aural-visual contribution to information pick-up modified?
    b. To what degree do 'enhanced' perceptual technology systems (e.g. night vision, expanded aural awareness, etc.) disrupt natural information pick-up and the ability to localize sources of information in the environment?
    c. How does the addition of head-mounted load relate to the ability to localize environmental information; what are the changing visual-aural dynamics with increased encapsulation from the local environment?
5. What are the consequences of integrating relevant cognitive tasks into the

Perception-Action cycle necessary for survival for the above tasks?

a. Aural Communication with/without Simple Repeated Response?
b. Aural Direction with/without Complex Response?
c. Retention of key information for prospective performance at different time scales during dynamic tasks.
d. How do coordination dynamics and performance change when these tasks are integrated into the intrinsic dynamics of marksmanship and threat identification during locomotion.

6. How can Survivability be modeled empirically based on the interaction of Mobility, Lethality, and Situational Awareness (Perception) for the above tasks under load?
    a. Can n-dimensional subordinate sub-space models be developed for Mobility, Lethality, and Situational Awareness that interact with a Superordinate Survivability Model for use in decision making, Analysis of Alternatives for load configuration and design metrics?
7. How does one design advanced equipment to carry the Ballistic and Fire Load required by the Warfighter in such a way that it complies with both empirical scientific findings and insights (relevant for *tactical* engagement) AND the realities of Operations across the spectrum of mission profiles (operational realities)?
    a. Are there advanced designers and products that can provide the tactical requirements for Warfighter and integrate recent scientific findings regarding Shoot and Move dynamics?
    b. Is there a way to modularize the equipment such that load distribution may be managed in such a way as to allow different mission profiles to be supported without substantial changes in configuration (e.g. a specific building block approach of increased load carriage requirements within operational realities)?
    c. Is there a way to modify current load carriage distribution and design to "meet in the middle" with operational requirements by suggesting changes to Tactics, Techniques, and Procedures (TTPs) that provide:
        1) Similar or increased performance at the level of the Task (e.g. speed accuracy).
        2) Quantitative improvement in the dynamics that underlie that task performance (e.g. improved segmental coordination, postural control, and postural-focal coupling in dynamic marksmanship tasks).
        3) Integrated changes in TTPs testable, acceptable, and modifiable (flexible) to the Warfighter when new concepts in load carriage and distribution are instantiated by Scientific/Industry teaming?

NOTE: Question 7 requires submitters to have substantial understanding of the history of load carriage and designs for tactical missions across the broad spectrum, Industrial capability for manufacturing advanced concepts designs, and significant tactical insight to understand and trade the Operational – Scientific perspective in such a way that optimizes Warfighter success in the execution of actions on the objective. The intent of Question 7 is to provide a basis for answering these questions as well as the development of advanced concepts that are testable in the larger program entailed in this BAA Section.

Basic Research Areas:

1. Fundamental haptic response to Load parameterization: effects on motor abundance, stability, and adaptability. Bio tensegrity models and dynamic touch as a means to understand the dynamics of segmental load.
2. Dynamic visual acuity (DVA) and precision performance underload.
3. Aural-visual localization under increased perceptual encapsulation and load.
4. Consequences of load on behavioral action modes. Biospectroscopic analysis of load parameterization in field conditions. Long time-scale impacts on affordances under load and reflections of route choice and task accomplishment in combat.
5. Marksmanship synergies under load: task space analysis and the constraints on the Degrees of Freedom. Postural-focal coupling in complex movement and systems-level dynamics.
6. Development and utilization of advanced techniques in non-linear analysis, fractal/dimensional analysis, and Human Dimension metrics. Multi-scale dynamics that underlie performance in visual-manual precision task interaction.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Ms. Blake Mitchell, katherine.b.mitchell.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803(Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

9. Soldier Centric Sensors, Information Portrayal, & Data Management Technologies.

The Army is currently leveraging a dismounted Soldier force networked with emerging mobile computing platforms such as tablets, handheld, and head-worn displays. Currently, tactical battlefield information portrayal and information processing techniques are not optimized for dismounted mission effectiveness and often burden the Soldier cognitively. Providing emerging sensor and mission command information down to and from the Small Unit level is a unique human systems integration challenge and requires considering the impact on the dismounted Soldier battlespace experience associated with maneuver, protection, and sustainment. Novel information portrayal and management technologies are needed for the Soldier and Small Unit to improve their situational awareness, mission effectiveness, and cognitive performance on the battlefield with respect to maneuver, protection, and sustainment.

Scientific and Technical Areas of Interest:

The following technical areas warrant research and development efforts.

a. Developing novel information portrayal and information management technologies for the Soldier and Small Unit to improve their situational awareness, mission effectiveness, and cognitive performance on the battlefield with respect to maneuver, protection, and sustainment.
b. Developing hands free, low cognitive workload user interfaces concepts and technologies; augmented reality graphical user interfaces, displays, and supporting technologies; information portrayal of Intelligence, Surveillance, and Reconnaissance (ISR) technologies; and modular device architectures for Soldier-worn electronic devices.
c. Applying human-computer interaction, human factors, and cognitive research to improve information portrayal and information management algorithms to cognitively unburden the Soldier.

Communication with the Technical POC prior to submission of concept paper or formal proposal is required.

Technical POC:
Mr. Josh Buller, TEL: (508) 206-3878, joshua.l.buller.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center

ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803(Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

10. Soldier/Squad Performance Optimization.

Tactical readiness is often characterized in terms of four warfighter performance pillars: Shoot, Move, Communicate, and Survive. To optimize the readiness of Soldiers and Squads, it is critical that they are trained, expertly led, fully manned, and supported by the most state-of-the-art technologies in the world. As the technology gap rapidly shrinks between global powers, there is interest in monitoring, assessing, and optimizing Soldier and Squad performance, understanding what characterizes Soldier and Squad performance degradation, and ultimately what decisions can be made to either reduce degradation of performance or avoid it altogether.
Of equal importance is to investigate optimization methods that may enable Soldiers to cope and manage tactical stressors in a more efficient and effective manner.

<u>Scientific and Technical Areas of Interest:</u>

a. Monitoring Soldier/Squad performance – Cutting edge sensor development for monitoring Soldier physical, cognitive, and socio-emotional states, to include but not limited to biomarkers, individual and group movement patterns, physiological status and stress responses, hydration and nutritional levels. Validation of emerging technologies and commercial off the shelf sensor or products, across laboratory, virtual, and field environments. Tracking Soldier performance through development/training, employment, and deployment phases of the Soldier life-cycle. Sensor fusion and/or technology integration strategies for rapid, pseudo-real time, or real time monitoring of Soldier/Squad performance.
b. Assessing Soldier/Squad performance – Methods for quantifying Soldier/Squad performance in controlled or changing environments, for applications such as live-fire exercises, training events, and marksmanship activities. Identification of tactical stressors that reliably mimic combat scenarios. Visualization of human performance measures for rapid and simplified decision-making tools and enhanced training feedback. Decomposition of physical, cognitive, and socio-emotional states from single or similar data inputs. Development of standardized classification and rating systems for assessing Soldier and Squad tactical performance.
c. Predicting Soldier/Squad performance – Development of algorithms or analytical approaches for predicting changes in Soldier/Squad performance measures. Validation of historical, recent, or emerging models for

Soldier/Squad performance. Big data approaches and solutions for down selecting relevant Soldier/Squad measures of performance from large scale, often disparate data sets.

d. Optimizing Soldier/Squad performance – Distinguishing novel intervention strategies for optimizing individual and group nutritional, biological, physical, cognitive (to include neurostimulation and other neuroenhancement research/strategies) and socio-emotional performance. Validation of current or novel training interventions for optimizing Soldier/Squad performance. Virtual reality approaches for non-invasive, iterative training for rapid optimization of Soldier/Squad operations. Squad optimization via individual and role-based teaming strategies.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Dr. John Ramsay, TEL: (508) 206-3888, john.w.ramsay4.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

11. Human Factors

The DEVCOM Soldier Center has supported and conducted product assessments of Soldier clothing and individual equipment, as well as organizational equipment (e.g., food service items, tents/shelters, air drop equipment), in both S&T and Acquisition. In support of these efforts, research is conducted to develop novel methodologies, understand impacts of clothing and equipment on performance, and provide design guidance for novel clothing/equipment.

Scientific and Technical Areas of Interest:

a) Development of tools (software or physical) to assist in the assessment of products for human system integration (and specifically human factors) considerations. These tools should 1. Streamline data collection capabilities, decreasing manpower requirements in data collection or analysis/post

processing/reporting or 2. Allow for standardized collection of novel objective measurements for use in measuring the impact of Soldier clothing/equipment on performance. Close coordination between government and offeror on matters such as user needs/requirements and prioritization of tool capabilities shall be required throughout the duration of the project.

b) Development of methodology (and obtain data) for the assessment of headborne systems, including capturing static and useful field of view, verbal/audio compression and localization, depth perception, dynamic visual acuity, etc. Close coordination between government and offeror on matters such as constraints of methodologies development, identification of relevant metrics, and examples of potential test technologies shall be required throughout the duration of this data collection effort.
c) Development of tools for capturing and processing marksmanship performance throughout the marksmanship process (i.e., acquisition, decision, engagement, transition) for utilization in both live fire and simulated training scenarios. Close coordination between government and offeror on matters such as user needs/requirements and prioritization of tool capabilities shall be required throughout the duration of the project.
d) Integration of eye tracking technology into standard and developing military systems to include head-borne systems and weapon sighting systems for utilization in an active, dynamic, and mobile environment. Close coordination between government and offeror on matters such as user needs/requirements and prioritization of tool capabilities shall be required throughout the duration of the project.
e) Development of integrated sensors for monitoring sleep, activity, light exposure, noise exposure, circadian biomarkers, pressure, comfort. Validation of emerging technology and commercial-off-the- shelf products in both laboratory, virtual, and field environments. Sensor data fusion and integration strategies required for rapid predictive modeling or real-time monitoring of individual physical and mental fatigue and associated readiness levels.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Ms. Blake Mitchell, katherine.b.mitchell.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)

General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or (508) 206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

12. Soldier Intelligence, Surveillance, and Reconnaissance (ISR)

Technology development efforts are underway to mature and integrate technologies that address capability gaps associated with small Unmanned Aerial Systems, primarily the need for greater autonomy to reduce cognitive burden, platforms, and components to reduce Soldier load, and increase Situational Awareness.

The primary thrust of this activity is the development and demonstration of a highly autonomous Small Unmanned Aerial System (SUAS) and enabling technologies that support Multi Domain Operations. These systems should have the capability to:

- Autonomously navigate to and from a target in a variety of environmental conditions (terrain, weather, etc.)
- Collect salient information, package it, and present it in a timely manner to the operator.
- Support mission planning.
- Collaboratively work with other platforms to accomplish goals.
- Disseminate relevant products to various Common Operating Pictures (video, telemetry, etc.)

All with the goal of reducing the operational burden on the user so that the Soldier gets the right information at the right time.

Interest under this topic is primarily on algorithms and sensors that support these various goals. Platforms may be of interest if they provide a unique capability to support accomplishing one or more of the stated capabilities. Algorithms should be focused on SUAS but especially on size, weight, power and computing constrained platforms with weights under 5 lbs. No formal size, weight, and power limits are described to allow respondents trade-space.

<u>Scientific and Technical Areas of Interest:</u>

Small UAS are tools to increase Situational Awareness and Situational Understanding. Maturation and demonstration of the following enabling technologies are required:

a. Low-cost platforms and components
b. Autonomy to support operation in all environments (e.g. GPS denied operation, localization, collision avoidance).

c. Algorithms to support multi system operation (i.e. swarming)
d. Data distillation and summarization algorithms for edge process devices (i.e. report only salient images or targets instead of video).
e. Sensors that can provide advanced capabilities for Size, Weight, Power, and Volume constrained platforms.
f. Communications systems that enable increased performance for Size, Weight, Power, and Volume constrained platforms.
g. Common controllers or common control software
h. Simulators and training tools to maintain flight skills.
i. Test methods or equipment to evaluate military peculiar performance requirements.
j. Advanced mission planning that can leverage additional sources of information to optimize for a variety of mission factors (e.g. stealth, time).
k. Applications that provide the capability to generate precise (Category III or better) military grid reference system (MGRS) coordinates for both fixed and moving objects observed within the sensor's video stream.

The goal of this effort is to provide value to the Warfighter through increased situational awareness and situational understanding, not increase the Warfighter's cognitive burden. Typically, ISR missions are performed in parallel with other combat duties.

Technology candidates must exhibit a Technical Readiness Level (TRL) of 4-7. Proposals will be entertained for both an overall system design as well as individual sub-systems.

Communication with the Technical Points of Contacts prior to submission of a formal proposal or concept paper is essential.

Technical POCs:
Mr. John Paul Kruszewski, john.p.kruszewski2.civ@army.mil
Mr. Michael Samuel, Michael.n.samuel.civ@army.mil

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM SC ATTN: FCDD-SCD-EXA
(Mr. Matthew Whipple or Ms. Jennifer Rourke) General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or (508) 206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

13. Biotechnology

Biological processes and systems have evolved efficient responses to pressures in the

environment. The science of biotechnology identifies those processes and systems that can be manipulated for enhancement of current technologies or development of new ones. The needs of the Warfighter in the field—enhanced protection from chemical and biological agents, lightweight clothing and gear, real-time detection and identification of enemy agents, energy creation and storage, and enhanced resiliency and recovery for human performance can be served by research in this growing field.

Scientific and Technical Areas of Interest:

A comparison of current capabilities versus Warfighter needs leads to interest in the following major areas of scientific knowledge and technological capabilities:

a. Novel biologically-based biocides for the generation of antimicrobial materials with non-leaching killing action. Experimentation and theoretical research into the structural interactions and mode of action of peptides at interfaces.
b. Development and enhancement of sensor technologies for detection of chemicals and biological materials.
c. Environmentally benign processes (i.e. low temperature and pressure, aqueous, pH 7) for production of materials.
d. Novel approaches to stabilizing bacteria, enzymes and natural dyes for long-term use in a broad range of environments.
e. Real-time generation of biofuels from renewable resources.
f. Novel, environmentally-friendly FR materials from renewable biological sources.
g. Development of improved antimicrobial and antisporal test methods
h. Novel approaches in the use of prebiotic, probiotics and dietary supplements to enhance the subsistence of the Warfighter.
i. Controlling polymicrobial environments as a strategy for defeating harmful organisms while promoting the growth of beneficial organisms.
j. Understanding self-assembly of structural proteins for fiber/nanofiber formation.
k. Biofermentation for production of recombitant proteins, enzymes, peptides, etc. of interest.
l. Biofermentation to understand novel metabolic capacity and function of gut microbiota, fungi, and viruses.
m. Characterization of skin and gut microbiome, or other relevant microbiomes, at bacterial and/or fungal community and/or functional genomics levels.
n. Influence of xenobiotics on gut and skin microbiome, or other relevant microbiomes, and nutritional or other suitable intervention to restore homeostasis.
o. Approaches to elucidate causative mechanisms across multiple axes including gut-muscle, gut brain, gut-skin, etc., of interest
p. *In vitro* and *ex vivo* eukaryotic cell and engineered tissue models for cognitive

and physical performance physiology

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POCs:
Mr. John Player, TEL:(508) 206-3849, John.player2.civ@army.mil
Mr. Jason Soares, TEL:(508) 206-3838, Jason.w.soares.civ@army.mil,

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA (Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

14. Physical Performance Technologies

The Army must meet the demands of the future operational environment in alignment with its strategic vision and priorities, to include enabling Multi-Domain Operations (MDO) through 2035. As such, the Army must make the Brigade Combat Team (BCT) and enablers leaner while retaining capability, prevent overmatch through 2035, and set the conditions for fundamental change. The Army MDO force must be leaner, smarter, more lethal, and more flexible. The Army must operate differently, enable forces differently, and organize differently to maintain overmatch, capable of responding to a myriad of threats to our national interests. In this vein, DEVCOM Soldier Center is interested in researching, maturing, integrating, and demonstrating human physical performance augmentation capabilities such as wearable load assistance technologies and exoskeletons. These physical performance augmentation capabilities offer improvements in strength, endurance and/or ergonomics while maintaining user safety and comfort. Other desired attributes that should be addressed include mitigating risk of load-induced injury and soreness, allowing for natural range of motion, reducing weight, and increasing power-efficiency, reliability and ease of use (for example developing simple don/doff mechanisms and intuitive/effective user interfaces), as well as addressing compatibility with Soldier clothing and mission equipment.

Physical performance augmentation technologies have the potential to assist various high stress/high fatigue tasks such as heavy and repetitive lifting and other forms of load transportation and carriage that occur during combat, mission support, and other operations. The goal is the technological advancement of physical augmentation capabilities that have the highest potential to optimize individual and small unit mobility

and load performance and serve as a force multiplier, to include application in the following operational environments:

1) Combat Support/Sustainment Type–Physical performance augmentation technologies that augment load carriage and reduces overall load burden to the Soldier, helping the wearer to conduct load tasks in logistics, sustainment, and combat support environments. These tasks include, but are not limited to, heavy and/or repetitive supply lifting, loading, unloading, and carrying, and ergonomically challenging tasks (awkward postures, long duration overhead work). Key focuses are injury risk reduction, strength assist, and throughput/ productivity augmentation. Customization of end-effectors based on lift, move, and carry tasks may be desired.
2) Movement & Maneuver/Mobility Type–Dismounted physical performance augmentation technologies to enable enhanced speed, agility and/or endurance, during operations, amplifying the human's ability to accomplish larger tasks, while mitigating the effects of load, mobility and/or repetitive motion on the body (e.g. injury risk reduction). These technologies must allow for typical Infantry Movement Techniques (IMTs) and Tactics, Techniques, and Procedures (TTPs) while providing a metabolic, productivity or other performance improvement during typical dismounted movement & maneuver missions.

Scientific & Technical Areas of Interest:

Concepts are requested to enhance Soldier mobility, relieve Soldier physical load burden, and provide overall load assistance. Innovative physical performance augmentation capabilities, including but not limited to wearable lower body, upper body, and/or full body systems, are requested. The principle concept of interest is providing improvements in physical and operational capability while maintaining user safety and comfort during load carriage activities, allowing the operator to perform mobility and load tasks more safely and effectively. Technology candidates must exhibit a Technology Readiness Level (TRL) of 4-7. Proposals will be entertained for both an overall technology system design as well as individual technology component/sub-systems.

Communication with the Technical Points of Contacts (POCs) prior to submission of a formal proposal or concept paper is essential.

Technical POCs:

Mr. Michael Samuel, TEL:(508) 206-3860, Michael.n.samuel.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center

DEVCOM Soldier Center
ATTN: FCDD-SCD-EXA
(Mr. Matthew Whipple or Ms. Jennifer Rourke
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803(Mr. Whipple) or 508-206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

D. EXPEDITIONARY MANEUVER SUPPORT

Research and Development.

Expeditionary maneuver support encompasses the capabilities of movement and maneuver, protection, and sustainment of Army forces, while developing, demonstrating and transitioning technologies that reduce or improve the energy, manpower, water, fuel, solid waste, packing, cost, weight, volume, environmental footprint, or logistics footprint associated with sustaining and protecting the soldier. These capabilities are often integrated for optimal effect and successful cross-domain maneuver. Our Research and Development mission focuses on expeditionary maneuver support threats and needs in Multi-Domain Operations, as identified by National Defense Strategy objectives and Army Modernization priorities. Mission areas include expeditionary command post infrastructure and sustainment, including additive manufacturing, and expeditionary operations field support services with integrated base defense. Threats encompass both combat and environmental threats, while science and technology capabilities to defeat these threats include improved obscuration, mobility, transportability, rapid deployment, durability, and reproducibility. Research and Development enhancements are grouped into the overall categories of protection, movement and maneuver, and sustainment. Within an overall category, new expeditionary maneuver support technologies needed to support our Soldiers and Soldier systems are organized by a key thrust area, as outlined below. Section 5. Unit/Organization Equipment describes additional interest areas and Scientific and Technical Areas of Interest for field support services.

<u>Scientific and Technical Areas of Interest:</u>

The following examples (though not inclusive) represent areas of science and technology that are relevant to the objectives supporting the Army's Modernization Priorities for Expeditionary maneuver and may be of interest to the Army.

1. Protection

Electromagnetic Interference/Electromagnetic Pulse (EMI/EMP) Protection

a. High permeability and high conductivity structural composites that provide EMI/EMP shielding.
b. EMI/EMP gasket with improved mechanical properties and performance in field environment. The gasket should not be subject to compression set and should require minimal to no cleaning.

Environmental Protection and Energy Efficiency

a. Insulative, shielding, rigid shelter panel technologies that minimize the acoustic and thermal signatures associated with on-board power generators.
b. Super-insulative panels for rigid wall shelters.
c. Low bulk and low cube insulative liners for tentage that may utilize active methods of membrane dispersion to produce dead air space and high insulation.
d. Functional treatments of tentage fabrics that produce reduced effects from solar loading, the capability to accept camouflage printing, and the capability to accept insecticides, etc.
e. Renewable energy generation/storage systems and conservation technologies applicable to expeditionary operations.
f. Vestible and Shelter Connectors.

Maneuver and Movement/Sustainment: Deployment/Durability

a. Fabric Wall Structures:
    1) Flame retardant fibers and fabrics that maintain mechanical strength, wear, and weather resistance for materials used for fabric structural applications.
    2) Bonding techniques that guarantee long-lasting shielding continuity and integrity at seams and cutouts of rigid wall structures.
    3) Novel stitching and joining techniques for leak-free seams in fabric structures through the possible use of durable, composite threads that can permanently expand with application of a stimulus (e.g. heat) to eliminate the possibility of seam leakage due to needle holes, as well as increase seam strength.
    4) Net-shape manufacturing processes for fabric structures utilizing tubular materials with integral end close-outs that form the final shape of a fabric structure without seams except for doors and windows.
    5) Technologies related to the maturation of inflatable structures that carry high loads, are reliable, and are affordable. Related topics include the development of rapid air-beam inflation systems and technologies for long term deployment of air-beam structures, such as alternative inflation substances and rigidifying, and in-field repair kits.
    6) Self-erecting fabric and rigid structures utilizing novel technologies such as shape memory materials and phase change materials.
    7) Technologies that improve soil/structural interfaces in world-wide environments to include soil stabilization and improved anchoring

techniques.

8) Soft wall structures that can become rigid with application of external stimulus, using reversible rigidizing polymers.
9) Fabrics and soft wall structures capable of operation and maintenance in all environments.

b. Rigid Wall Structures:
    1) Lightweight, durable, high strength, low-cost, fiber composite rigid panels for expandable rigid wall structures with low flame propagation, smoke generation, and no toxic fumes.
    2) Highly expandable rigid wall structures with expansion ratio of 12 or higher.
    3) Improved expandable rigid wall designs for expandable structures or improved composites to existing rigid wall structures that reduce cost, the number of personnel needed, and/or the amount of time required to set up and tear down.
    4) Improved vehicle mounted or trailer-based rapidly deployable rigid structures.
c. Applications of electro textiles to rigid and soft-walled shelters.

Functional Integration of Multiple Technologies

a. Integration of multiple protection technologies (EMI/EMP/CB) to demonstrate a highly protected "operate-on-the- move" command post.
b. Integration of multiple structural technologies to demonstrate a shelter complex that provides multiple survivability capabilities integral with the system's components along with rapid deployment through low weight, high expansion, and air-beam/framed support.
c. Technologies that integrate multiple base infrastructure functions to enhance the utility of expeditionary rigid structures.
d. Rapidly emplaced expeditionary sustainment technologies.
e. Novel power supplies for efficiently producing/storing and/or providing electric power to operate field equipment including consideration of such factors as size, weight, cost, reliability, safety, maintainability, useful life, and environmental factors.
f. Equipment technologies to ensure the sanitary protection of hardware during set-up, deployment, operation, and pack out; ensure efficient and effective cleaning and sanitation of mobile military equipment.

Miscellaneous

a. The development of alternative applications for new inflatable, pressurized composite structures technology such as breakwaters, rapid port enhancement, water/fuel containers, munitions barricades, and high-pressure hoses.
b. Modeling of nonlinear fabric structures, fabric/yarn mechanics, constitutive relation, wind structure interactive modeling, and failure criteria.
c. New technologies that will benefit shelter electrical systems such as high efficiency lighting, power management, and field photovoltaic systems.
d. Novel technologies to enhance command post operations.
e. Additive manufacturing of lightweight structures and their components that could be printed in the field. This would include replacement parts for shelter systems (walls, support structures) and additive manufacturing of components that can be assembled in the field into a desired protective position or cover.

NOTE: Some of the technical approaches for topics within this solicitation may be subject to export control restrictions under existing export control laws, and/or required to be conducted as classified projects as outlined in the National Industrial Security Program Operating Manual (NISPOM) and its supplements. Contractors who would like to submit proposals pertaining to such technologies are encouraged to contact their local Defense Investigative Service (DIS) Industrial Security representative or have the Technical POC listed in the solicitation for guidance.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POCs:
Mr. Nicholas Brossi, TEL; 508-206-3654 Nicholas.a.brossi.civ@army.mil

All concept papers, proposals and administrative inquiries for Soldier Sustainment Directorate should be submitted to:

U.S. Army Combat Capabilities Development Command Soldier Center,
Engineered Systems Division, Soldier Sustainment Directorate
ATTN: FCDD-SCD (Ms. Donna Glowka & Ms. Jean Trumpis)
General Greene Avenue Natick, MA 01760-5018
TEL: 508-206-3397, donna.m.glowka.civ@army.mil
TEL: 508-206-3398, jean.m.trumpis.civ@army.mil

E. AERIAL DELIVERY

ADVANCED PERSONNEL AND CARGO AIRDROP SYSTEMS

Airborne force projection and aerial delivery methods are critical operational capabilities of the military's strategic shift toward a CONUS-based force. Increasing mission responsibilities now include humanitarian missions and all types of aerial delivery applications from a wider range of air vehicles. Aerial Delivery science and technology is focused on: 1) increasing aircraft (manned and unmanned, fixed wing and rotary wing)/airborne force survivability in a threat environment by expanding the aerial delivery operational envelope; 2) improving airdrop accuracy through the use of various levels of Lift to Drag ratios and actuator technologies and power augmented offset for precision-guided aerial delivery; 3) manned/unmanned aerial, ground, and ship-launched autonomous cargo delivery and personnel extraction/insertion; 4) Advanced High Altitude Low Opening (HALO) capabilities and low level airdrop systems; 5) rapid automated cargo derigging; 6) Resupply and delivery from non-traditional platforms (e.g. other than large mobility aircraft); 7) reducing personnel injuries/casualties by improving system functional reliability while reducing ground impact velocity, oscillation, and exposure time to threats; 8) enhance personnel airdrop capabilities both for high altitude standoff and low level operations by improving both canopy and auxiliary systems performance; 9) reducing the cost and time required for parachute development and production by new manufacturing techniques and using novel parachute designs developed by computational analytical methods to reduce manufacturing and testing requirements; and 10) technologies to improve Helicopter (manned and unmanned) Helicopter Sling Load (HSL) and External Air Transport (EAT) capabilities.

Scientific and Technical Areas of Interest:

An assessment of current personnel and cargo airdrop capabilities and ongoing research and development efforts versus future requirements has led to the following areas of interest:

a. Cargo airdrop technologies should focus on precision aerial delivery for all cargo weights (1-60K+ lbs.) and varying ranges of off-set distances, including higher altitudes and/or high glide and extended off-set powered systems. Affordable high altitude precision delivery systems and, where applicable, low-cost guidance, navigation, and control (GN&C) systems to include sensors, avionics, and software for use in Global Positioning System (GPS) and GPS denied environments. In addition, technologies for compatible mission planning systems at various levels of integration with delivery platforms and aircraft to support all types of airdrops from all types of aircraft, manned and/or unmanned. Complimentary weather sensors and forecasting

technologies for integration and/or use with mission planning and/or precision aerial delivery systems.

b. Concepts and development of extraction systems for light (10K lb.) through heavy (60K+ lb.) payloads from a range of transport aircraft and a range of aircraft velocities/altitudes (through range of aircraft flight envelopes).
c. Lighter weight and lower cost airdrop components than currently used for cargo and/or personnel airdrop systems. New rapid rigging/derigging to speed the preparation and recovery phases of airdrops and accommodate unmanned vehicle automated derigging and reduced velocity landing technologies for heavy drop platforms are desired. Methods to increase survivability of fragile payloads in an airdrop or aerial delivery environment.
d. Steerable personnel parachute systems that provide accurate delivery and minimize body injuries by means of low velocity landings and ground wind attenuation. Specific areas of interest include: 1) high glide and high off-set distance wing/system designs, to include powered systems, 2) high tech communication and video/audio systems, 3) navigational aids that support operation in GPS denied/challenged environments, 4) improved altimeter and situational awareness tools and 5) lightweight, increased capacity oxygen systems are needed to support increased duration missions for high altitude deployed paratroopers.
e. Advanced low altitude personnel mass tactical airdrop systems that incorporate novel concepts/technologies and increase parachutist safety. Development of medium and/or higher order modeling and simulation capabilities for individual systems, exploring new insertion concepts and/or new methods of deploying, material improvements as well as automatic opening technologies, and/or new aircraft exit technologies. Additionally, explore concepts for rapidly assembling a full end-to-end current or future global response force.
f. Technologies, concepts, and techniques to minimize the signature and risk of mission compromise of personnel and/or cargo airdrop systems to include any/all of the following types of detections: visual (day and night), electrical and radio frequency (RF) emissions, acoustic (aerodynamic noise), thermal (infrared), and radar return signatures.
g. Technologies to support “combination drops” in which cargo is dropped with jumpers following. This mission involves deconfliction, digital communication between jumpers and aerial guidance units, full situational awareness, and the ability of jumpers to command drop zone changes for their cargo in flight.
h. Next generation environmental protection for HALO/HAHO parachutists. These systems will allow free fall jumpers to perform insertion operations from greater offsets that require remaining aloft for extended lengths of time in a harsh environment.
i. Next generation parachutist oxygen delivery systems to address increased O2 requirements resulting from high altitude standoff missions. These systems will

allow for reduction in weight and size and provide more efficient ways to deliver O2 while parachutists pre-breathe or are under canopy.

j. Advanced personnel and cargo infiltration and exfiltration technologies such as powered flight or extended glide to maximize offset for airborne insertion and allow for exfiltration of personnel and cargo.
k. Advanced and/or automated construction/manufacturing methods, and/or autopacking methods, and/or automated inspection technologies for all types of parachute and aerial delivery systems.
l. New/Novel low-cost materials for aerial delivery systems.
m. Environmentally friendly materials for one-time use aerial delivery systems. Dual use materials that may be used for shelter, fuel, power generation, etc. after aerial delivery mission.
n. Development of interactive/electronic textiles (fabrics, cordage, and webbing) for parachutes to monitor and improve aerial delivery system performance and/or textile structural health monitoring such as canopy fabric structural behavior during inflation, variable glide ratio capabilities, textile structural integrity monitor/indicator, textile tension/stress/strain sensing capabilities, and environmental-adjustable materials.
o. Development of materials that have a more user and environmentally friendly disposal method than materials currently used in low-cost, one-time use cargo parachute. Current material is a woven polypropylene geotextile and is disposed of through burning. The most desirable technologies would allow the users to completely abandon the parachutes on the drop zone where they land with the confidence that within days or weeks the material will have fully or partially degraded to eliminate its physical footprint. Materials that have the ability to partially or fully degrade through various trigger mechanisms (such as thermal, mechanical, photochemical, biological, chemical, or electrical) in a time period that could range from a few seconds to a few days are ideal. Degradation could be initiated by natural means (such as ambient light or heat) or via a man-made trigger (application of water or voltage).
p. Study of the storage and use factors that influence the degradation of material and parachute performance over time (service life/storage life of personnel, cargo, HSL, LCADS equipment).
q. Technologies that will both reduce the footprint and signature (e.g. visual, IR, etc) of landed parachutes while also able to survive the challenging airdrop environment.
r. Modeling and experimental investigation of all the stages of parachute systems to include inflation and steady descent for modified round canopies, cross canopies, single-skin and ram-air parafoils, and new parachute designs.
s. Advanced sensors, instrumentation, and measurement methods to measure and investigate parachute aerodynamics and structural dynamics during opening, descent, and landing phases including aerial delivery system spatial position,

motion and geometry, fabric strain, opening force, air velocity, air pressure, and overall flow field.

t. Advanced technologies for precise and/or autonomous delivery and derigging of robots, unmanned vehicles, and unattended ground sensors.
u. New Helicopter Sling Load (HSL) and External Air Transportation (EAT) concepts that will reduce or eliminate the ground personnel required for hookup, increase flight stability ranges for HSL items, and increase flight envelope while not modifying the current airframes.
v. Autonomous airdroppable and/or ground launchable technologies/systems for ranges between 250-1000KM that can deliver up to 500 lbs. or more of cargo in any weather/environment. Reusability is desired but not required. The ability to deploy payloads from the system in smaller weight increments (20 to 100 lbs./drop) is also desired but not required. Technologies to enhance mission planning capabilities for a long range system, perhaps utilizing some artificial intelligence to autonomously determine the optimum route based on weather forecasts provided and/or measured on route, to prioritize either speed to location, and/or avoiding populations, and/or reducing signature during certain aspects of the route, etc.
w. Technologies to enable precision delivery of cargo and personnel in a GPS denied environment, in all conditions (day/night, weather, etc.), to include sensors, sensor integration, hardware, firmware, software, and GN&C algorithms.
x. Other aerial delivery applications with DoD and/or other US Government applications to include aerial delivery from VTOL aircraft and UAS.
y. Mission planning technologies to support emergency aerial resupply whether by legacy airdrop or autonomous aerial systems, to include integration with sustainment software applications, and vehicle command and control platforms.
z. Sustainment technologies to enable small unit resupply and predictive logistics at the tactical edge, to include web-based software, Tactical Assault Kit platform applications, sensor integration, and integration with mission planning and/or communication and control platforms.

Communication with a Technical POC prior to submission of a formal proposal is essential.

Technical POCs:

Mr. John Gildea, TEL: 508-206-3041, john.g.gildea.civ@army.mil
Mr. Eric Campagna, TEL: 508-206-3208, eric.j.campagna2.civ@army.mil
Mr. Andrew Meloni, TEL: 508-206-3261, andrew.w.meloni.civ@army.mil
Mr. Michael Henry, TEL: 508-206-3203, michael.r.henry48.civ@army.mil

All concept papers, proposals and administrative inquiries should be submitted to:

U.S. Army DEVCOM Soldier Center
Combat Capabilities Development Command Soldier Center,
Aerial Delivery Division, Soldier Sustainment Directorate
ATTN: FCDD-SCD-SAE (Ms. Allison Griffin & Ms. Jean Trumpis)
General Greene Avenue, MA 01760-5017
TEL: 508-206-3263, allison.k.griffin4.civ@army.mil
TEL: 508-206-3398, jean.m.trumpis.civ@army.mil

F. SIMULATION AND TRAINING TECHNOLOGY

Live Training Simulation and Battlefield Effects:

Army doctrine requires units to train as they intend to fight—that is, training must simulate realistic battlefield conditions ranging from small arms weapons engagements to large-scale chemical, biological, or nuclear attacks. To accomplish this, the Army needs advanced technologies to provide Soldiers with fully immersive, live, virtual, and constructive training environments with the ability to accurately replicate ballistics for all types of weapons (current and future), battle damage effects, visual and auditory cues, and haptic or force-based feedback (e.g. weapon recoil or explosive blasts). Systems must be able to operate both indoors and outdoors and allow trainees to interact with both live and virtual targets, personnel, vehicles, and other battlefield entities in support of a train anywhere, anytime doctrine. Furthermore, to be effective for future training environments, solutions should leverage, wherever possible, a modular open systems approach and take advantage of embedded training opportunities utilizing existing platform capabilities to achieve training objectives while minimizing new hardware requirements and appended systems.

Scientific and Technical Areas of Interest:

The following technical areas are being sought for innovative applied research, development, evaluation, and testing efforts that address current limitations in live, virtual, and constructive training environments:

(1) Weapon/Position Tracking: Exploration of innovative wireless, low size, weight, and power (SWaP) weapon tracking capabilities, including inertial, optical, and computer vision sensors that enable tracking of weapon systems and soldiers in a live training scenario. Special interest areas include precise navigation-grade inertial measurement units (IMUs) and wireless and/or marker-less tracking technologies.

(2) Replication of Battlefield Effects: Simulation or accurate replication of visual and auditory cues for battlefield effects, such as weapon launch signatures, terminal ballistic effects, and chemical or biological attacks. Solutions may include, but are not limited to, virtual, augmented, or mixed reality systems, non-pyrotechnic explosion/blast indicators, and training environment instrumentation.

(3) Dynamic Occlusion: Research that enables accurate, real-time depth sensing and occlusion mapping for use in virtual, augmented, and/or mixed reality solutions, with a specific emphasis on outdoor performance in highly complex environments and at ranges beyond 300 meters (out to five kilometers).

(4) Signals and Data Processing: Novel methods for processing signals and data, particularly in areas involving multi-sensor (e.g. video/imagery, physical state, timing, and electromagnetic signals) inputs. Methods should enable data

collection, analysis, simulation, and presentation of events specific to live training environments. Example applications include landmark or object detection for tracking or engagement adjudication purposes, position tracking using radio signals of opportunity, or fusion of multiple data streams to produce automated after-action reviews.

(5) Statistical Methodologies for Engagement Simulation: Applications of statistical modeling and simulation to help mitigate technical challenges associated with sensor accuracy, terrain database uncertainty, and multi-sensor integration. Relevant areas of study may involve the use of Monte Carlo simulation, Markov chains, or Stochastic modeling to integrate with existing force-on-force training algorithms to improve adjudication results.

(6) Novel Use of Artificial Intelligence/Machine Learning (AI/ML): The use of AI/ML to increase capabilities in any of the aforementioned areas of interest. Special topics of interest include prediction of GNSS receiver satellite availability due to terrain features (e.g., building obscuration), high accuracy pedestrian dead reckoning, video denoising, and video scene feature depth and distance estimation to include accurate passive range finding under conditions of high pixilation.

Technical POC:

Travis Hillyer, 407-639-7423, travis.r.hillyer2.civ@army.mil

Medical Simulation and Training

The Army requires improved medical readiness for future operations. Soldiers must be trained to move, shoot, communicate and treat casualties by achieving competence in cognitive and psychomotor medical and warfighter tasks. Medical simulation and training capabilities are needed to improve medical skills while supporting and integrating with Joint Warfighter simulations. Training capabilities are required for medical missions across all roles from tactical combat casualty care through Roles 1, 2, & 3. This includes advanced skills for providers at Role 2 and higher. Areas of consideration include:

(1) Technologies to reduce or eliminate the use of live tissue and cadavers in military medical training
(2) Virtual patients and novel interaction capabilities
(3) Integration with live, virtual, and constructive warfighter simulations
(4) Medical training technologies that realistically simulate human trauma
(5) Patient simulation technologies that mimic human tissue and anatomy
(6) Simulated tissue with dynamic properties of live human tissue
(7) Olfactory and malodor simulation technologies
(8) Prolonged casualty care training at all roles
(9) Accurate tactile feedback for medical procedures in virtual environments
(10) Computer, game, and mobile training technologies

(11) Methodologies that improve cost effectiveness, performance, and skill
(12) Mixed, augmented, and virtual reality solutions for medical training
(13) Medical treatment of non-humans such as military working dogs
(14) Training solutions addressing treatment gaps attributed to gender, race, and other social effects
(15) Automated objective methods to assess individual and collective skill and knowledge
(16) Methods to detect competency and predict future performance
(17) Augmented cognition techniques enhancing skill acquisition, performance, and retention
(18) Medical care in extreme environments such as cold, heat, jungle, desert, and micro-gravity
(19) Interoperability standards, including interfacing medical simulation outputs with existing medical standards.

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Dr. Jack Norfleet, TEL: 407-384-3897, Jack.e.norfleet.civ@army.mil

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM SC ATTN: FCDD-SCD-EXA
(Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or (508) 206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

Advanced Interactive Simulation

We continue to see simulation systems developed that are largely monolithic, often provide limited visibility into models within, and interface externally using limited Application Programming Interfaces (APIs). In turn, there are often differences between internal models representing the same phenomena across simulations, which introduces fair fight issues and additional inconsistencies. Furthermore, we are still limited by computational requirements for simulations and have only begun to enable the ability to deliver simulation to the point of need. While computer science and computing technology continue to evolve, the simulation domain has had limited success taking advantage of these technologies to innovate our simulation development.

Advanced Interactive Simulation aims to enhance the art of simulation to build on architectures that are based on composable models and services as opposed to the traditional method of various complex simulations interoperating. It further aims to enable robust Army simulation capabilities with composable synthetic representations delivered where they're needed in the form in which they're needed. Finally, it also aims to leverage emerging computing and networking technologies for application towards simulation execution environments.

Science and Technical Areas of Interest include, but are not limited to, research studies, demonstrations, and development involving:

(1) Methods and means that enable simulation architectures capable of supporting complex real-time and non-real time uses
(2) Composable simulation environments (Modular Open Systems Approach/MOSA) and Modeling and Simulation (M&S) as a Service across geographically distributed areas
(3) Application of advances in computing and networking to the simulation domain with example uses included simulation scalability, enabling real-time and faster-than-real-time simulation execution, geographic distribution of processing, cloud computing architectures and agility in design to support simulation execution in Denied, Degraded, Intermittent, or Limited Bandwidth (DDIL) environments
(4) Novel encapsulation of military representations, models, behaviors, and data for broad use in military simulation
(5) Applications of code generation to accelerate the ability to create simulation modules, support integration of simulation components, and enhance interoperability, as well as other innovative uses
(6) Exploration and application of emerging game technologies to the simulation domain
(7) Novel application of Digital Engineering, Systems Engineering, Model-Based Systems Engineering, and other tradespace analysis methodologies in the context of simulation environments
(8) Methods and means to represent Multi-Domain Operations (MDO)/All Domain Operations (ADO) in a simulation environment, including integrating US Army, Navy, Air Force, Marine Corps, Space Force, Cyber, and Coalition capabilities

Research activities should be demonstrated through uses cases with broad relevance across the six Army M&S Communities (Acquisition, Analysis, Experimentation, Intelligence, Test and Evaluation, and Training).

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:

Mr. Chris McGroarty, TEL: 407-208-3323, christopher.j.mcgroarty.civ@army.mil

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U.S. Army Natick Soldier Systems Center
DEVCOM SC ATTN: FCDD-SCD-EXA
(Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or (508) 206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

Cyberspace Warfare for Training (CyWar-T)

The Cyberspace Warfare for Training (CyWar-T) research program at the Soldier Center's Simulation and Training Technology Center (STTC) is addressing science and technology gaps in cyberspace training through modeling and simulation (M&S). The CyWar-T research program focuses on the Army's M&S technologies to represent cyberspace environments such as networks, the electromagnetic spectrum (EMS), space and positioning, navigation, and timing (PNT), and the information environment (IE), enabling the modeling and simulation of cyberspace activities and effects at the appropriate fidelity and resolution necessary to prepare the Army for conducting cyberspace electromagnetic activities (CEMA) in support of multidomain operations (MDO). Examples of prior and current efforts in the CyWar-T program include: 1) applications that simulate effects of cyberattacks on mission command information systems, 2) cyber data exchange models that integrate LVC&G systems with cyber ranges, 3) architectures and simulation environments that enable CEMA training, 4) cyber simulation models, 5) intelligent cyber adversary models, and 6) tools that synchronize electromagnetic warfare (EW) events and effects across LVC&G exercise environment. As the Army prepares to conduct MDO, the CEMA training and relevant simulation environments that the CyWar-T program is enabling will become commonplace.

Scientific and Technical Areas of Interest:

(1) Data Models and Ontologies for Cyberspace -related M&S
(2) Synthetic Representation of Cyberspace Terrain
(3) Service-based Network Simulations for L/V/C-G Training Systems
(4) CEMA Models and Simulations across the gamut of the cyberspace domain. Including, but not limited to:

a) Intelligence
b) Signal
c) Information Operations (IO)
d) Cyberspace
e) Space and Positioning, Navigation, and Timing (PNT)
f) Fires (as related to the cyber domain)

(5) CEMA Visualization Concepts and Tools
(6) Simulated Populations capable of Generating Dynamic Content in the Information Environment synchronized with L/V/C-G Training Systems

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Mr. Allen Geddes, TEL: 407-384-3926, james.a.geddes2.civ@army.mil

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM SC ATTN: FCDD-SCD-EXA
(Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or (508) 206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

Adaptive Instructional Systems

The U.S. Army seeks to leverage emerging adaptive learning technologies to enhance simulation-based training and promote active experiential learning and competency development for individuals and teams. Examples of these emerging technologies include generative artificial intelligence (AI), hybrid and multi-modal data analytic methods, machine learning (ML), extended reality, and distributed computing. Our goal is to advance adaptive training technology using various AI-supported services that influence training scenario design, automated assessment, learning modeling, and intelligent coaching/tutoring through feedback, conversational reflection, and data-driven recommendations. These services require the development and validation of a scalable learning analytic framework that leverages best practices in learning engineering, experience design, and generative AI methods to drive content generation and Socratic learning opportunities.

Additionally, technologies are needed to rapidly visualize performance data, provide actionable feedback to instructors, trainees, and leaders, and to automatically adapt

training strategies and feedback to trainee and team characteristics.

The following are specific areas of interest:

1. Technologies for automating measurement, assessment, and diagnosis of team and individual mastery of training objectives.
2. Tools and methods to operationalize training experience design across learning phases (before, during, and after training event) and modes of training (i.e., live, virtual, and constructive).
3. Next-generation automated coaching capabilities that leverage generative AI tools like Large Language Models.
4. Technologies for training strategy decision support systems that can automatically adapt training and develop content utilizing an ecosystem of resources and environments.
5. Data capture technologies that are unobtrusive, scalable across echelons and training modalities, and that support near real-time assessment and feedback to trainees.
6. Scalable best practices and authoring workflows applicable to existing learning technology standards.
7. Strategies and technologies that induce stress and other challenges associated with combat to improve the tactical effectiveness of synthetic training.

The Combat Capabilities Development Command, Soldier Center is requesting white papers describing research to address these challenges for training Army individuals and teams across a variety of missions including dismounted infantry, armored, aviation, and mission command.

Technical POC:

Ben Goldberg, (407) 384-3903, benjamin.s.goldberg.civ@mail.mil.

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM SC ATTN: FCDD-SCD-EXA
(Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020
TEL: (508) 206-3803 (Mr. Whipple) or (508) 206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

Battlespace Visualization and Interaction

Existing battlespace visualization capabilities often consist of physical map views or sand tables with limited capability to display information as the operational environment becomes more complex, especially as the Army evolves in support of Multi-Domain and Large Scale Combat operations. There is a growing need to provide the Warfighter with the tools and improved user interfaces to ingest and interact with diverse datasets as well as other users in ways that increase comprehension and improve training, planning, and mission command. The Army needs to determine the effectiveness of advancements in audio, visual, and haptic interfaces methods of sharing and collaborating across modalities including holographic displays; 3D monitors; mobile devices; projected & extended reality; augmented, virtual, and mixed reality head-mounted displays; and other wearables.

Battlespace Visualization and Interaction seeks to enable users with novel and innovative technologies that support geographically distributed collaboration, collective training, and command & control as well as other military uses. Furthermore, we seek to reduce the user's task load through increased usability and ease of use.

Research, Science and Technical Areas of Interest including research studies, demonstrations, and development involving areas in which we are interested:

(1) Novel display technologies
(2) Novel user interface (i.e. hardware- and software-based) technologies
(3) Innovative approaches to distributed simulation, training, and collaboration
(4) Methods and means that enable Warfighters to deploy scalable displays that support the sharing and manipulation of data across a variety of surfaces
(5) Technologies that provide innovation towards an immersive environment that mimics "reality" with increased accuracy

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Mr. Charles Amburn, TEL: 407- 384-3901, charles.r.amburn.civ@army.mil

All concept papers, proposals, and administrative inquiries should be submitted to:

U.S. Army Natick Soldier Systems Center
DEVCOM SC ATTN: FCDD-SCD-EXA
(Mr. Matthew Whipple or Ms. Jennifer Rourke)
General Greene Avenue
Natick, MA 01760-5020

TEL: (508) 206-3803 (Mr. Whipple) or (508) 206-3853 (Ms. Rourke)
Email: usarmy.natick.devcom-sc.mbx.osi-spod@army.mil

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Artificially Intelligent Agents

The US Army continues to work towards adding additional automation to its military simulation capabilities. There is a desire to move towards fully automated simulation where Opposing Forces (OPFOR), Blue Forces (BLUFOR), and Neutral Forces have explainable behaviors that can be quickly authored and modified. Artificially Intelligent Simulation Agents aims to reduce the need for personnel to manually control simulated units during simulation exercises and decrease the authoring time of military behaviors for simulation reducing cost. It further aims to explore novel applications of Artificial Intelligence (AI) to create simulation agents that have explainable goals for behavior and can replicate behaviors observed in the field, ultimately increasing the number of military representations supported by AI-enabled simulated forces.

Science and Technical Areas of Interest include, but are not limited to, research studies, demonstrations, and development involving:

(1) Hardware acceleration
(2) Cognitive and behavioral use case development
(3) Development of common testing platforms or components (algorithms, models, simulation, analysis of alternatives, discovery of AI policies, explainable AI, etc.)
(4) New algorithmic technologies
(5) User interface technologies for creating and controlling AI agents
(6) Aggregation and disaggregation of AI forces into larger/smaller units
(7) Analysis functions and development of novel fitness functions for training AI agents
(8) Discovery and explainability of AI policies from agents to human operations
(9) Integration and demonstrations of AI agents into various simulations
(10) Agent development from live/real and simulated data sources
(11) Adjustable difficulties of AI agents for training purposes

(12) Simulation-enabled Mission Planning, Mission Rehearsal, and After Action Review (AAR)

Research activities should consider a broad mix of military phenomena with broad relevance across the six Army M&S Communities (Acquisition, Analysis, Experimentation, Intelligence, Test and Evaluation, and Training).

Communication with the Technical POC prior to submission of a formal proposal is essential.

Technical POC:
Chris Mcgroarty, christopher.j.mcgroarty.civ@army.mil

Collaboration with the Institute for Creative Technologies

The Under Secretary of Defense for Research and Engineering (USD(R&E)) established the ICT, a Department of Defense University Affiliated Research Center (UARC) located in Playa Vista, California, in 1999 with the goal to enrich simulations through infusion of Hollywood technologies. The ICT's mission is to conduct modelling and simulation research, development, and prototyping in support of the Combatant Commands, Component Commands, and Service Commands in training and educating the force in the defense of the United States and its Allies. The ICT is one of the Army's four designated UARCs. PM ICT directs the activities and executes the ICT's mission through a separate IDIQ contract that includes basic and applied research.

Research Areas of Interest. PM ICT has interest in collaborating with Industry and Academia in the following technologies.

1. Generation and display of realistic sensory input for immersive virtual environments.

This area includes basic, applied, and advanced developmental research for the creation of realistic virtual environments including, but not limited to:

a. Research and development of hardware with software for 2D and or 3D computer graphics that capture, manipulate, render, and present images, animations, videos, databases, data visualizations, and/or movies.
b. Research and development of hardware with software to create immersive audio, 3D sound acquisition, and adaptive rendering. Areas include sonification and information presentation.
c. Development and systems integration of hardware with software of virtual reality-based immersion that can stimulate the senses, support mobility, and position sensing.

2. Use of Artificial Intelligence (AI), Generative AI (GAI), and Machine Learning (ML) technologies to generate computer-based individual and collective echelons of models and behaviors.

a. This area of interest primarily includes basic, applied, and advanced developmental research for AI, GAI, and ML.
b. It also includes natural language processing, automated reasoning, cognitive architectures, perceptions, spatial reasoning, knowledge representation, simulation execution with monitoring and direction, emotion modeling, interactive cognitively realistic virtual humans, and social simulations that replicate human social interaction at the individual and collective echelons of warfighting commands.

3. Study and development of applications for learning theory, instructional design, and assessment to create effective instructional content.

a. This area of interest includes basic, applied, and advanced developmental research of new paradigms for effective learning such as the use of narrative, tutoring systems, and tools for improving instructional content, effectiveness, and after-action reviews.
b. Focus of interest includes the following.
    (1) The application of new learning techniques within the context of military training.
    (2) Research and development of evaluation techniques using instrumentation, data collection, measurement tools, and methodologies.
    (3) Research and development of models and strategies for determining the effectiveness of training focused-performance of individuals and collective echelons in simulations and other computer-based environments.

4. Development of engaging virtual simulation, video-based training, and medical/health related content.

Interest in this area includes basic, applied, and advanced developmental research in training, learning, and other content that involves:

a. Research and development of hardware, software, and AI to be used in the development of training and medical/health related content using video, film, computer animations, digital media, static media (such as writing, still photography), along with sound and music composition.
b. Synthesis of creative content with simulation technologies, including AI

research, to develop immersive learning environments that are engaging and effective.

c. Support of the setup and configuration of simulation environments, terrain, and entity models to include content generation and scenario authoring.

5. Knowledge integration and conduct of purpose-based research.

This area of interest includes basic, applied, and advanced developmental research methods as stated below.

a. Research End State is to integrate knowledge from core simulation disciplines in support of training, education, operations, mental well-being, physical health, and other areas where technologies may be applied.

b. Research objective is to develop a dual use-based philosophy that addresses Department of Defense (DoD) and Services defined Science and Technology (S&T) gaps resulting in supporting transition opportunities among Federal, academia, and industry communities of simulation interests. The objective promotes mission and public service-oriented research, engineering, prototyping, evaluation, and systems analysis that responds to Federal requirements and needs of dual-use partners.

Parties Interested in Collaboration. See contact individuals below.

Technical POC:
Keith.W.Brawner.Civ@army.mil

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