# ARL submission to BRIMS sponsor panel

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The US Army Research Laboratory (ARL) provides fundamental underpinning research and development for the Army Materiel Command and supplies innovative science, technology, and analysis to enable full-spectrum operations. The Army relies on ARL for scientific discoveries, technologic advances, and analyses to provide Warfighters with capabilities to succeed on the battlefield. The Human Research and Engineering Directorate (HRED) of ARL conducts a broad-based program of scientific research and technology development directed toward optimizing Soldier performance and Soldier-machine interactions to maximize battlefield effectiveness. ARL HRED provides the Army with human factors leadership to ensure that Soldier performance requirements are adequately considered in technology development and system design. Although ARL is not part of the Medical, Personnel, Training and Doctrine, or Test and Evaluation Commands; we collaborate with our colleagues there and throughout the Department of Defense to address Human Systems Integration issues.

ARL HRED high priority research areas include Soldier Performance, Neuroergonomics, Social/Cognitive Network Science, Human Robotic Interaction, and Human Systems Integration. Opportunities and challenges for BRiMS exist in each of these areas. Addressing them entails empirical data collection, development of theoretical frameworks, algorithm development, validation, and usability testing as well as code development. Many of the issues have been presented by sponsors at earlier BRiMS conferences (notably those by Surdu 2007 and Allender 2007[1]) and remain relevant.

The goal of ARL's Soldier performance research is to optimize sensory, perceptual, and physical demands on the Soldier and the Soldier-system to improve survivability, sustainment, efficiency, and performance effectiveness. While much progress has been made on modeling and simulation of human locomotion and to a lesser extent load carriage, challenges remain in representing cooperative team and group tasks. M&S of sensory and perceptual processes exist but compelling cross sensory modality presentations are lacking. Empirical data collection and often as a result BRiMs does not address the combined effects of performance moderators particularly those combinations in which moderators counteract each other at different levels.

ARL's neuroergonomics program seeks to assess Soldier cognitive and neurophysiological function, understand Soldier behavior, and develop non-subjective, operationally relevant cognitive metrics through the translation of laboratory techniques. The goal is to enable the Army to match the capabilities of Soldiers and advanced technologies to maximize investments in systems development. Given recent interest and investment in this area, challenges for BRiMS are well known by the community however additional emphasis should be given to two topics to meet Army needs. BRiMS must be generalizable to militarily relevant settings, conditions and functions i.e. outside the laboratory setting. Also, schema and corresponding BRiMS must be developed to deal efficiently but validly with aggregating from individuals to populations. The Department of Defense may define (aggregate) its members in various ways for example job specialty, rank, mental category, skill level, or gender.

ARL's social/cognitive network science research area involves applying principles from the cognitive, computer, and social network sciences to the conduct of complex dynamic network-enabled operations. Decision makers are not able to use the sheer volume of information available over the network effectively. The goal is to align Warfighter and system capabilities. Specific topics of focus are situation awareness, decision making in environments characterized by information overload, information uncertainty, trust in automation, or joint and multinational operations. Efforts include computer models, tool development, data collection in exercises, and data collection in controlled experimentation. Expected benefits are information to assist the proper design of units and the development of methods to support distributed collaborative planning and decision making at the tactical and operational levels. BRiMS particularly those that are predictive and can underlie intuitive commander planning and decision support tools are of interest to ARL. Social and cultural modeling, as noted in a 2007 BRiMS symposium conducted by Allender and Sutton, continues to be of interest to the Department of Defense. Social and cultural factors should be included across the full spectrum of modeling and simulation research and applications. In this area the emphasis is on using M&S to support on-going operations of all types.

The purpose of ARL's Human Robotic Interaction effort is to reduce workload and improve combat performance for the Soldier-robot team through a better understanding of the human dimension. The expected result is improved interface and adaptive Soldier support technologies scalable to dismounted and

mounted warrior systems in multi-mission environments. In this area, BRiMS is needed as an enabler for exploration, analysis and empirical data collection of concepts for human-robot interaction, human robot teams and interaction with robot-robot teams. M&S that represent perception, management of concurrent tasks, operator control units, adaptive automation, social and cultural norms, and group behaviors are important to this research area.

ARL's mission in Human Systems Integration includes developing tools and analytic methodologies for cost effective insertion of human factors criteria into early acquisition (pre-milestone A) requirements to optimize Soldier-system performance and cost at the systems of systems level. ARL also conducts Soldier-centered analyses to ensure manpower requirements, workload, and skill demands are considered collectively and systematically, avoiding information and physical task overload and taking maximum advantage of aptitudes, individual and collective training, and numbers of Soldiers for an affordable future force. Given this mission, BRiMS is useful in informing system design tradeoff decisions and has proven an effective means of convincing acquisition managers that human factors issues need to be addressed. Improvements in BRiMS already mentioned will help ARL's HSI mission. Attention to verification, validation and accreditation as well as decreasing the resource requirements for using predictive BRiMS will make it more feasible for HSI practitioners to employ this technology. Another aspect of HSI tool development and analysis is the importance of relating human and system component performance to mission performance. To be useful for HSI, BRiMS must be scalable and able to account for the effect of changes in that state of components (including human operators) on mission goals and vice versa. Links that cross classes and application of models are important to decreasing resource requirements for employing M&S and to increasing collaboration with other design fields such as systems engineering.

ARL has recently awarded or will soon award several Collaborative Technology Alliances (CTAs) with Industry and Academia that are expected to advance BRiMS in several of ARL's high priority research areas. A CTA about network science was awarded in September 2009 and two other CTAs – one about Robotics and another about Cognition and Neuroergonomics – are still in competition.

Footnote:
[1] Available online at http://brimsconference.org/archives/2007/abstract/07brims-203.htm