

# Innovation

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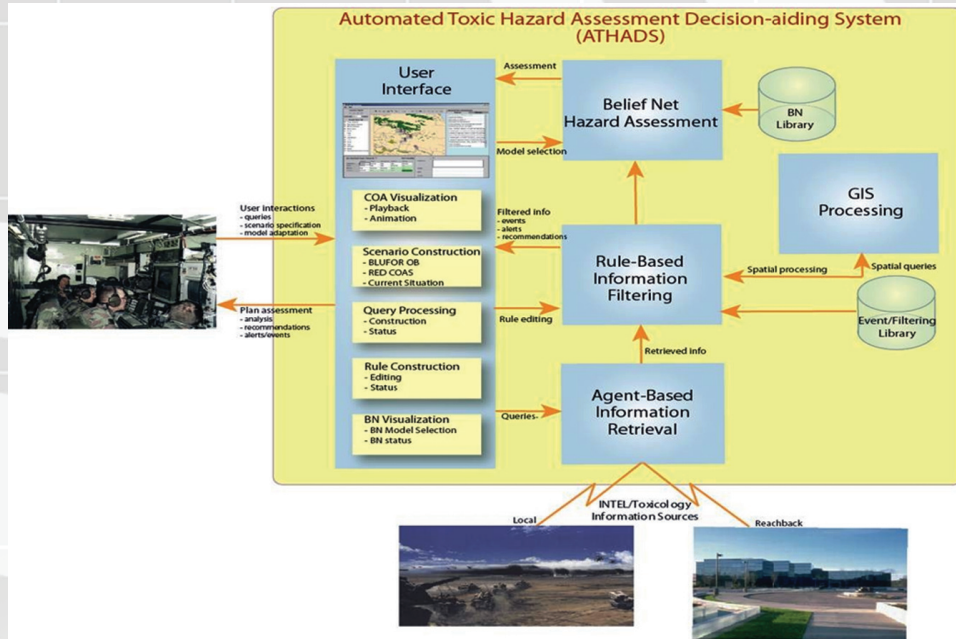
**SBIR Title:**  
Advanced Force  
Protection Tools (AFPROT)  
for Integrated Mission  
Planning

**Contract Number:**  
FA8650-04-C-6551

**SBIR Company Name:**  
Charles River Analytics, Inc.  
Cambridge, MA

**Technical Project Office:**  
AFRL Human Effectiveness  
Directorate, Wright-  
Patterson AFB, OH

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



## Automated Toxicity Hazard Assessment Decision-aiding System (ATHADS)

- The Air Force has a requirement for a near real-time mission planning tool to address scenario-specific toxic industrial chemical/material (TIC/TIM) exposure hazards for operational personnel
- ATHADS provides a decision aiding system for assessing the risks associated with TIC/TIM for ground maneuver forces without the tedious and repetitive work currently performed by human analysts
- Charles River Analytics' ATHADS system addresses this need by performing complex event processing of toxicology, weather, geographic, and course of action data via a unique combination of rules and Bayesian processing
- The modularity and extensibility of ATHADS allows application to intelligent systems in general and to other domains such as homeland defense, cyber security and environmental hazard assessments

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## Air Force Requirement

Intelligent (computational) assessment of potential toxic industrial chemical/material (TIC/TIM) exposure hazards is necessary for 21st century military mission planning. Increasingly, the modern battlespace engages industrialized areas. Currently, only rudimentary estimations can be made of the human health hazards associated with personnel exposures during operations in complex industrial chemical-rich environments. Simple knowledge of TIC/TIM presence or toxicity level is virtually useless in a planning context associated with personnel movement and other mission efforts. Thus, a near real-time hazard assessment system is needed to assist in the planning process that accounts for scenario-specific factors during deployment. Factors that would influence the potential effects of chemicals include, but are not limited to, the length of the operation, the potential routes of exposure (e.g. inhalation, skin absorption, drinking water), the availability of personal protective equipment, weather conditions, and the availability of reliable toxicity (health hazard) information. Furthermore, the amount of intelligence information that must be electronically gathered and parsed for decision analysis, including chemical hazard information, clearly requires the assistance of computational tools to produce simple decision assessments for command officers.

## SBIR Technology

The presence of toxic industrial chemicals and materials (TIC/TIM) can have a dramatic impact on mission success and is seen as a key impediment to force protection. Charles River Analytics, Inc. developed their Automated Toxicity Hazard Assessment Decision-aiding System (ATHADS) under the SBIR program in order to support enhanced mission planning. Their approach leveraged three synergistic technologies: intelligent agent-based information retrieval of toxicology data; a rule-based mechanism for information filtering based on retrieved information; and a Bayesian belief network approach to environmental hazard assessment and prediction. In effect, ATHADS performs complex event processing (CEP) of toxicology, weather, geographic information system (GIS), and course of action data using an innovative combination of rules and Bayesian processing to provide hazard assessment and risk mitigation predictions for the intelligence preparation of the battlespace (IPB). This is an essential element in military planning; it consists of a

continuous process that defines the battlespace environment and its effects and determines and evaluates likely enemy actions.

## Potential Application

ATHADS provides a decision aiding system for assessing the risks associated with toxic industrial chemicals and materials (TIC/TIM) for ground maneuver forces. Specifically, the system is targeted at supporting the maneuver battlestaff in the mission planning phase to account for the potential mission impacts and force protection issues associated with TIC/TIM both in the U.S. and abroad. ATHADS is seen as a potential supplementary technology within medical intelligence toolsets, such as the Medical Situation Awareness Tool (MSAT), and could support efforts such as the Armed Forces Medical Intelligence Center (AFMIC) site intelligence analyses. In this application, it could alleviate much of the tedious and repetitive work currently performed by human analysts. Additionally, the modularity and extensibility of ATHADS would allow application to other domains including homeland defense, environmental hazard assessments performed by federal and state regulatory agencies such as the Environmental Protection Agency (EPA), First Responder protection concerns, industrial accidents and acts of terrorism such as chemical attacks.

## Company Impact

The modularity and interoperability of components developed under the ATHADS Phase II and Phase II Extension efforts make them potential candidates for embedding in intelligent systems in general and in rules- and/or belief network-based inference systems in particular. The hierarchical approach to belief network modeling offers benefits to any inferential study of any complex system. Charles River Analytics has specifically leveraged the innovative combination of rules and Bayesian network processing to perform complex event processing (CEP) in several cyber security efforts including the Integrated Network Attack Fusion System (INAFS) and Attack Centric Autonomic Detector of Insider Adversaries (ACADIA). In addition, the hazard assessment models developed under this SBIR effort have directly impacted the development and enhancement of Charles River's desktop belief network software product, BNet.Builder™.



# SBIR/STTR

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