

Science.

Technology.

Innovation

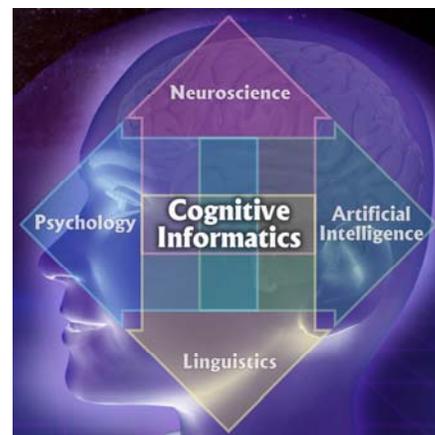
PNNL's Cognitive Informatics program focuses on two broad R&D areas: Information Technology to enhance Human Information Interaction; and interactive paradigms for enhanced Learning and Skill Development.

Rich Interaction Environments:

## Cognitive Informatics

**Cognitive Informatics (CI)** is the multidisciplinary study of cognitive and information sciences, which investigates human information processing mechanisms and processes and their engineering applications in computing.

The goals of PNNL's CI program are to conduct applied Research and Development (R&D) to augment human abilities to understand, remember, learn, and decide via new technologies, custom-tailored for human-computer collaboration and symbiosis.



The primary focuses of PNNL's CI program are

- Human Information Interaction (HII)—Develop computational approaches that enhance human performance and that of human-machine systems.
- Learning and Skill Development—Develop innovative applications of interactive technologies to enhance human learning.

Members of PNNL staff within the Rich Interaction Environments thrust area and collaborators from across the Laboratory bring diverse interests, expertise, and technologies to bear in solving challenging problems for clients in government and industry. Representative capabilities and technologies are:

### Capabilities

- Human-Computer Interaction
- Information Analysis
- Memory and Learning
- Thinking, Reasoning, and Problem Solving
- Cognitive Linguistics
- Knowledge Representation
- Cognitive Mechanism and Process
- Evaluation Research Methodology
- Technology Impact Assessment
- Instructional Systems Design
- Usability Engineering

### Technologies

- Web-based Information Systems
- e-Learning
- Learning Content Management System
- Learning Management System
- Multimedia
- Artificial Intelligence
- Agent Technologies
- Machine Learning
- Neural Networks
- Pattern Recognition
- Bioinformatics

**Pacific Northwest  
National Laboratory**

Operated by Battelle for the  
U.S. Department of Energy



## Human Information Interaction R&D

PNNL's CI program in human information interaction spans several areas of application aimed at improving human-system performance, enhancing human-computer interaction, and developing solutions to information analysis and visualization to effectively raise human-computer bandwidth. Representative projects include:

### *Intelligent Multi-agent Systems for Knowledge Discovery*

This research aims to design and develop systems that enhance human-information interaction in information analysis and discovery for diverse applications, such as intelligence analysis and bio-informatics. The goal is to enable a decision maker to ask a complicated question and receive fused information to support knowledge discovery. Our approach integrates a cognitive model and a cooperative community of intelligent software agents into a computer-based data analysis architecture that supports information analysis, synthesis, and discovery from massive, complex, and heterogeneous data sets to aid in research.



### *Methodology and Metrics for Tool Evaluation*

The research community has been seeking technology-based solutions to reduce the decision maker's workload and improve the throughput and quality of products. PNNL researchers have helped to define functional requirements and to develop test/evaluation methodologies and performance measures to assess the impact of such products.



## Learning & Skill Development R&D

PNNL's cognitive approach to learning and performance assessment has helped to advance the field of online/interactive training through the design and development of new computer-mediated approaches to scenario-based instruction and guided-discovery learning. Representative projects include:

### *Guided-Discovery e-Learning*

PNNL uses cognitive science principles and innovative guided-discovery learning concepts in an innovative e-Learning application to train Department of Energy Security Incident Inquiry officials on human errors that contribute to security incidents. The guided discovery process engages the learner through a virtual exploration of the workplace where an incident occurred, progressing from simple to complex scenarios and providing varying levels of feedback, coaching, and hints. This experiential approach represents a unique and significant advancement in the field of e-Learning.



### *Scenario-Based e-Learning*

This interactive e-Learning is used to train operators and maintainers of U.S. Army logistics communications equipment deployed world wide. The training begins with simple concepts, provides frequent interactive checks on learning using real-life examples, and builds up to integrated interactive scenario-based troubleshooting exercises. Implemented using PNNL's Pachelbel © e-Learning content development and delivery system, this SCORM-conformant Web-based training is also distributed on CD media.



## Impact of This R&D

PNNL's research on **Human-Information Interaction** is being applied to enhance performance of human-computer systems in the domains of intelligence analysis and bio-informatics. A significant impact of our work is the recent focus on evaluation methods and metrics by the intelligence community.

PNNL's research on **Learning & Skill Development** is recognized by training organizations and clients for leadership and innovation in creating dynamic, interactive instructional environments that more closely represent real-life, "hands-on" training while maintaining the highest standards of cognitive-based instructional design principles.

PNNL's CI program clients and stakeholders include:

- Advanced Research & Development Activity (ARDA)
- U.S. Defense Intelligence Agency
- U.S. DOE Office of Science
- U.S. DOE CIO Cyber Security Office
- U.S. Army CAISI Project Office
- U.S. Navy, Naval Surface Weapons Center (NSWC)
- U.S. Army Logistics Transformation Agency

As a U.S. Department of Energy multi-program national laboratory, PNNL develops and deploys technology for national missions in energy, the environment, defense, and human health.

### **For more information, contact**

**Dr. Frank L. Greitzer**  
**Pacific Northwest National**  
**Laboratory**  
**P.O. Box 999, K7-28**  
**Richland, WA 99352**  
**509-372-4251**  
[frank.greitzer@pnl.gov](mailto:frank.greitzer@pnl.gov)

Please visit PNNL's Cognitive Informatics Web site:

<http://www.pnl.gov/cogInformatics>