FFRDCs: Where are the National Laboratories?
Human Dimension work at the National Laboratories

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BLUF:
Engage the National Labs in NDIA-HSI

- Substantial R&D at National Laboratories
  - DOE Investments
  - Done at National Laboratories, primarily Federally-Funded Research and Development Centers (FFRDCs)
  - Significant DoD and other Agency R&D at National Laboratories

- There is HSI-Relevant work at many of these Laboratories

- Issues
  - FFRDC status?
  - Coherence – need for organization and rally point
FY 2015 Federal Obligations for R&D with FFRDC Proportions

FY 2015 Federal Obligations for R&D to FFRDCs

National Laboratories of the U.S. Department of Energy

Source: U.S. Department of Energy

http://energy.gov/maps/doe-national-laboratories
National Laboratories with identified active human dimension activity
What makes FFRDCs unique?

- **A special relationship** between the federal government and an FFRDC which is significantly different in nature than other government contractors

- Meet special **long-term research or development needs** that cannot be met as effectively by existing in-house or contractor resources

- FFRDC contractors have:
  - **Enhanced access** to privileged government information
  - Access to government *personnel, facilities*, and other resources

- Long-term relationships between the Government and FFRDCs ensure:
  - Familiarity with the needs of the sponsor(s)
  - Currency in field(s) of expertise
  - Objectivity and independence
  - Continuity to attract high-quality personnel
  - A quick response capability
FFRDCs have special requirements

- All work must be within the FFRDC’s purpose, mission, general scope of effort, or special competency
- An FFRDC’s sponsor determines if work may be accepted from other than the sponsor and approves all work
- Must conduct its business in a manner befitting its special relationship with the Government:
  - Operate in the public interest with objectivity and independence
  - Be free from organizational conflicts of interest
  - Cannot use privileged information or access to compete with the private sector
  - Fully disclose its affairs to the sponsoring agency
- Intellectual Property generally remains property of the U.S. Government
Sandia’s National Security Missions

- Reduce Global Chemical & Biological Dangers
- Secure & Sustainable Energy Future
- National Security Space Innovations

- Global Nuclear Assurance and Security
- Cyberspace
- Synergistic Defense Products

Nuclear Weapons

LABS’ FOUNDATION
Exploring Human Cognition

Data visualization, Pattern Analytics to Support High-Performance Exploitation and Reasoning (PANTHER)

1. Study strategies of visual information foraging in novices vs. experts
2. Develop algorithms to predict strategies
3. Informed by basic visual cognition research, enhance data visualizations (e.g. graphs), visual representation software etc.

Working Memory, Human Performance Lab (HPL)
1. Study neural signatures of memory via EEG
2. Study impacts of tDCS
3. Test memory training strategies

POC, PANTHER:
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POC, Memory:
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The Human System Simulation Laboratory (HSSL)

- Reconfigurable full-scale control room simulator facility
- Operator workstations for performance analysis.
- Technologies to measure human response:
  - audio and visual surveillance,
  - heart rate,
  - breathing
  - skin conductivity
  - eye-tracking)
- Instrumental in nuclear power plant control room modernization in the U.S
Leaders of Army and Marine brigades and battalions receive training on laptop and desktop computers where they react to incoming digital information while executing a commander’s tactical plan,” (JCATS, S&TR April/May)

Planning and rehearsal capabilities that extend from the Joint Task Force level to that of individual soldier

POC
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Energy efficiency
- Basic research on how people interact with energy technology

Ex: Gesture-sensing Thermostats
- Thermal Confidence Index (TCI)

Real-world applications:
- Application of machine-learning (e.g. TCI) to energy technologies
- Nest thermostats (smart thermostats that learn a user’s habits)

Goal:
1. Create technologies that make energy saving user-friendly thereby...
2. Encouraging the user to save energy.

TCI predicts comfort/discomfort with 75%-80% confidence

POC:
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A proof of concept to...

1. Place accelerometers on building floors provide data on harmonic base excitation – maybe an earthquake.
2. Data is preprocessed.
3. Data is then encoded as vibrotactile stimulus which human subjects feel through a glove.
4. Humans asked to characterize the damage to the structure.

POC:
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Implantable and Wearable Neural Interface Electronics

Objective:
• Enhanced neural control of prosthetics for amputees

Proof of concept designed to:
• Match flexible, biocompatible, conductive materials to nerve fibers so they can integrate with nerve bundles.

Example:
• Thin evaporated metal or patterned multi-walled carbon nanotubes

POC:
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Transportation Security Administration (TSA), understanding human decision-making during threat detection by...

- observing officers’ behaviors and accuracy
- in representative, non-laboratory samples (e.g. in actual airports, actual TSA officers)

Possible effects on behavior and accuracy: supervisor emphasis (accuracy or throughput), image resolution, officer experience/training, cognitive attributes ....

Cognitive psychologist and TSA research team lead Ann Speed conducts research aimed at quantifying human behaviors.

POC: Ann Speed
Data-driven & Neural Computing
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Theory-based framework
Individual and group/organizational decision-making
Informs High Consequence Decisions
- Likely range of outcomes of potential courses of actions or events
- Assess higher-order (cascading) effects
- Track confidence levels
- Transparent

POC
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Neuromorphic computing at SNL leverages a broad research foundation

**Neural Theory**
- Modeling and Simulation
- Computational Neuroscience
- Neuro-informatics

**Neural Computing Capabilities**
- Neural Machine Learning Algorithms
- Formal Neural Computing Theory
- UQ / SA of Neural Algorithms and Neural Architectures
- Configurable CMOS Neural Architectures
- Adaptive post-CMOS Neural Architectures

**Deployable National Security Applications**
- Cyber Defenses
- Embedded Pattern Recognition Systems
- Smart Sensor Technologies

**Enabling Advanced Scientific and Data-driven Computing**
- Neural-inspired communication paradigms
- Adaptive memory management
- Robust machine learning

**Memory technology**
- Micro-sensors
- Non-von Neumann architectures

**Micro-sensors**
MESA Fabrication Facility provides materials and design research capabilities for next generation neural systems

IARPA MICrONS Government Team for Test & Evaluation of Neural Models and Machine Learning

HAANA Grand Challenge – Flagship LDRD across computing, materials, and cyber security centers
Industry Strategic Alliances Successes

Bridging lab interests and industry capabilities in service to the nation
Industry: Interested in partnering with a laboratory?

**Agreement Type**

CRADA (Cooperative Research & Development Agreement): Sandia and one or more partners outside the Federal government (usually from industry, nonprofit organizations, or academia, domestic or foreign) collaborate and share the results of a jointly conducted research and development project.

**Benefits**

- Leverages research efforts by Sandia and partner.
- Each party may take title to its own CRADA-generated intellectual property.
- Partner has option to obtain license to Sandia's CRADA-generated intellectual property in limited field of use on agreed-upon reasonable terms and conditions.
- Designated CRADA-generated information can be protected for up to five years.
- CRADA non-disclosure provision protects proprietary information.

**Funding**

Funding to support the work Sandia performs for a CRADA may come from:

- 100% partner funds.
- 100% government program funds (from DOE/NNSA or other Federal agencies).
- Combination of funding from the partner(s) and the government.

**Requirements**

- Partner “in-kind” contributions of labor and possibly property or services.
- Work must benefit a DOE/NNSA mission.
- Written statement of work.
- Related collateral documentation.
- Acceptance of legal terms and conditions.
- Substantial U.S. manufacturing requirements (or benefit to U.S.).
- Government retains non-exclusive, paid-up, royalty-free license to all CRADA-generated intellectual property for U.S. government use.
- Approval by DOE/NNSA required before Sandia can perform work.
- Final report upon completion of project.

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Or visit:

www.sandia.gov/working_with_sandia/technology_partnerships/index

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Academic Partnerships

University Partnerships / Academic Alliances

http://nnsa.energy.gov/aboutus/ourprograms/defenseprograms/stockpiles stewardship/upaa

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Conclusion: Engage the National Labs in NDIA-HSI

- Substantial R&D at National Laboratories
- There is HSI-Relevant work at many of these Laboratories

Issues
- FFRDC status?
- Coherence – need for organization and rally point

NDIA Human Systems as that rally point?
- Many expressed interest in the possibility.
- Propose to spend the next year exploring how NDIA could be a unifying force among these National Lab pockets, culminating in contributions to next year’s Conference.
Questions?

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Why does the nation need FFRDCs?

- **Comprehensive knowledge of sponsors needs** – mission, culture, expertise and institutional memory regarding issues of enduring concern to the sponsor
- **Adaptability** – ability to respond to emerging needs of their sponsors and anticipate future critical issues
- **Objectivity** – ability to produce thorough, independent analyses to address complex technical and analytical problems
- **Long-term continuity** – uninterrupted, consistent support based on a continuing relationship
- **Broad access to sensitive government and commercial proprietary information** – absence of institutional interests that could lead to misuse of information or cause contractor reluctance to provide such information
- **Quick response capability** – ability to offer short-term assistance to help sponsors meet urgent and high-priority requirements
Human as Supervisor
Human as Component
Human as Subject
Human as Inspiration

Performance Augmentation
Human/System Integration
Vulnerability Compensation
Human Observability
Influence Human
Neuro-inspired Computing
Anthropomimetic Robotics

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