Human Factors/Behavioral Sciences Division

Research ♦ Transition ♦ Innovation

Dr. Sharla Rausch, Head
Human Factors/Behavioral Sciences Division

Science and Technology Directorate
U.S. Department of Homeland Security

May 2009

Homeland Security

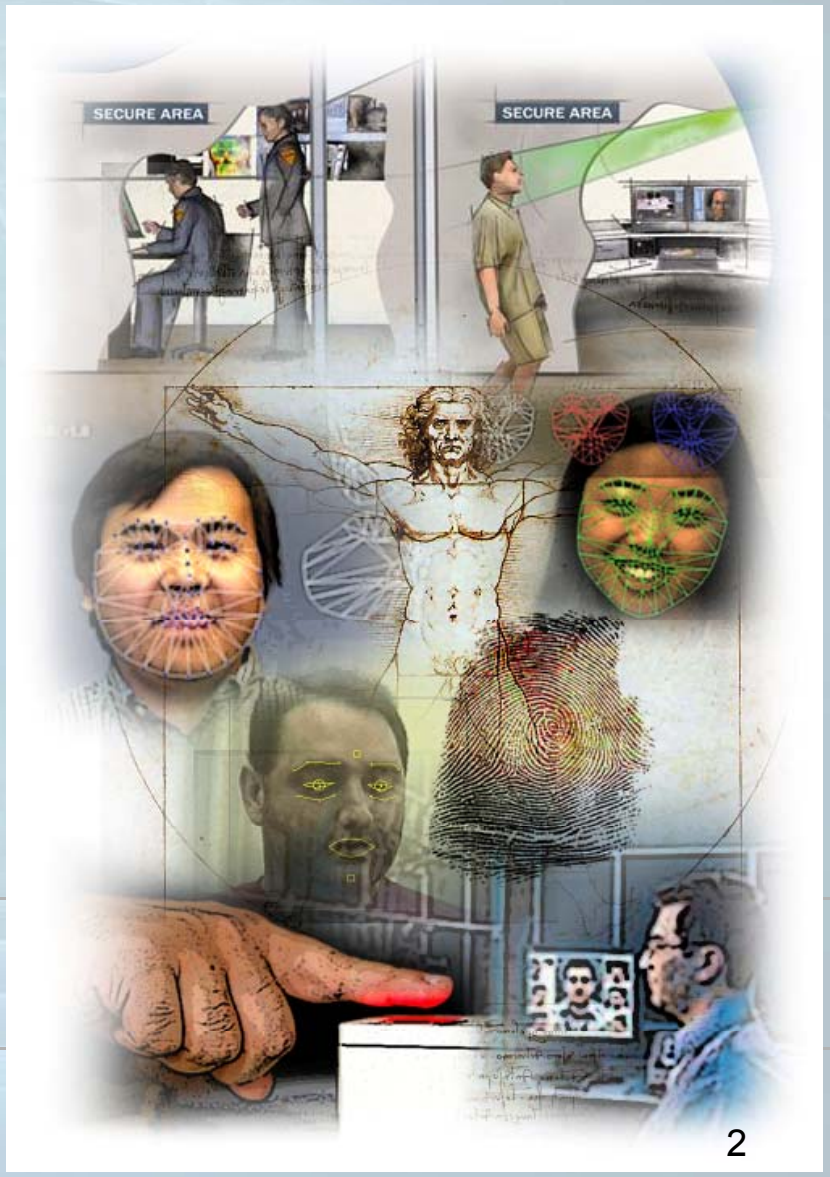
Human Factors/Behavioral Sciences Division

Vision:

A safer, more resilient nation that incorporates the human dimension into homeland security analysis, operations and policy development.

Mission:

We will advance national security by developing and applying the social, behavioral, and physical sciences to improve identification and analysis of threats, to enhance societal resilience, and to integrate human capabilities into the development of technology.



Customers: TSA, US-VISIT, USCIS, ICE, SCO, USSS, FEMA, OI&A, USCG, State & Local, S&T Divisions

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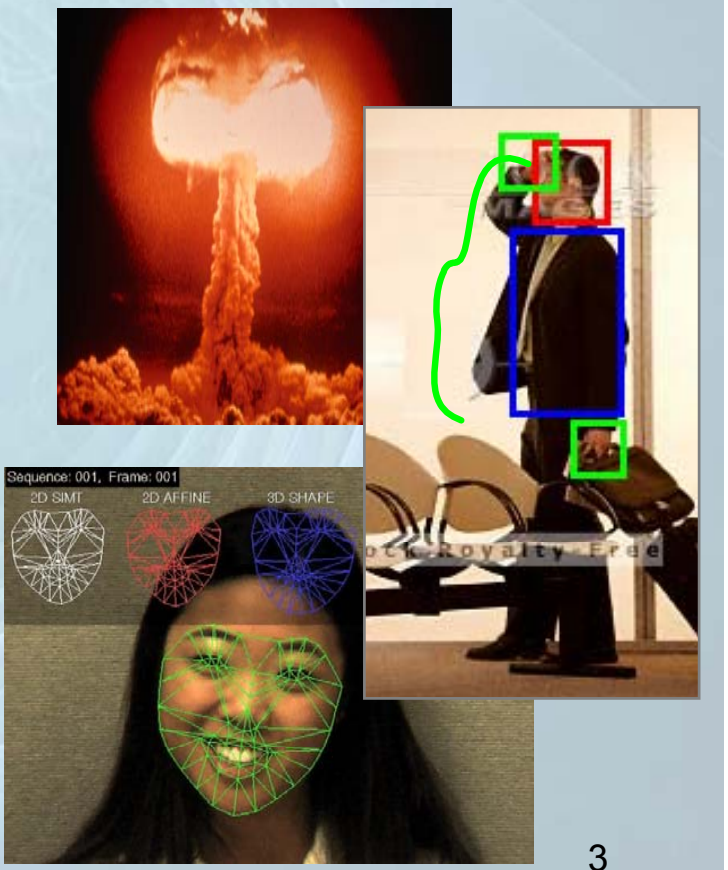
HFD Thrust Areas

The DHS S&T Human Factors/Behavioral Sciences Division is comprised of three primary thrust areas, with programs under each:

- **Social-Behavioral Threat Analysis**
  - Motivation and Intent
  - Suspicious Behavior Detection
  - Community Preparedness and Resilience
- **Personal Identification Systems**
  - Biometrics
  - Credentialing
- **Human Technology Integration**
  - Human Systems Research &Engineering
  - Technology Acceptance and Integration



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Human Factors/Behavioral Sciences Program Objectives

1. Enhance the capability of the Department to analyze and counter terrorist motivation, intent and behavior.
2. Improve screening by providing a science-based capability to identify *unknown* threats indicated by deceptive and suspicious behavior.
3. Improve screening by providing a science-based capability to identify *known* threats through accurate, timely, and easy-to-use biometric identification and credentialing validation tools.
4. Enhance safety, effectiveness, and usability of technology by systemically incorporating user and public input.
5. Enhance preparedness and mitigate impacts of catastrophic events by delivering capabilities that incorporate social, psychological and economic aspects of community resilience.

Know our enemies, understand ourselves; put the human in the equation.

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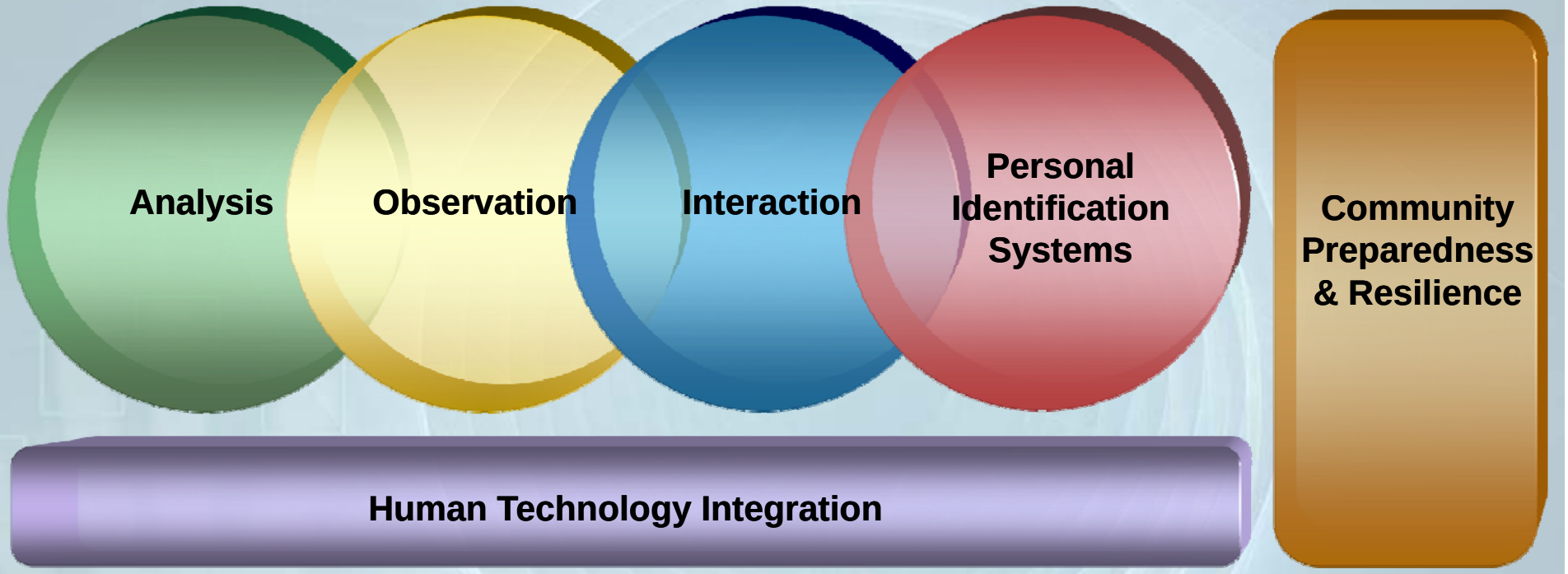
Human Factors/Behavioral Sciences S&T Focus Areas



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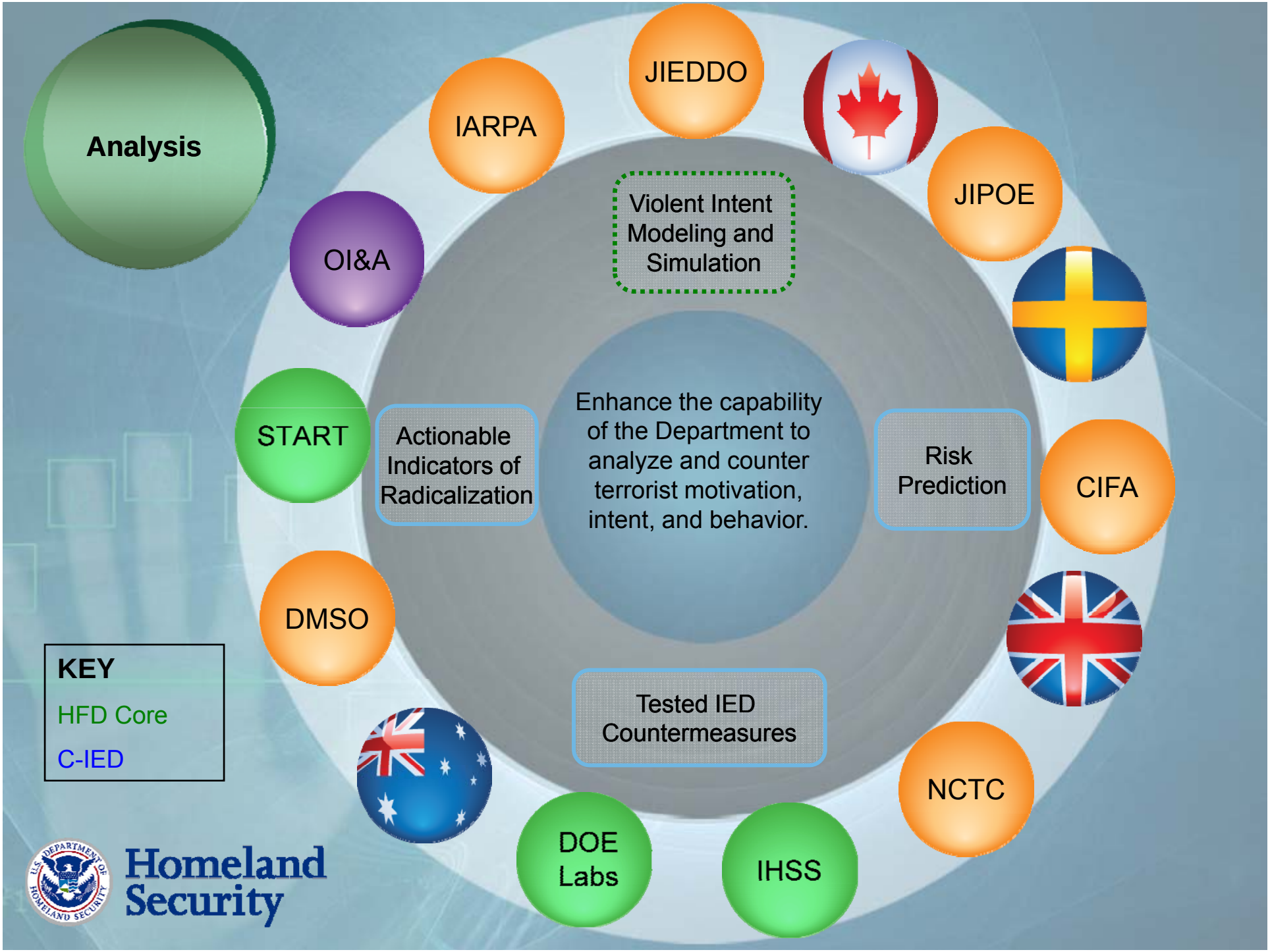
Analysis
JIEDDO
IARPA
JIPOE
OI&A
Violent Intent Modeling and Simulation
START
Actionable Indicators of Radicalization
Enhance the capability of the Department to analyze and counter terrorist motivation, intent, and behavior.
Risk Prediction
CIFA
DMSO
Tested IED Countermeasures
NCTC
DOE Labs
IHSS
KEY
HFD Core
C-IED
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Motivation and Intent

Informing DHS Policy, Intelligence, and Operations

Supporting DHS components' and the interagency policy community's research priorities:

- Understanding how radicalization develops within individuals, groups, and societies;
- Measuring the level of radicalization in the U.S. homeland;
- Understanding the roles communities, governments, and civic organizations play in moving individuals toward and away from radical violence; and
- Documenting the impacts of various media on the spread of radicalization.

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START

Providing a Basic Research Foundation

- The National Consortium for the Study of Terrorism and Responses to Terrorism (START) is a DHS Center of Excellence that conducts basic social and behavioral science research aimed at understanding the formation and dynamics of terrorist groups, as well as the social and psychological impacts of terrorism. Relevant projects include:
  - Understanding Ethnic Political Violence
  - Developing a U.S. Extremist Crime Database
  - Conducting International Surveys
- START is matrixed to HFD and the knowledge it generates forms a foundation upon which HFD-sponsored projects can be built.

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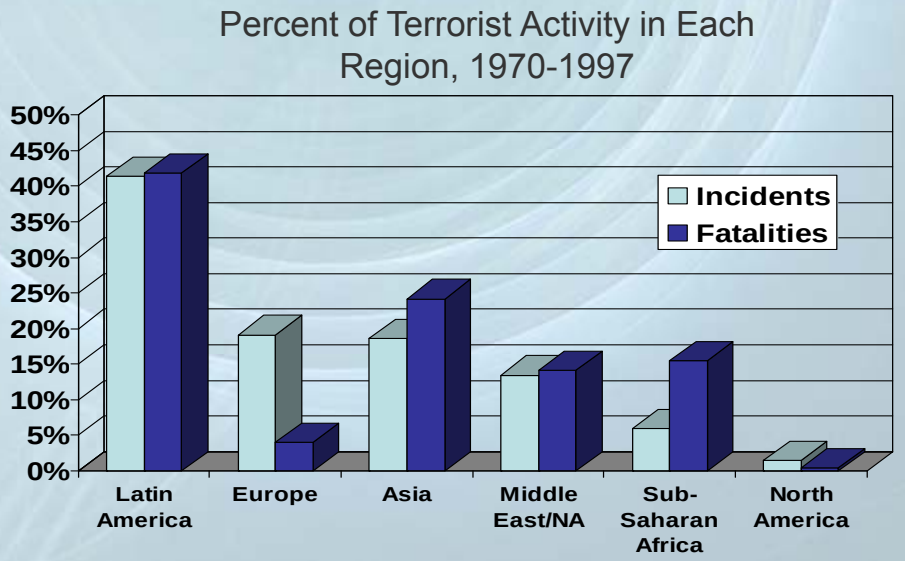
The Global Terrorism Database

Collecting and Analyzing Social Science Terrorism Data

- Largest terrorist event database, with more than 80,000 events, including all worldwide terrorist attacks that have occurred since 1970
- Housed at the DHS Center of Excellence for the Study of Terrorism and Responses to Terrorism (START)
- Provides increased accuracy in terrorist trend analysis
- Addresses the need for a comprehensive, up-to-date unclassified database of terrorist incidents for use by researchers and intelligence analysts



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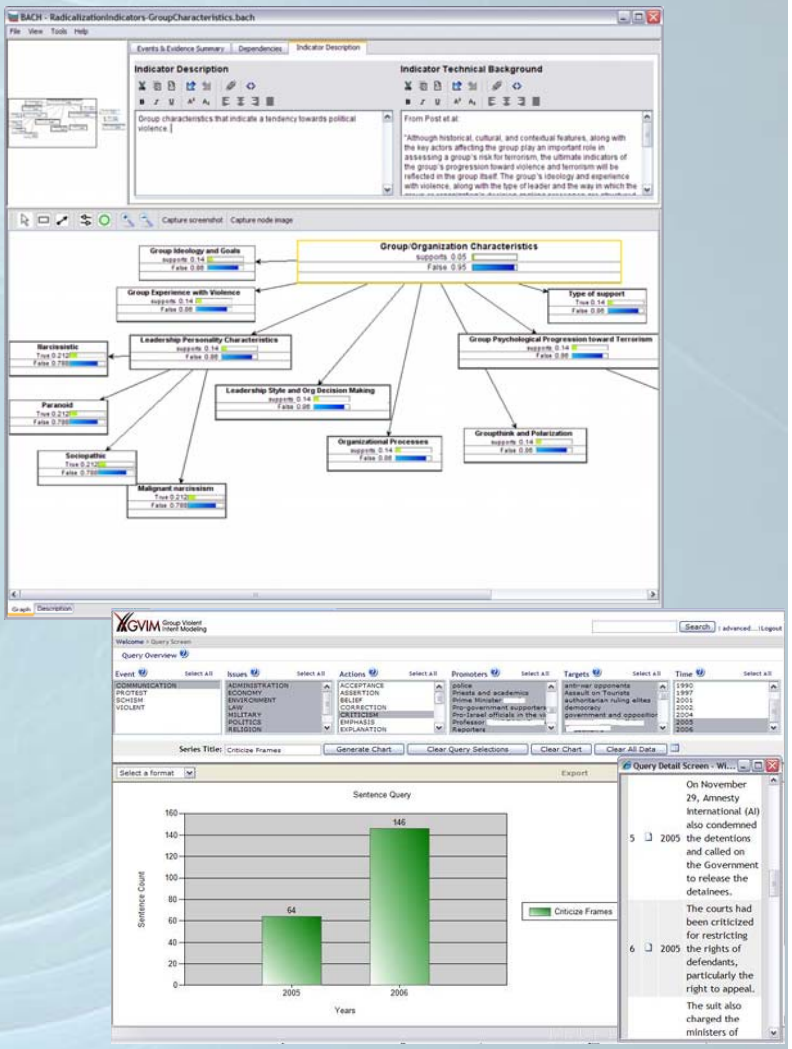
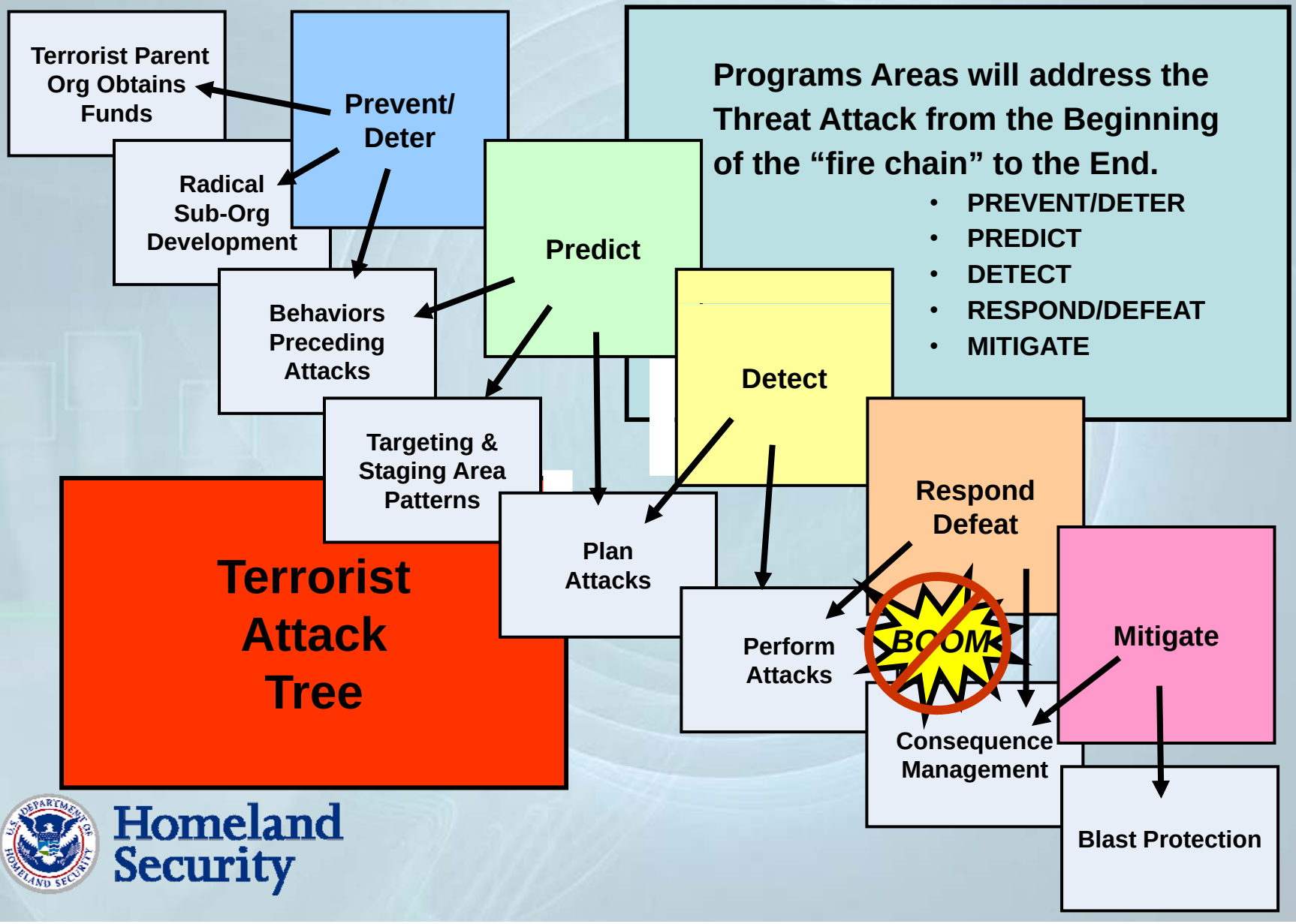
Violent Intent Modeling & Simulation

Analytic Tools for the Study of Group Behavior

- Intelligence analysis framework that will include:
  - information extraction of indicators of terrorist intentions
  - systematic estimation of future terrorist behavior based on social and behavioral sciences
  - modeling and simulations of influences on future terrorist behavior
- Enables systematic collection and analysis of information related to understanding terrorist group intent to engage in violence
- Enhances analytical methods for estimating a group's intention to engage in violence
- Increases ability to rapidly assemble and test competing scenarios



Preventing IED Attacks



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Counter-IED Prevent/Deter Program

Left of Boom, Right on Target

Program Goals

- Develop actionable indicators to aid the intelligence and law enforcement communities in identifying and deterring those that pose significant threats of IED attacks
- Provide empirical findings to aid policymakers in developing longer term radicalization and IED prevention efforts

Approach

- Analyze event databases focused on both international and domestic terrorism
- Study the relationship between community attitudes and the violent activities of radical groups using retrospective data
- Conduct content analyses of the rhetoric of groups who have and have not conducted terrorist incidents
- Evaluate IED radicalization countermeasures

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HFD Funded START Research
The Basics of Counter-IED

Survey Syntheses

Examines whether communities' attitudes towards the government, violence, and other issues are related to terrorist activity by compiling existing survey data from a range of U.S. sources and examining them in the context of actual terrorist events.

Database Analyses

Conducts empirical analyses of past cases of IED attacks drawing on START databases as well as other public databases in order to address questions including: Are variables such as ideology and group size associated with IED use? Have trends in IED use changed over time?

Forensic Investigations

Uses forensic psychology methods to collect data on the behavioral features of terrorist bomb attacks (e.g. planning, organization, and motivation). It will develop a typology of bombings and examine bombing as a terrorist strategy.

Case Study Evaluations

Examines the types of de-radicalization strategies used in five countries – Saudi Arabia, Yemen, Indonesia, Colombia, and Northern Ireland – and explores the applicability of different countermeasures to the U.S. context.

Ethnographic Research

Conducts ethnographic research to examine the experiences of Muslims and non-Muslims in several communities throughout the United States with the goal of providing insight into participants' perceptions of American society and their roles and status within it.

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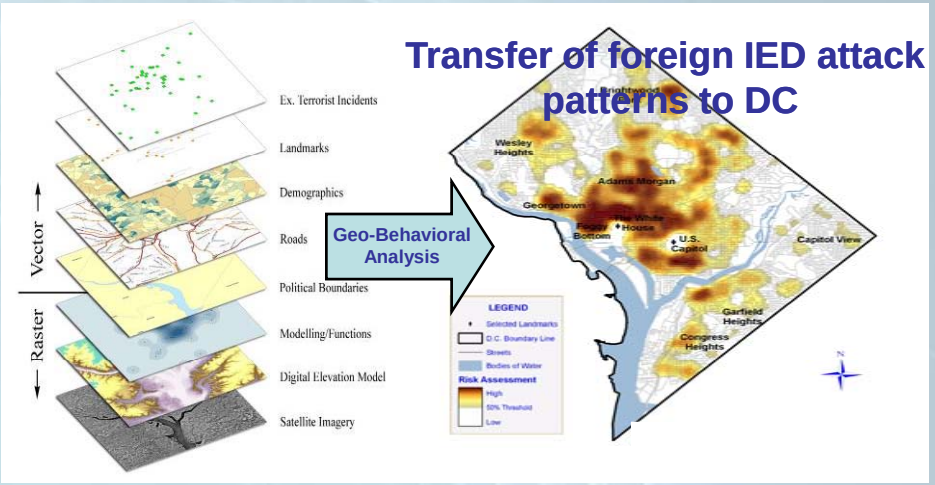
Risk Prediction

Predicting Locations of Potential IED Attacks

Goal

- Support for interdiction decisions and indication and warning assessments
- Support for prioritization of intelligence, surveillance, and reconnaissance assets
- Support of real-time hypothesis testing



Approach

- Leverage targeting strategies from overseas IED attacks to identify high risk U.S. targets
- IED targeting strategies are derived using multi-layered analysis of infrastructure, terrorist tactics, and regional cultural, political, and demographic data
- Existing geo-behavioral pattern discovery algorithms and engine
- This technology will be tested by DHS operational components

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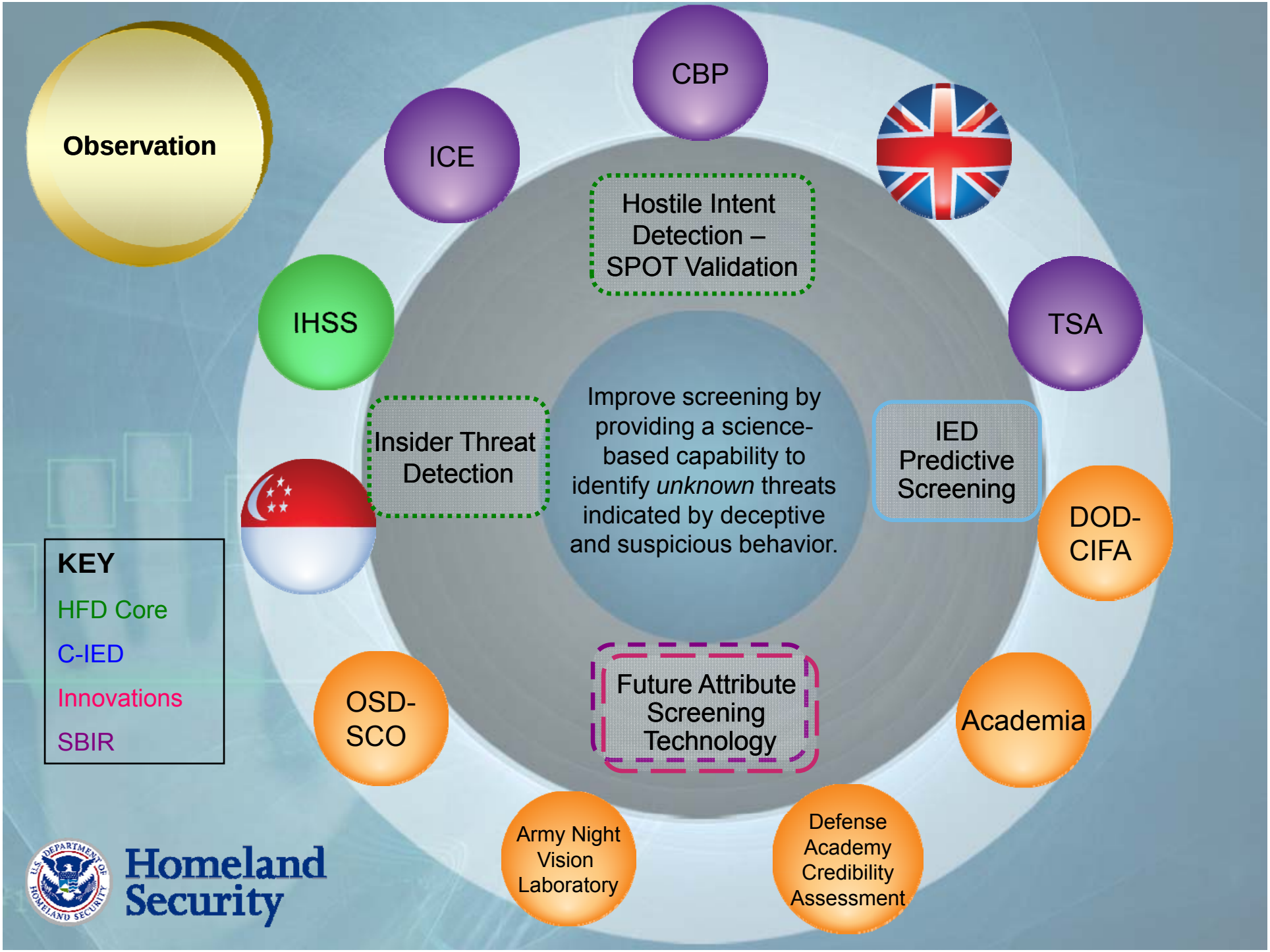
Observation
CBP
ICE
Hostile Intent Detection – SPOT Validation
IHSS
TSA
Insider Threat Detection
Improve screening by providing a science-based capability to identify *unknown* threats indicated by deceptive and suspicious behavior.
IED Predictive Screening
DOD-CIFA
KEY
HFD Core
C-IED
Innovations
SBIR
OSD-SCO
Future Attribute Screening Technology
Academia
Army Night Vision Laboratory
Defense Academy Credibility Assessment
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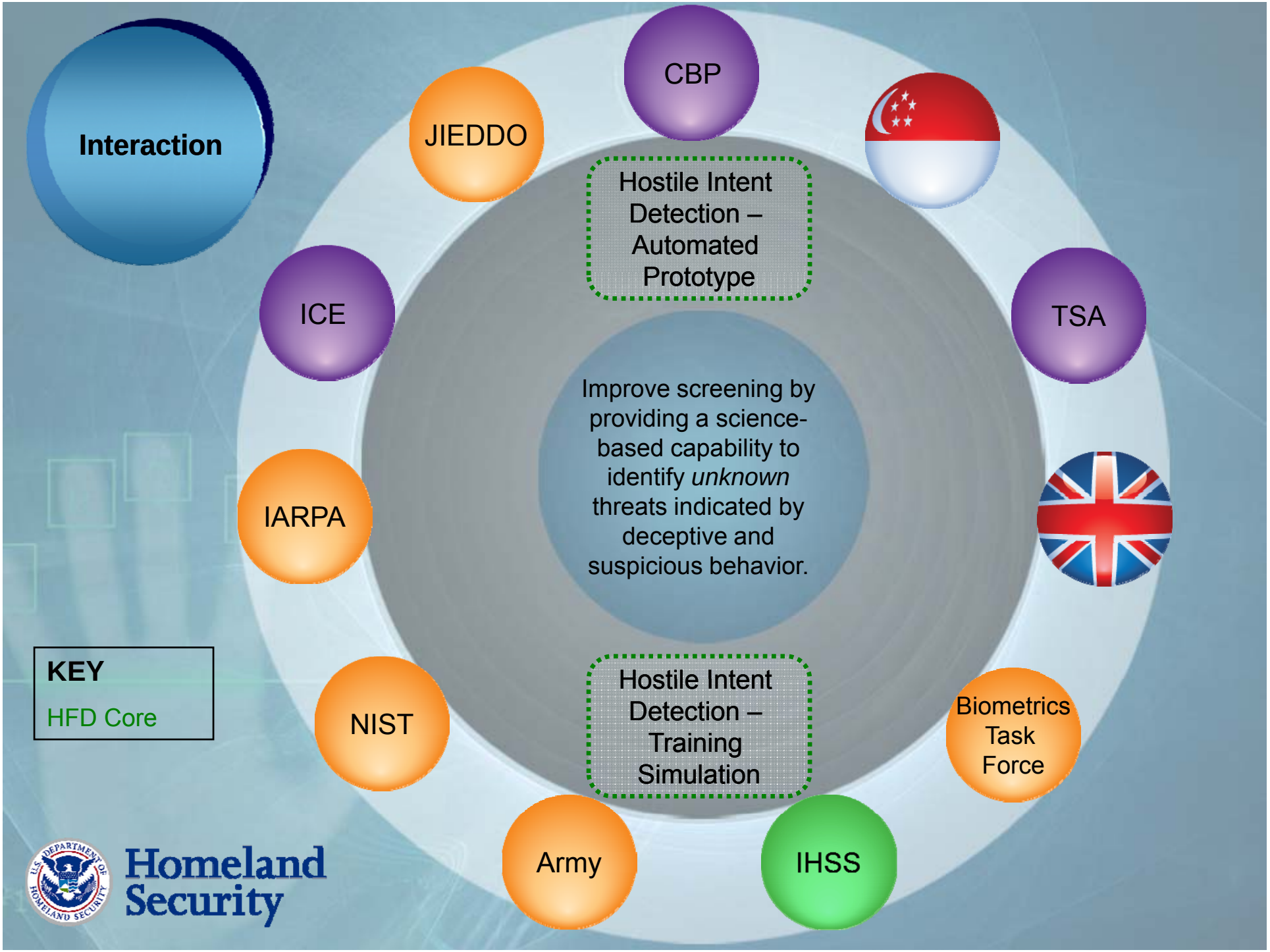
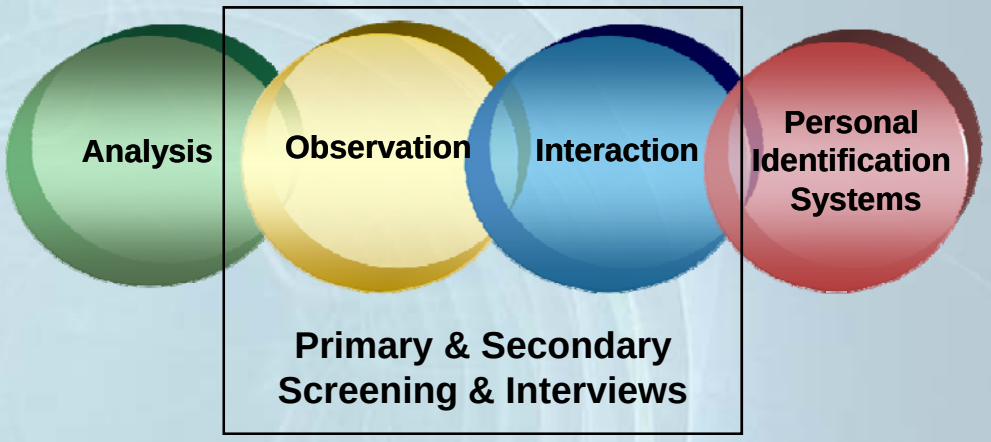

Interaction
CBP
JIEDDO
Hostile Intent Detection – Automated Prototype
ICE
TSA
Improve screening by providing a science-based capability to identify *unknown* threats indicated by deceptive and suspicious behavior.
IARPA
KEY
HFD Core
NIST
Hostile Intent Detection – Training Simulation
Biometrics Task Force
Army
IHSS
Homeland Security

Project Hostile Intent
Detecting Unknown Hostile Threats

Goal

- Identify deception and hostile intentions in real-time using non-invasive sensors



Approach

- Validate behavioral indicators of deception and hostile intent
- Develop training courseware & simulation to provide screeners with increased deception detection skills
- Develop a prototype to detect deception and hostile intent in real-time using non-invasive, culturally independent sensors algorithms

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Suspicious Behavior Detection
Project Hostile Intent – Accomplishments

- Transitions
  - Intent Training Simulation
    - Interim transition of behavioral indicators of deception embedded into a deception detection training course and support materials
    - Course being updated for CBP and local law enforcement sessions this summer
- Accomplishments
  - Automated Prototype
    - Solidified partnership with ICE to use their operational data to validate behavioral indicators of hostile intent across cultures
    - Interim validation of behavioral indicators of “intent to deceive about a future action” within a 2 minute high deception base rate environment
  - Cross-Cultural Optimization of SPOT (Screening Passengers by Observation Technique)
    - Interim validation of behavioral SPOT indicators for possession of illegal items (weapons, false documents), including Computer-Aided Passenger Pre-Screening (CAPPS) program
    - Proof of concept demonstration Mobile-SPOT technologies, a hand-held device to support recording and reporting SPOT behaviors

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Suspicious Behavior Detection
Project Hostile Intent – Upcoming Events

- Significant Upcoming Events
  - Hostile Intent Detection: SPOT Validation
    - Transition Culturally Independent Indicators - Q4 FY09
  - Hostile Intent Detection: Intent Training Simulation
    - Transition Cross-Culturally-Validated Simulation – Q3 FY 10
  - Hostile Intent Detection: Automated Prototype
    - Demonstrate Real-Time Auto Intent Detection - Q4 FY09

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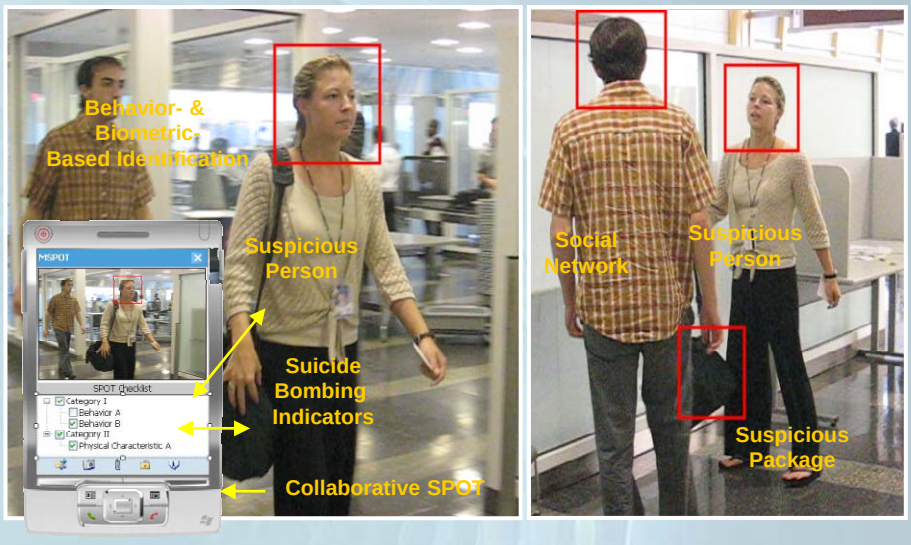
Predictive Screening
Detecting Behavioral Precursors of an IED Attack



Goal

- Deter potential attacks
- Predict risk
- Intelligently screen

Approach

- Identify and track suicide bombing behavior & anomalous or suspicious behavior and packages using automation technology
- Leverage validated SPOT indicators to designate and drive automated tracking algorithms
- Extend capability to identify & track potential suicide bombers at longer stand-off distances

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Suspicious Behavior Detection
Predictive Screening – Accomplishments & Events

- Significant Upcoming Events
  - Counter - IED: Suicide Bombing Behavior
    - Literature- and SME-based international effort to define observable behaviors that precede a suicide bombing attack - FY09 Q4
  - Counter - IED: Automated Prototype
    - Conduct follow-on open competition of automated video extraction algorithms technologies - FY09 Q4

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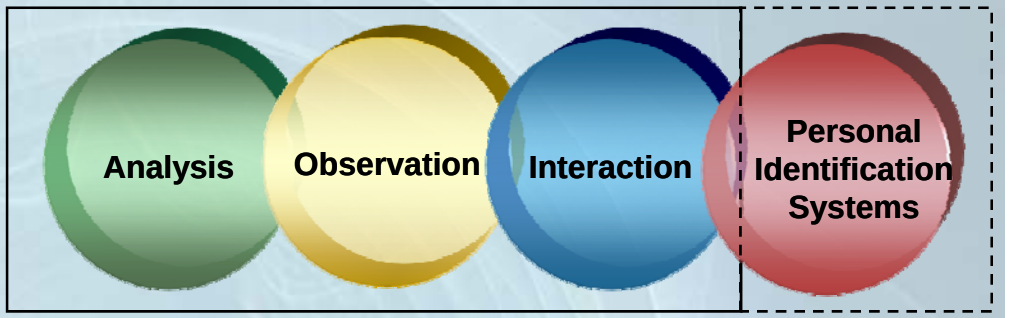
Insider Threat

Identification and Mitigation of Public Trust Betrayal

Goal

- Develop technologies and methods for identifying intentional and unintentional threats posed by organizational insiders



Approach

- Conduct workshop involving government, industry, academia and international stakeholders (July 2009) to benchmark technical, operational, psychological and legal issues associated with detection of insider threats (in coordination with DHS S&T Special Programs Division (SPD))
- Conduct empirical study using TSA historical records to assess in a matched sample of violators and non-violators whether social and behavioral indicators were present prior to malicious acts (in coordination with DHS S&T SPD)
- Develop a common codebook to allow international research into identification and mitigation of insider threats (in coordination with U.K. and DHS CBP)

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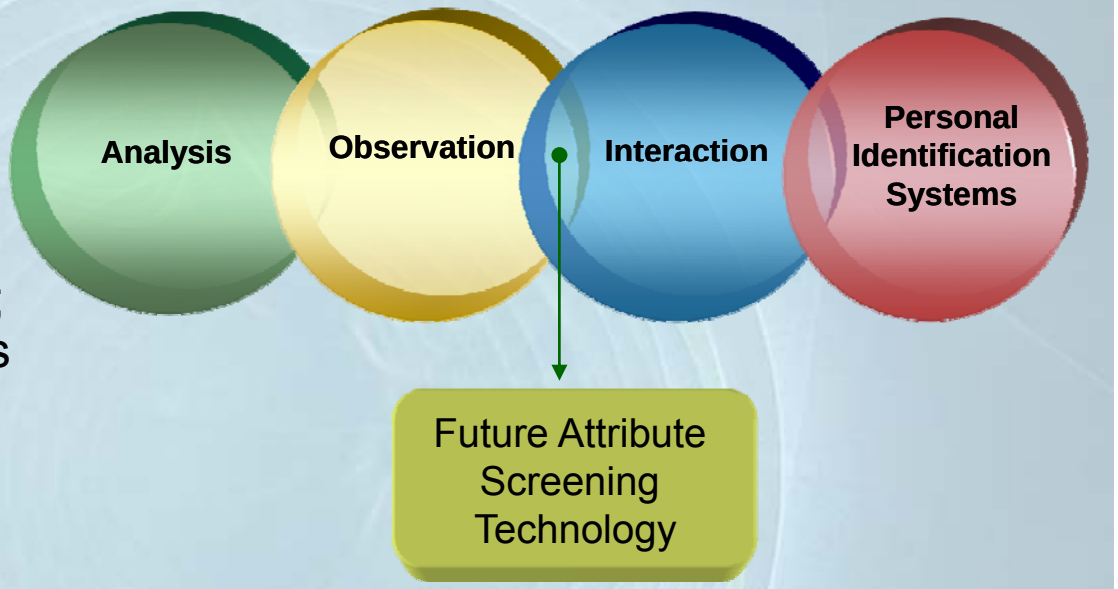
Future Attribute Screening Technology (FAST)

Improving Checkpoint Screening

Goals

- Improve user experience; provide automated behavior based screening integrated with multiple physiological screening technology systems; validate technical requirements and establish performance metrics for primary screening systems



Approach

- Validate Basic Theory
- Evaluate Individual Physiological and Behavioral Cues
- Develop/demonstrate an operational lab environment based on a Security Screening Scenario
- Combine Detection Theory, Sensors and Operational Environment
- Demonstrate functionality of the sensors within the operational lab environment, validating sensor operation

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Future Attribute Screening Technology (FAST)
Accomplishments & Events

Theory Development
- Malintent – "*Intention or desire to cause harm*"
- Initial Identification of physiological, and behavioral cues

Initial Sensor Suite
- Non-contact, non-intrusive physiological sensors

Events
- Successful Demonstrations
  - Initial Sensor Suite Demo
  - FAST Mobile Module Virtual Demonstration
  - FAST Mobile Module Operational Protocol Demonstration
- Upcoming Events
  - Malintent Theory Validation
  - Primary Screening in Operational Environment
  - Multi-function Sensor Suites Prototypes

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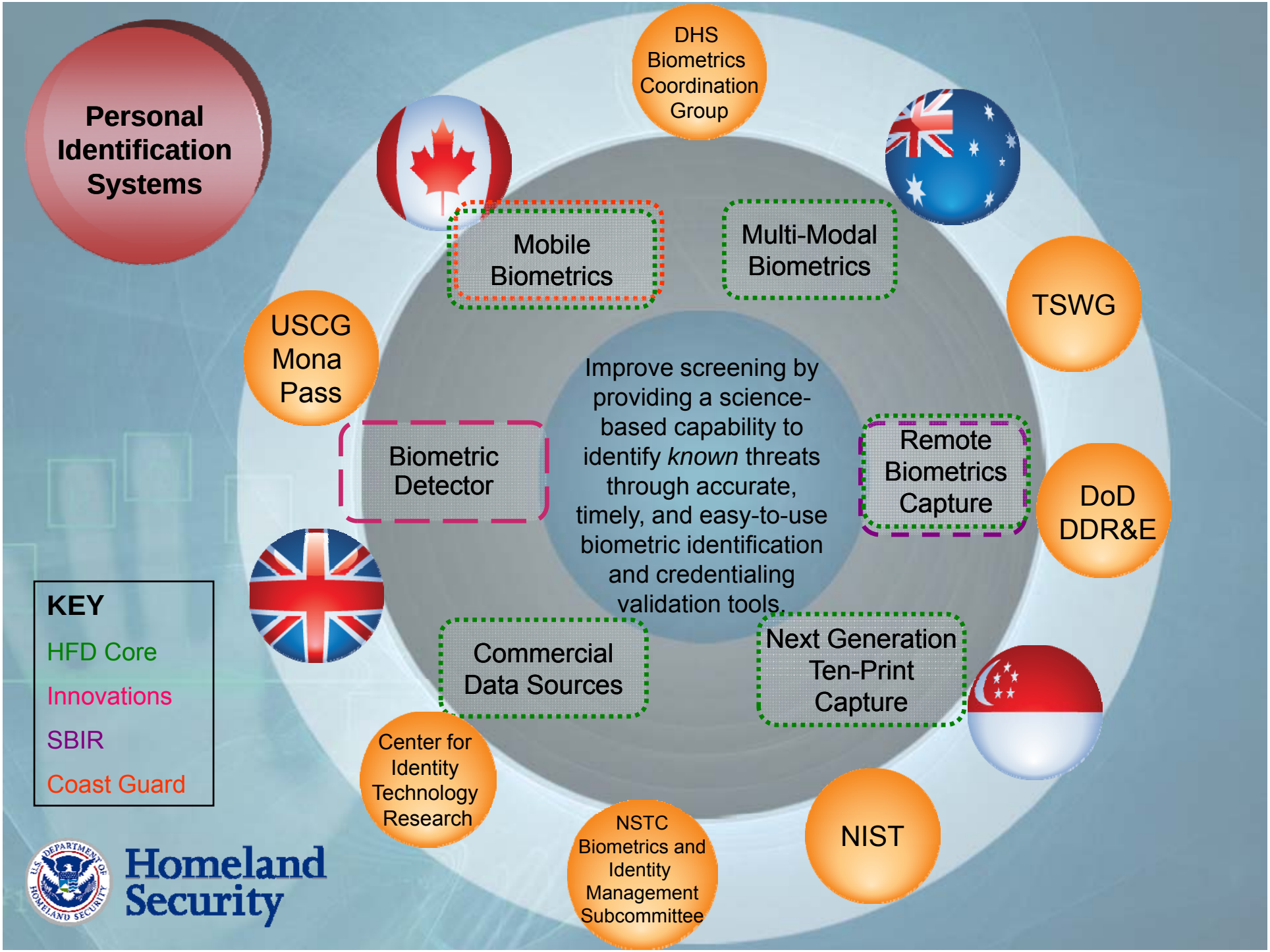
Personal Identification Systems
DHS Biometrics Coordination Group
Mobile Biometrics
Multi-Modal Biometrics
TSWG
USCG Mona Pass
Biometric Detector
Improve screening by providing a science-based capability to identify *known* threats through accurate, timely, and easy-to-use biometric identification and credentialing validation tools.
Remote Biometrics Capture
DoD DDR&E
KEY
HFD Core
Innovations
SBIR
Coast Guard
Commercial Data Sources
Next Generation Ten-Print Capture
Center for Identity Technology Research
NSTC Biometrics and Identity Management Subcommittee
NIST
Homeland Security

Biometrics
DHS's Unique Challenges

- DHS operational components have identified biometrics as a high priority capability gap.
- Screening operations within the DHS Mission Space pose unique challenges to widespread deployment of biometrics.
  - Scale and diversity of screening sites
  - Need to accommodate existing DHS screening practices
    - Minimal impact on screener workload
    - Minimal impact on wait time and throughput of screened individuals
  - Harsh lighting and environmental factors
  - Extreme Outdoor Mobile Conditions
  - Non-cooperative users
  - Field-collected samples of mixed quality
  - Real-time access to match results across the DHS enterprise
  - Interoperability with mission partners

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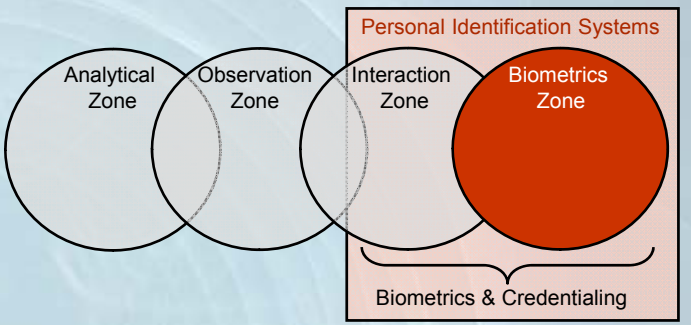
Multi-modal Biometrics

Utilizing the Full Range of Identification Tools

Goal

- Develop Multi-modal biometric tools (fingerprint, face, and iris) to accurately and rapidly identify known terrorists
- Develop a framework to facilitate the integration of biometric technologies across the DHS operational mission space.



Approach

- Support development of interoperable biometrics tools and technologies
- Develop multi-modal biometrics collection capability suitable for use in DHS operational environments
- Develop fusion technologies to synthesize identity matches from DHS field-collected (non-ideal quality) multi-modal biometric data

Payoff

- Improved biometrics-based identification of known terrorists
- Increase throughput of lawful travel across U.S. borders

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Mobile Biometrics
Biometrics on the Front Lines

Goal

- Spiral development of mobile multi-modal biometric sensors and technologies to provide accurate identification capabilities anywhere in the DHS area of responsibility

Approach

- Collaborate with DHS components to identify and document requirements for mobile biometrics new and existing DHS operations
- Develop technologies, sensors, and components for integration in future multi-modal mobile biometrics collection systems
- Leverages activities of DHS S&T, USCG (Mona Pass), CBP, CIS, ICE, TSA, and US-VISIT

Payoff

- Biometric screening can occur at non-fixed sites beyond U.S. borders, between ports of entry, and within secure sites/facilities

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Mobile Biometrics – Accomplishments

Maritime Biometric Identification System: Handheld Biometric System Pilot in the Mona Pass

Goal

- Real-world operational pilot of Coast Guard maritime mobile biometrics technologies in the Mona Pass.
- The pilot will identify strengths and shortfalls associated with the use of mobile biometrics.

S&T and Homeland Security Payoff

- Timely identification of interdicted immigrants to determine if they are on a watch or wanted list
- Results of pilot will inform S&T's FY09 Mobile Biometric transition project of specific real-world operational shortfalls that exist with the use of mobile biometrics devices

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Mobile Biometrics – Accomplishments

Maritime Biometric Identification System: Operational Impact

~ Data as of 5 February 2009:

Metric	**Number Encountered**	**% of total possible**
Biometrics Collected	4026	99% of persons encountered
Database Matches	1028	26% of records collected
Prosecutions	467	45% of matches

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Biometric Detector
Touchless Fingerprints

Goal

- Develop technologies for efficient, high quality, contact less acquisition of fingerprint biometric signatures

Payoff

- Ergonomic and user-friendly design provides significantly improved throughput and signal quality
- A fingerprint acquisition device that can be transitioned for implementation across DHS operational mission space
- Customers - US-Visit, USCIS, CBP, ICE, TSA

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Small Business Innovation Research Projects (SBIR)

Remote Biometrics

- Three (3) SBIR Phase I efforts initiated to develop a methodology and test and evaluation framework, for assessing the maximum standoff ranges in which multiple biometrics can be captured while still ensuring accuracy in determining an individual's identity

Mobile Biometrics

- Three (3) SBIR Phase I efforts initiated to provide an analysis of DHS needs for mobile biometric devices; an assessment of candidate and enabling technologies; and a risk assessment for each technology

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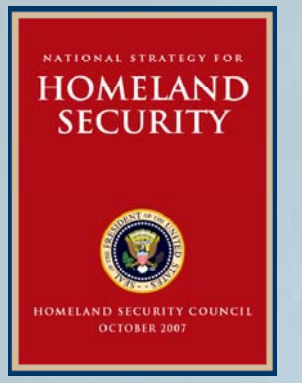
Drivers of DHS Biometrics S&T

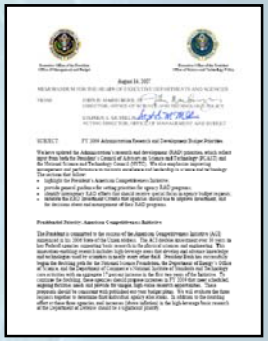


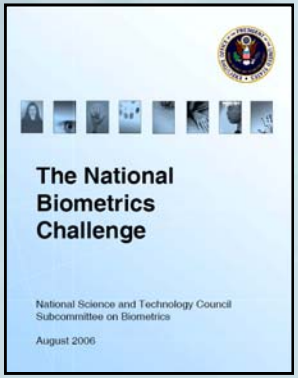
"In the face of resourceful terrorists, however, we must continue to expand the US-VISIT program's biometric enrollment from two fingerprints to ten fingerprints, as well as leverage science and technology to enable more advanced multi-modal biometric recognition capabilities in the future that use fingerprint, face, or iris data."

- National Strategy for Homeland Security, Homeland Security Council, October 2007

"…agencies are to place emphasis on the priorities outlined in The National Biometrics Challenge and the resulting agenda developed by the NSTC Subcommittee on Biometrics and Identity Management."

- OMB and OSTP FY2009 R&D Budget Priorities (www.ostp.gov)





THE WHITE HOUSE

National Security Presidential Directive and Homeland Security Presidential Directive

Biometrics for Identification and Screening to Enhance National Security

DHS People Screening IPT

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Current State of Multi-modal Biometrics

R&D Remains to be Done

Existing Capability
R&D remains
Much R&D remains

	Fingerprint	Other Biometric Modalities		
		Iris	Face	**Novel Biometrics** (Vascular pattern, Dynamic signature, etc.)
Interoperable Data	Data standards exist and are proven in operational use	Non-proprietary Data Standards are under revision and have not been demonstrated	Non-proprietary Data Standards are under revision and have not been demonstrated	Data Standards are under development
Specifications for Collection Sensors	Specifications for some types of sensors exist. Work required for other sensors.	Specifications do not exist. Work is required to initiate this effort.	Specifications do not exist. Work is required to initiate this effort.	Specifications do not exist. Work is required to initiate this effort.
Well-defined Definition of Quality	No consensus on definition of quality	No consensus on definition of quality	No consensus on definition of quality	No consensus on definition of quality
Large-scale identification Capability	Capability using non-propriety data is demonstrated and proven	No capability has been demonstrated using non-proprietary data. Capability demonstrated using proprietary data	No capability exists	No capability exists

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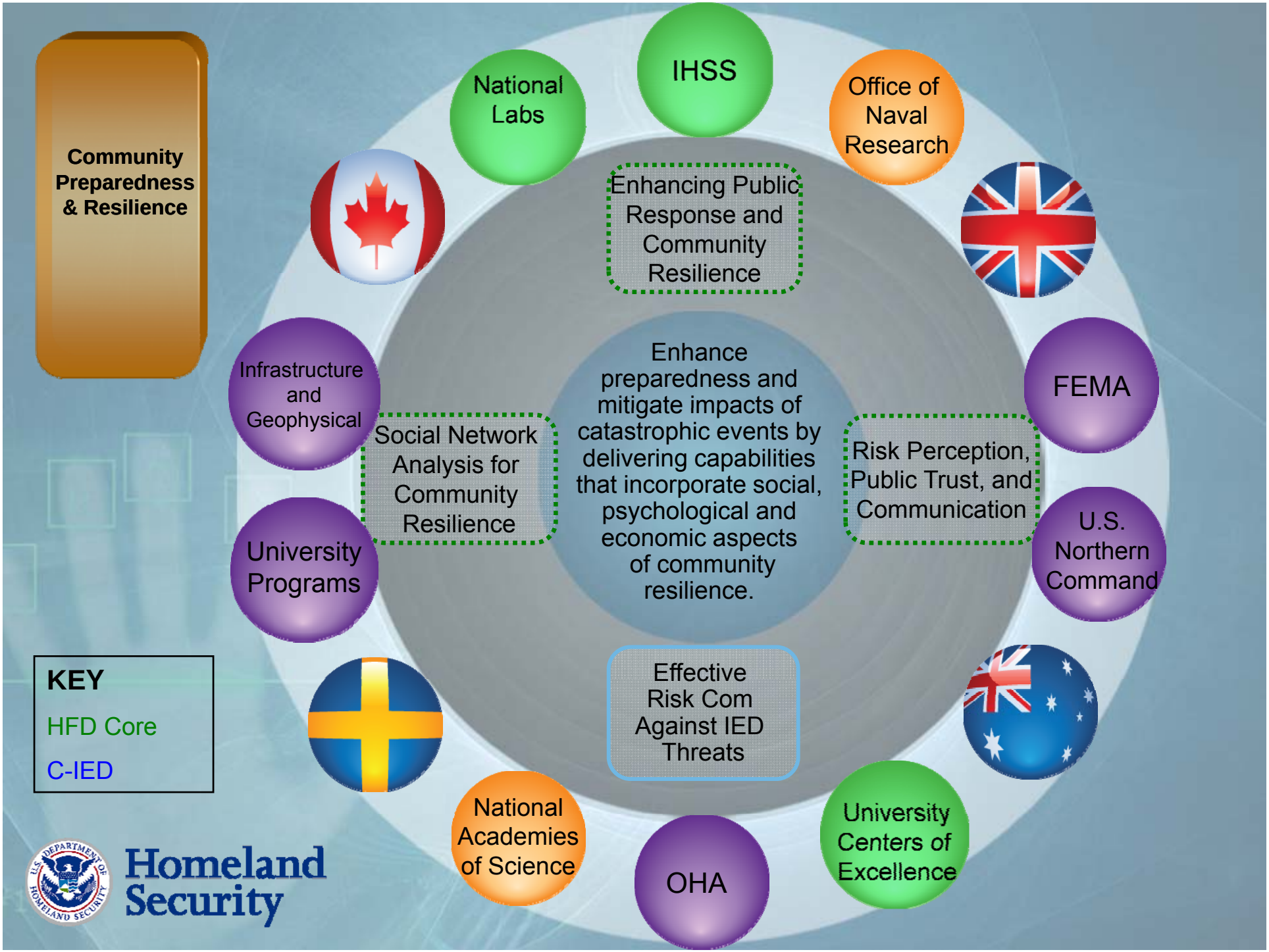
Community Preparedness & Resilience
National Labs
IHSS
Office of Naval Research
Enhancing Public Response and Community Resilience
Infrastructure and Geophysical
Social Network Analysis for Community Resilience
University Programs
Enhance preparedness and mitigate impacts of catastrophic events by delivering capabilities that incorporate social, psychological and economic aspects of community resilience.
FEMA
Risk Perception, Public Trust, and Communication
U.S. Northern Command
Effective Risk Com Against IED Threats
National Academies of Science
OHA
University Centers of Excellence
KEY
HFD Core
C-IED
Homeland Security

Community Preparedness and Resilience
Enhancing Emergency Communications and Public Response

- Collects, analyzes and classifies emergency communications and requests for assistance generated by Texas residents during Hurricanes Katrina and Rita over Texas 211 call system
- Generates a standard template for streamlining the collection of 211 call system information collected by states who operate those systems
- Develops a methodology to overlay call system data onto geospatial mapping to aid in analysis of disaster scenarios, regional evacuation and relief planning, and response procedures

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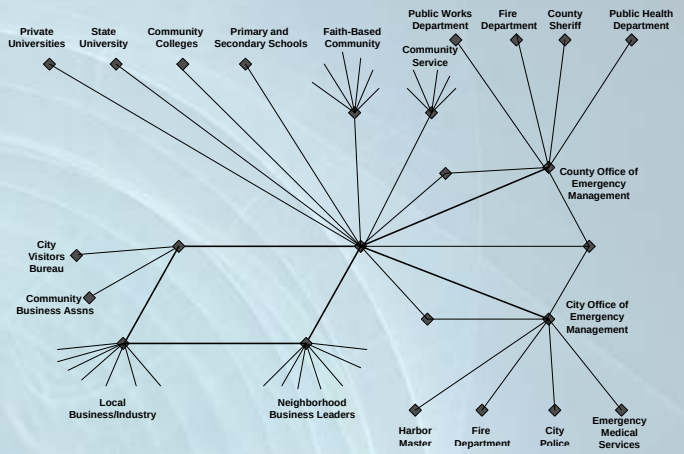
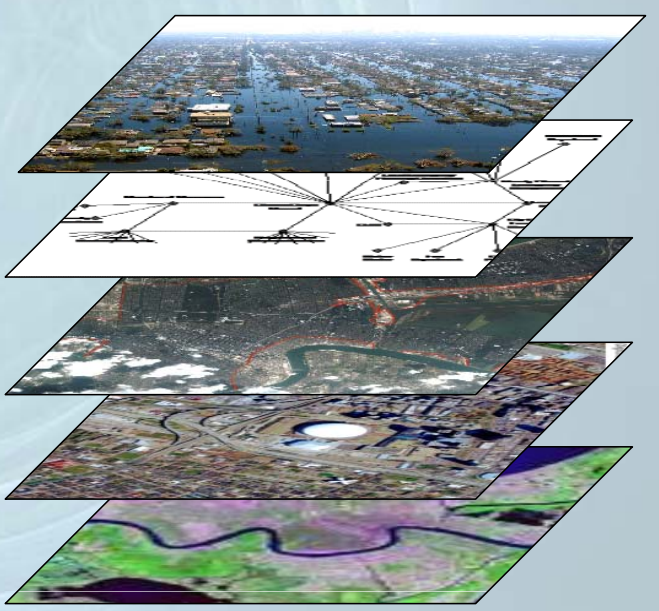
Community Preparedness and Resilience
Social Network Analysis to Enhance Collaborative Planning & Response

- Examines the current state of the art in social network analysis (SNA) and its applicability to the identification, construction, and strengthening of social networks within U.S. communities for the purpose of building resilience across private and public sectors
- Identifies collaborative and cooperative endeavors between private and public sector entities for the specific purpose of strengthening the resilience of communities and regions





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Community Preparedness and Resilience
Risk Perception, Public Trust, and Communication

- Develops a methodology for assessing the impact of risk communications and warnings on the public's response during emergency situations
- Determines the effectiveness of various means of emergency communication on affected populations
- Develops a means for assessing the effectiveness of guidance and direction provided by civic leadership
- Incorporates lessons learned into exercises and training methodologies to improve public warnings during civil emergencies and disasters

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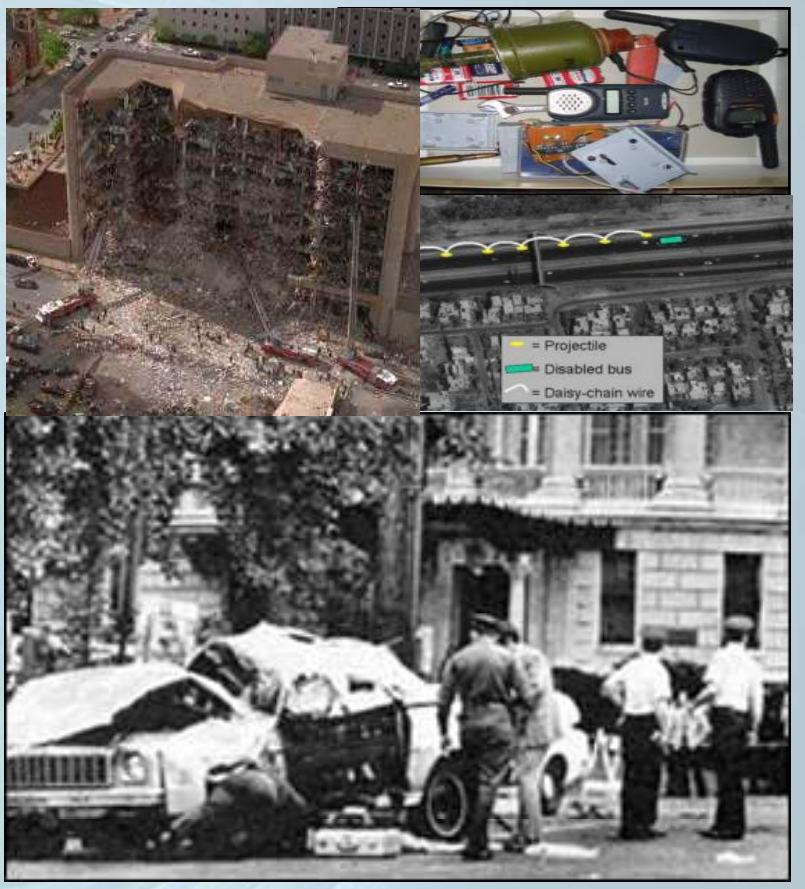
Community Preparedness and Resilience
Effective Risk Communications Against the IED Threat

- Conducts research into methodologies for effective hazard and risk communications to enhance the ability of local officials to convey understandable and credible warnings of IED activity to the public
- Develops a modeling and simulation capability to test effective public communications methods for training local officials in IED hazard and risk warnings
- Research supports local officials in developing effective public information strategies for IED threat, to enhance public safety and maintain public confidence post-event



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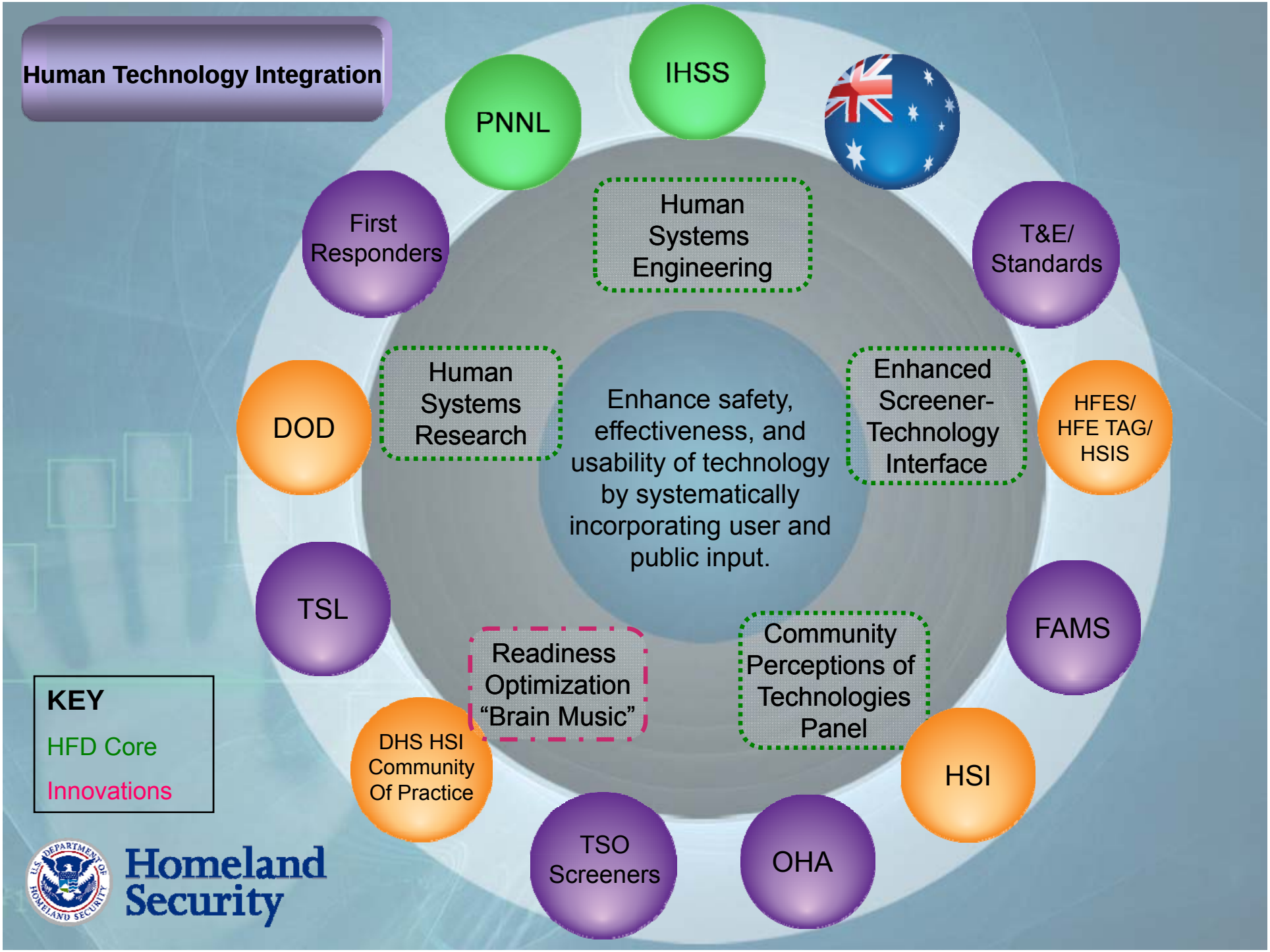
Human Technology Integration
PNNL
IHSS
First Responders
Human Systems Engineering
T&E/ Standards
DOD
Human Systems Research
Enhance safety, effectiveness, and usability of technology by systematically incorporating user and public input.
Enhanced Screener-Technology Interface
HFES/ HFE TAG/ HSIS
TSL
FAMS
Readiness Optimization "Brain Music"
Community Perceptions of Technologies Panel
DHS HSI Community Of Practice
HSI
TSO Screeners
OHA
KEY
HFD Core
Innovations
Homeland Security

Human Systems Research and Engineering

Program Goal

- To maximize human performance and safety in the field and ensure that basic human capabilities and limitations (both cognitive and physical) are considered throughout the product development lifecycle so that technologies will be usable, acceptable, reliable, affordable, supportable, and safe.

Approach

- Conduct fundamental research designed to maximize human performance and feed the development of technologies for enhanced human performance

- Integrate Human Systems Integration methods, tools, and data into DHS S&T and Acquisition processes, as well as provide support for the implementation of HSI activities in relevant DHS programs

- Establish a DHS Human Systems Integration Community of Practice (CoP) to provide a forum for the exchange of information across all DHS components, National Labs, and Centers of Excellence on human systems integration benefits, challenges, and best practices

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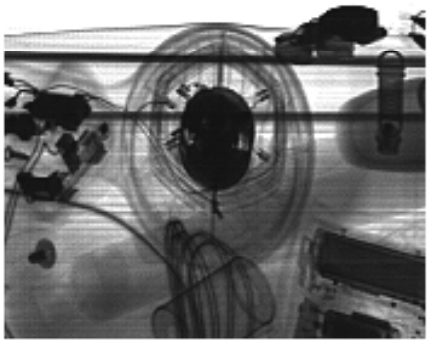
Human Systems Research and Engineering
Optimizing Technology for Detection Accuracy

Motion X-Ray

- Motion provides the best perceptual clue for object identification
- Motion X-Ray images showed an increase in hits and decrease in false alarms over Static X-Ray images



Automation Effects on Weapons Detection

- Assess the effect that automated explosive alarms have on the detection of other unidentified explosives, guns, knives, liquids, etc
- Expected to result in an increase in weapons detection accuracy when using an Advanced Technology X-Ray at security checkpoints

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Human Systems Research and Engineering
Maximizing the Effectiveness of Human Performance

Screener Performance

- X-Ray Priming Method (XPM) designed to overcome the decrease in performance associated with low target prevalence
- Result in Increased Screener Vigilance and Threat Detection Performance

Fatigue

- Created new 3-minute version of Performance Vigilance Test (PVT) that is sensitive to fatigue and X-Ray performance deficits caused by fatigue

Discrimination Pilot Training

- Training Reduced False Alarm Rate by 50%
- Exposure and Identification Training:
  - Increased Correct Rejection rates≈ 59% to 75%
- Perceptual Discrimination Training:
  - Increased Hit rates for Difficult Targets ≈ 65% to 80%

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Technology Acceptance and Integration Program

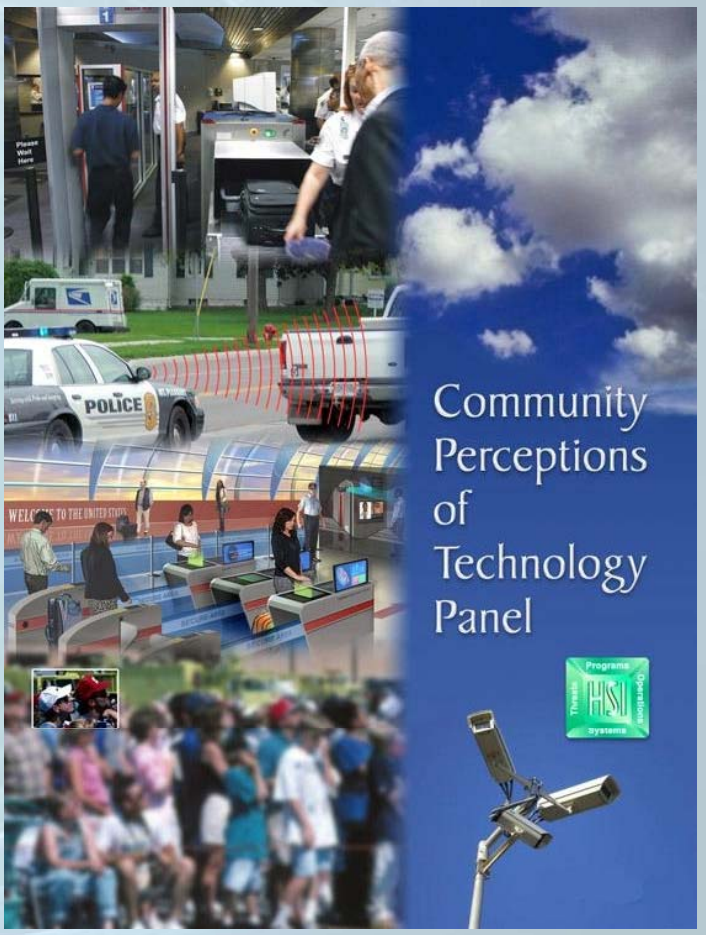
Incorporating Community Perspectives into Technology Development

Goal

- To successfully develop and adopt application specific, publicly acceptable technologies and processes.

Approach

- Community Perceptions of Technology (CPT) Panel focuses on a selected technology/process.
- Experts selected from industry, public interest, and community-oriented organizations to participate.
- Qualitative data collected is utilized to inform operational processes, to develop and deploy technology, and to guide the design of additional research tools.



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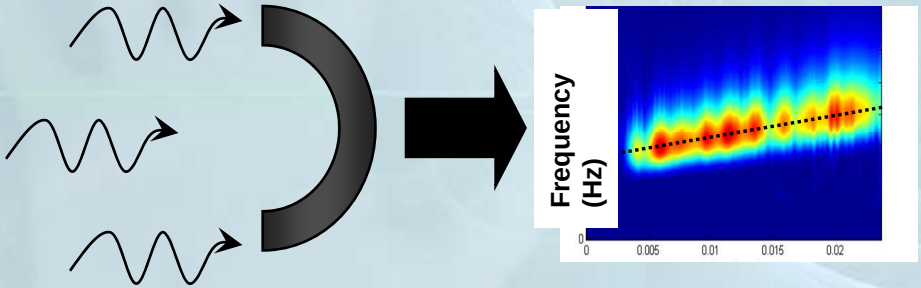
Incorporating Community Perspectives into Technology Development



CPT Panels 2008

- February 2008: Microwave Vehicle Stopping
- May 2008: Raman Spectroscopy- IED Standoff Explosive Detection
- August 2008: Mobile Biometric Technology
- December 2008: Nonlinear Acoustic IED Standoff Threat Detection

CPT Panels 2009

- March 1-3: Northern Border Technology- Radio-Frequency Identification (RFID) Registration and Low Resolution Imaging Technology
  - Joint panel with the Canadian Government

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Incorporating Community Perspectives into Technology Development

What we have done so far

- Published report on panel processes and discussions of technology for each panel.
- Collected a range of opinions and perspectives on issues that might inhibit community acceptance and deployment.
- Identified major themes for each technology: health and safety, unintended consequences/collateral damage, compromised technology, perceptions of threat, and potential impact on privacy and civil liberties.
- Provided potential public information/communication initiatives
- Developed international partnerships

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Incorporating Community Perspectives into Technology Development

Where we are going next

- Incorporating panel process into the technology life cycle
  - Where in the technology life cycle is the panel most beneficial?
  - How can S&T better utilize qualitative data in requirements gathering, risk assessment, and testing and evaluation of technology?
- Developing operational support tools for S&T Directorate
- Developing communication and informational materials
- Convening working group of academics in the field of science communication and public perception research
- Publishing literature reviews on the integration of public perception, national security, and technology development

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