National Center for Border Security and Immigration
Research Lead: The University of Arizona (Tucson, Arizona)

WORK PLAN – YEAR 5
July 2012 to June 2013

Department of Homeland Security – Grant No. 2008-ST-061-BS0002

"This research was supported by the United States Department of Homeland Security through the National Center for Border Security and Immigration under grant number 2008-ST-061-BS0002. However, any opinions, findings, and conclusions or recommendations in this document are those of the authors and do not necessarily reflect views of the United States Department of Homeland Security."

Revised July 24, 2012

http://www.borders.arizona.edu
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Overview</td>
<td>3</td>
</tr>
<tr>
<td>Automated Virtual Agent for Truth Assessments in Real-Time (AVATAR)</td>
<td>10</td>
</tr>
<tr>
<td>BORDERS Engage to Excel: Preliminary Project Description</td>
<td>10</td>
</tr>
<tr>
<td>BORDERS Workshop</td>
<td>29</td>
</tr>
<tr>
<td>AVATAR E2E Workshop</td>
<td>29</td>
</tr>
<tr>
<td>Biometric Identification: Research Directions</td>
<td>33</td>
</tr>
<tr>
<td>Localization and Tracking of Vehicles, Cargo and Persons</td>
<td>35</td>
</tr>
<tr>
<td>Border Patrol Checkpoint Effectiveness: Models and Metrics</td>
<td>40</td>
</tr>
<tr>
<td>BORDERS Workshop</td>
<td>44</td>
</tr>
<tr>
<td>Identifying Research Requirements in Immigration Studies</td>
<td>44</td>
</tr>
<tr>
<td>New Immigrant Survey</td>
<td>49</td>
</tr>
<tr>
<td>BORDERS Awards in Immigration Research</td>
<td>49</td>
</tr>
<tr>
<td>E-Verify: Profile of Enrolled Employers</td>
<td>53</td>
</tr>
<tr>
<td>Post-apprehension Survey of Illegal Immigrants</td>
<td>56</td>
</tr>
<tr>
<td>Appendix A: BORDERS Engagement Plan</td>
<td>59</td>
</tr>
</tbody>
</table>
Center Overview

Jay Nunamaker & Elyse Golob – University of Arizona
jnunamaker@borders.arizona.edu, egolob@borders.arizona.edu

Introduction

The National Center for Border Security and Immigration (BORDERS) is a university-based Center of Excellence (COE) funded by the Department of Homeland Security (DHS) Science and Technology (S&T) Directorate, Office of University Programs. The University of Arizona was awarded the research lead in July 2008, and serves as the Center’s headquarters.

Mission

BORDERS’ focus is to provide scientific knowledge, develop and transition technologies and techniques, and evaluate policies to meet the challenges of border security and immigration.

Stakeholders

BORDERS’ stakeholders include: U.S. Customs and Border Protection (CBP), U.S. Immigration and Customs Enforcement (ICE), U.S. Citizenship and Immigration Services (USCIS), U.S. Coast Guard (USCG), Office of Immigration Statistics (OIS), Transportation Security Administration (TSA), Federal Law Enforcement Training Center (FLETC), and the Federal Emergency Management Agency (FEMA).

We also serve as a resource for other federal, state and local agencies involved in border-related issues, such as the Department of Justice (DOJ), Drug Enforcement Agency (DEA), and the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF).

Participants

Management Structure

BORDERS Director and PI is Dr. Jay F. Nunamaker, Jr., Regents and Soldwedel Professor of Management Information Systems (MIS), Computer Science, and Communication and director of the Center for the Management of Information (CMI). The Executive Director is Dr. Elyse Golob. Riley McIsaac is the full-time BORDERS Program Manager, responsible for outreach, communications, and educational components of the Center. Tara Mysak is the part-time budget manager and Chris Diller is the part-time IT manager.

1 “This research was supported by the United States Department of Homeland Security through the National Center for Border Security and Immigration (BORDERS) under grant number 2008-ST-061-BS0002. However, any opinions, findings, and conclusions or recommendations in this document are those of the authors and do not necessarily reflect views of the United States Department of Homeland Security.”
Partners
BORDERS partners include leading research universities located on the southern and northern borders, as well as other institutions providing critical capabilities in border security and immigration.

- Arizona State University
- Georgetown University – New!
- Migration Policy Institute (MPI)
- New Mexico State University
- New Mexico Institute of Mining and Technology
- Pennsylvania State University
- RAND Corporation
- RTI International
- San Diego State University
- University of Arizona
- University of California – Irvine
- University of Minnesota
- University of Nebraska at Omaha – New!
- University of New Mexico
- University of Texas – Pan American
- University of Washington
- West Virginia University

BORDERS National Advisory Board
In 2009, BORDERS formed its National Advisory Board. This distinguished group of subject matter experts provides invaluable experience and knowledge in the fields of border technologies, management and operations, as well as immigration policy and technology transition. Its members include:

**Neville Cramer, IE Solutions, LLC**: Neville Cramer has over 26 years of federal government experience with specialties in executive level leadership and training with the legacy Immigration and Naturalization Service (INS). He has held numerous executive positions within the INS such as Deputy Assistant Commissioner/SAVE Program Director, Special Agent-in-Charge/Office of International Affairs, and Chief of the Immigration Officer Academy/Federal Law Enforcement Training Center. One of IE Solutions’ primary services is consulting businesses and other entities on the proper use of E-Verify, and acting as a Designated Agent of E-Verify for the U.S. Department of Homeland Security.

**Major General B. Donald Lynch, United States Marine Corps (Ret.)**: General B. Donald Lynch served as commandant of Camp Pendleton, California and at the Pentagon. He was in charge of the Marine Corps Advanced Technology Group at Quantico, Virginia. He was an advocate for the use of information technology and systems in the Marine Corps for decision-making. After retiring from the Marine Corps, General Lynch was Executive Vice President for a large semi-conductor manufacturing firm in Dallas, built oil fields in Kazakhstan, and was the President of Bechtel Corporation Brazil. He dealt with major security issues in Kazakhstan and in Camp Pendleton.

**Doris Meissner, Migration Policy Institute**: Doris Meissner, former Commissioner of the US Immigration and Naturalization Service (INS), is a Senior Fellow at the Migration Policy Institute (MPI) where she directs MPI's work on U.S. immigration policy. Ms. Meissner directed MPI’s Independent
Task Force on Immigration and America’s Future, which made recommendations for future U.S. immigration policies, and co-authored MPI's E-Verify reports.

**Major General Donald W. Shepperd, United States Air Force (Ret.):** Major General Shepperd has been involved with information technology, strategic planning, leadership development and trust building at the highest levels of government and industry for many years. Major General Shepperd retired in 1998 from the Pentagon, where he served as head of the Air National Guard.

**Gary Shiffman, Georgetown University:** Dr. Gary M. Shiffman is an adjunct professor at Georgetown University’s Security Studies Program in the School of Foreign Service, and is a Senior Fellow at the Center for Peace and Security Studies. His work focuses on homeland security, counter-insurgency, and intelligence issues. Dr. Shiffman served at DHS from 2004 until 2006 as Chief of Staff at U.S. Customs and Border Protection, and is currently a Managing Director for the Chertoff Group.

**Michael W. Boardman, US Army Intelligence Center:** Michael W. Boardman, liaison to the BORDERS National Advisory Board, is the Director of the Office of Homeland Intelligence Support at the U.S. Army Intelligence Center, Fort Huachuca, AZ. He is a retired Army Colonel with a J.D. from Willamette University School of Law and an MA in International Security Studies from the Navy War College, and a former member of the Oregon State Bar. Prior to his Army retirement, Mr. Boardman served as the Commander of the Intelligence and Electronic Warfare Test Directorate at Fort Huachuca and as the Director of Intelligence, US Forces Afghanistan. Mr. Boardman currently resides in Sierra Vista, AZ and in addition to his work at the Army Intelligence Center, he teaches international relations as an Adjunct Professor at the University of Arizona South, in Sierra Vista.

**Year 5 Objectives**

BORDERS’ overall objectives for YR 5 are:

1. Further develop our E2E project through field testing and the solicitation of user requirements
2. Continue to develop other (non-E2E) border security research projects in alignment with stakeholder requirements
3. Develop a new immigration portfolio focused on enforcement, population dynamics and policy in alignment with stakeholder requirements
4. Expand engagement with stakeholders
5. Continue to engage and educate students within the field of border security and immigration studies

**Research Overview**

Effective border security and immigration policy must achieve several intertwined goals. First, it must restrict the illegal entry of people and goods into the U.S. Second, it must regulate and expedite the flow of people and goods lawfully entering the country. Third, it must protect against terrorism and other threats, such as criminal activities, violence and risks to the quality of life in the border region. The tragic events of September 11, 2001 combined with the explosive growth in global trade and travel have exposed serious flaws in the nation’s border control system. In response, there has been a proliferation of new technologies and initiatives to meet these challenges. BORDERS’ research addresses these vital concerns by developing innovative technologies and providing objective,
scientific evidence that will benefit stakeholders, inform policymakers and contribute to the public good. In doing so, we consider the costs and limitations of technology and reflect changing requirements.

Research Areas

- Research Area (RA) 1 – Detection, Identification and Screening
- Research Area (RA) 2 – Sensor Networks and Communication
- Research Area (RA) 3 – Immigration Policy and Enforcement

BORDERS YR 5 Project Guide

Table 1: BORDERS YR 5 Projects

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research Area 1- Detection, Identification and Screening</strong></td>
<td></td>
</tr>
<tr>
<td>AVATAR E2E</td>
<td>Burgoo &amp; Nunamaker</td>
</tr>
<tr>
<td>BORDERS Workshop: AVATAR E2E</td>
<td>Nunamaker &amp; Golob</td>
</tr>
<tr>
<td>Biometric Identification: Research Directions</td>
<td>Cukic &amp; Ross</td>
</tr>
<tr>
<td>Border Patrol Checkpoint Effectiveness: Models and Metrics</td>
<td>Nunamaker &amp; Golob</td>
</tr>
<tr>
<td><strong>Research Area 2 – Sensor Networks and Communication</strong></td>
<td></td>
</tr>
<tr>
<td>Localization and Tracking of Vehicles, Cargo and Persons</td>
<td>Gebre-Egziabher</td>
</tr>
<tr>
<td><strong>Research Area 3 – Immigration Policy and Enforcement</strong></td>
<td></td>
</tr>
<tr>
<td>New Immigrant Survey: BORDERS Awards in Immigration Research</td>
<td>Golob</td>
</tr>
<tr>
<td>E-Verify: Profile of Enrolled Employers</td>
<td>Gans</td>
</tr>
<tr>
<td>Post-apprehension Survey of Illegal Immigrants</td>
<td>Golob &amp; Nunamaker</td>
</tr>
<tr>
<td>BORDERS Workshop: Identifying Research Requirements In Immigration Studies</td>
<td>Golob &amp; Nunamaker</td>
</tr>
</tbody>
</table>
Research Transition Strategy

All BORDERS’ projects have a transition strategy to move their innovations into the field. Please see the individual work plans for further details.

Metrics/Project Evaluation

Individual project evaluation is a multi-step process that continues throughout the performance year, as well as the lifespan of the project. The first step starts mid-way through the performance year and has two parts: a review by BORDERS directors of the required interim progress report submitted by the PI; and an assessment of the project’s progress based on the PI’s presentation at the annual partners meeting. If there is cause for concern about a project’s progress and scientific merit, the directors will contact the PI for a discussion about obstacles, alternative paths, and other strategies. We define project “success” as scientific validation of the experiment, field studies, prototyping and publishing the results in a top-tier “A” quality journal. In addition, the peer-review process double-blind system is an outstanding measure of success. Another measure of success is having the results verified by other researchers from prestigious universities.

The second step occurs at the end of the performance year, when the BORDERS directors assess whether the project has met its annual milestones and metrics. Based on the outcomes as described in the annual report and at the annual partners meetings, the PIs will make a recommendation as to whether the project should continue to be funded. Additional input will be obtained from the Management Operations Committee (MOC) consisting of members from partner institutions; the National Advisory Board (NAB); DHS Program Manager and stakeholders; and the Federal Coordinating Committee (FCC).

Factors to be considered in the decision to continue or cease funding include scientific merit; ability to meet milestones; significance to DHS, publications, including quality of journal; compliance with workplan metrics, demos to stakeholders, development of prototypes, etc. Once these factors have been taken into account, a conditional decision is made whether to move forward with the project, at which time the PI is given an opportunity to respond to any concerns. After concluding this process, a final decision will be made as to whether the project will continue to be funded through BORDERS.

Education

Student Involvement

As the DHS-designated research lead for the Center, BORDERS funding is allocated to research projects. Education projects are funded through the education lead at UTEP. Education activities at BORDERS occur primarily through student involvement in research projects and incorporation of research materials into course curricula.

Student involvement ranges from the undergraduate level to masters and doctoral students. For example, in YR 5, The University of Arizona will continue to engage the prestigious Zipperman Scholars, a group of students in a competitive program for high achieving freshmen and sophomores in the Eller College of Management who are interested in an MIS major. The 2011 year’s focus was on Border Security, which provided a natural fit with BORDERS’ research portfolio.
Through their involvement with this research, students across many disciplines are becoming familiar with DHS’ mission and needs and gaining expertise in the HS-STEM and immigration-related disciplines. As a result of this unique experience, they will be well positioned to serve as DHS professionals upon graduation.

**Minority Serving Institutions (MSI)**

Over the past four years, BORDERS has shown its commitment to working closely with MSI’s. In YR 5, we will work to foster further collaborations with MSIs in order ensure diversity in the next generation of scientists and researchers, and provide well-trained agency personnel. In addition to our co-lead Center, The University of Texas, El Paso, two of our partners, New Mexico State University and University of Texas Pan-American, are MSI institutions.

In the summer of 2012, BORDERS is hosting a Minority Serving Institution Summer Research Team from Texas Southern University. The team is led by Dr. Yuhong Zhang, who will bring two of her students with her. During their 10 weeks stay at BORDERS, Dr. Zhang and her student team will investigate advanced signal processing techniques on the signals generated from sensor networks and experimental sensor data collected by BORDERS. The objective of applying these techniques is to make these signals more suitable for submission into data mining algorithms for classifying deception. Zhang will lead her team in applying different algorithms including filtering and spectrum analysis and comparing performance and detection accuracy.

BORDERS will also continue to collaborate with its co-lead center, NCBSI, at the University of Texas, El Paso (UTEP), on an on-going supplemental project called “Border Patrol Checkpoints.” This 2-year project began on September 1, 2010 and will assess the effectiveness of border checkpoint operations and their impact on local communities. It is scheduled for completion on December 2012.

**Collaboration with COE Network**

**NCBSI**

National Center for Border Security and Immigration: University of Texas at El Paso (co-lead, Education. In YR 4, BORDERS and NCBSI will continue to collaborate on their respective milestones for the Border Patrol Checkpoints project, a supplemental project to BORDERS’ portfolio.

**START**

National Consortium for the Study of Terrorism and Responses to Terrorism: The BORDERS and START Centers of Excellence have started the second year of a collaborative study called “Crossings and U.S. Terrorist Attacks: Lessons for Protecting against Dangerous Entrants.” The project, funded by DHS S&T, is designed to provide guidance on border screening methods and techniques that will be most effective in identifying individuals who might pose a terrorist threat, based on an empirical analysis of the behaviors of actors who have been involved in previous terrorist attacks in the U.S. In YR 5, START will complete the coding of 145 terrorism criminal cases (e.g., records, legal files, news reports) involving a border crossing into 224 variables. BORDERS will analyze these variables using social network analysis and descriptive statistics to create a report, Port of Entry specific performance metrics, and guidance materials for detecting potential terrorists at border crossings. For comparison and context, both teams will participate in a case study exploring the details of a successful terrorist attack involving a border crossing.
CIMES
BORDERS is partnering with The Center for Maritime, Island and Remote and Extreme Environment Security (CIMES) on a field trial of experimental communication technology and medical sensors sponsored by the US Air Force – Surgeon General. The project, titled “Surgeon General Border Security Applications for Micro-Unmanned Air Vehicles (MUAVs)” has successfully demonstrated in an austere environment how medical, environmental, and biometric data can be transmitted over an ad-hoc wireless network created by technology carried on micro UAVs. In the coming year, we will propose further research that outlines a set of border security–related problems which could be addressed by CIMES and BORDERS researchers.

As new funding opportunities become available, BORDERS will continue to explore project proposal collaboration with other COEs and their partners.

Outreach and Communications

Stakeholder Engagement
YR 5 will continue BORDERS’ engagement in outreach and communication activities. BORDERS will persist in forging advantageous connections with various stakeholders including DHS agencies; federal, state and local agencies; industry, university and international constituents. BORDERS will engage in outreach with Congress, law enforcement agencies and DHS customers to disseminate our research findings and accomplishments.

In addition, we will utilize Dr. Nunamaker’s collaborative software platform, ThinkTank, which has a specific module expressly designed to elicit stakeholder requirements, to accomplish this process efficiently and effectively. Efforts such as the January 2012 Partners Meeting in Tucson, Arizona serve as effective venues for the essential dialogue that that needs to take place between BORDERS researchers and DHS stakeholders. We will continue to pursue these efforts and engage stakeholders regarding additional requirements in the coming years of the Center.

For a full description of our Engagement Plan, please see Appendix A.

Communications
In an effort to increase its communicative capacity, BORDERS undertook a complete overhaul of its website (www.borders.arizona.edu) in YR 4. In YR 5, BORDERS will continue to improve and expand the site’s content and will work to make research publications available to the public through this medium. BORDERS views this website as the go-to resource for information relating to the Center of Excellence and its research projects. Moving forward, we will continue to update and simplify the user interface so that resources such as publications are easier to access for stakeholders.

In YR 5, we will also continue the distribution of our quarterly newsletter which will allow stakeholders and the general public to keep up-to-date with the work being done through the Center. This newsletter will also have content from our co-lead Center, the University of Texas at El-Paso.

To assist with the Communication and Outreach functions of the Center, BORDERS has hired a part-time employee. The result of this hire will be a greatly expanded Communication and Outreach program for BORDERS including updated brochures, press-packets, a quarterly newsletter and updated website. Through these communication products, BORDERS will strive to inform the public of the important work being done at the Center and to make inroads into potential new funding streams.
Automated Virtual Agent for Truth Assessments In Real-Time (AVATAR)

BORDERS Engage to Excel: Preliminary Project Description

Jay F. Nunamaker, Judee K. Burgoon, Aaron C. Elkins – University of Arizona
Douglas C. Derrick – University of Nebraska at Omaha

jnunamaker@cmi.arizona.edu, jburgoon@cmi.arizona.edu, aelkins@cmi.arizona.edu,
dcderrick@unomaha.edu

1 Description

There are many circumstances, particularly in a border-crossing scenario, when credibility must be rapidly and accurately determined. At the same time, people constantly deceive for a variety of reasons and the process of detecting these deceptions is extremely difficult. Using artificial intelligence and sensor technologies, BORDERS researchers are developing an avatar-based screening system termed the Automated Virtual Agent for Truth Assessments in Real-Time (AVATAR). The AVATAR is designed to flag suspicious or anomalous behavior that should be investigated more closely by a trained human agent in the field. This screening technology is designed for use at Ports of Entries, airports, detention centers, visa processing, asylum requests, and personnel screening.

In YR 5, we propose to create the third-generation AVATAR and to develop the first kiosks that are field-ready. In YR 4, we demonstrated that automated agents (AVATARs) have the potential to greatly assist DHS by freeing personnel to focus on mission-critical tasks, automating interviews and document/information collection, and providing enhanced multi-sensor credibility assessments suitable for rapid screening environments. This was demonstrated through a successful field trial with CBP where the AVATAR conducted over one hundred interviews with Trusted Traveler program applicants—relieving existing personnel and providing detailed interview response and behavior summaries to officers to assist their final decision.

We have been informed by our stakeholders that as operational demands increase, the current model of one officer/agent conducting one interview at a time is unsustainable. This project will improve effectiveness and efficiency because AVATAR kiosks can be replicated and function as force multipliers to alleviate the traffic load on human officers and improving human decision-making. These kiosks can conduct interviews and provide real-time feedback to officers based on a AVATAR’s sensor data that measures cues of deception that are not perceptible by human senses. Using this technology, one officer may be able to monitor 4-8 AVATAR kiosk stations at a time. Furthermore, the AVATAR provides an attractive solution because of the fact that it does not get fatigued and can perform standard interviews multiple times with the same level of vigilance each time. Human

---

2 The workplan for this project is considered a living document and improvements will be made on a quarterly basis based on interactions with stakeholders at DHS.

3 The monetary value of the AVATAR (ROI) for DHS is discussed in detail below in reduced labor/personnel costs offsetting product costs. The metrics section further clarifies how security/safety improvements will be evaluated.
beings do not have this ability. The AVATAR can also detect cues of deception and malicious intent that are not perceptible to human senses.

Previous years have focused on the development of the prototype systems and basic research necessary for reliably analyzing human behavior for deceptive cues. The next phase of this research will perform field trials and technology development expressly focused on preparing the current prototype system for the operational environment. Within four years, this project will realize a commercially available AVATAR system for multiple DHS stakeholders.

2 Horizon Scan

We will continue to update our literature reviews and attend academic conferences with an eye towards duplication of research. Our PIs are regarded as experts and industry-leading researchers in the MIS, engineering, computer science, communications and psychology disciplines. These researchers will continue to publish in top journals and conferences, demonstrative that the deliverables from research within the Center are not redundant to extant literature. Furthermore, we will continue to consult with experts in the field of embodied conversational agents, such as Dr. Jon Gratch at USC and Dr. Jeremy Bailenson at Stanford University. Additionally, we consult with the National Center for Credibility Assessment on their progress and developments of their AVATAR project. Within DHS, we have been in discussions with the Human Factors/Behavioral Sciences division on our shared research directions in the areas of automated behavioral analysis and deception detection. In addition, we will plan to meet with University Programs Director Matthew Clark on a quarterly basis to monitor progress on this project.

3 Definite End Users

- U.S. Customs and Border Protection Office of Field Operations (CBP-OFO and OBP)
  - Trusted Traveler program application interviews (SENTRI, NEXUS, Global Entry)
  - I-94 processing and payment
  - Primary/secondary screening
  - Detention Centers
4 Potential End Users

- U.S. Citizenship and Immigration Services (USCIS)
  - Refugee/Asylum seeker interviews
- U.S. Coast Guard
  - Maritime Screening
- U.S. Immigration and Customs Enforcement (ICE)
  - Credibility assessment for investigations and integrations
- Transportation Security Administration (TSA)
  - Passenger security screening
  - Border document processing and passenger identification
- Secret Service
  - Event/building entrance screening
- Federal Emergency Management Agency (FEMA)
  - Disaster assistance interviews
- Federal Law Enforcement Training Center (FLETC)
  - Rapid screening and interviewing training for DHS personnel
- Department of Defense
  - Access Entry for military bases and visitor centers

5 Transition Partners

University of Arizona
The National Center for Border Security and Immigration (BORDERS) was established as a Center of Excellence in 2008 by the Department of Homeland Security. BORDERS is a consortium of premiere institutions that is dedicated to the development of innovative technologies, proficient processes, and effective policies that will help protect our nation’s borders, foster international trade, and enhance long-term understanding of immigration determinants and dynamics. Additionally, the University of Arizona’s Office of Technology Transfer is the University’s representative for licensing and intellectual property issues.

U.S. Customs and Border Protection, Office of Field Operations (OFO)
OFO is CBP’s largest component and is responsible for securing the U.S. border at ports of entry while expediting lawful trade and travel. OFO oversees the Trusted Traveler program (SENTRI, NEXUS and Global Entry), which provides expedited CBP processing for pre-approved, low-risk travelers. Ensuring an acceptably low risk requires a human interviewing process, which can be partially automated by AVATAR. Because OFO can provide the field environment for application, BORDERS will partner with OFO and implement automated screening kiosks as part of the Trusted Traveler process. To date we have engaged through briefings and technology demos of the AVATAR to Commissioner David Aguilar, Former Commissioner Alan Bersin, Executive Director John Wagner (Trusted Traveler Program), Assistant Commissioner Borkowski (OTIA), Director of Technology Management, David Throckmorton (OTIA), and Director of Field Operations (Tucson) David Higgerson. We have completed our first phase field trial at the Nogales POE by automating the Trusted Traveler interview. Borkowski and Throckmorton advise on the AVATAR technology development and transition process and are kept regularly updated on its progress. We will formally partner with John Wagner’s office during the transition phase through a MOU.
Office of Technology Innovation and Acquisition (OTIA)
OTIA will facilitate the acquisition and transition of the AVATAR into CBP operations. This includes important input on the technology management life cycle, testing and evaluation requirement, and legal/policy requirements that will be addressed before, during, and after technology transition of the AVATAR.

The Federal Law Enforcement Training Center (FLETC)
FLETC serves as an interagency law enforcement training organization for over 80 Federal agencies. The FLETC also provides services to state, local, tribal, and international law enforcement agencies. The FLETC is headquartered at Glynco, Ga., near the port city of Brunswick, halfway between Savannah, Ga., and Jacksonville, Fla. In addition to Glynco, the FLETC operates two other residential training sites in Artesia, N.M., and Charleston, S.C. BORDERS is partnering with FLETC to access test sites for kiosks. BORDERS is currently developing a CRADA with FLETC and will use their facilities for testing and training with the AVATAR system.

University of Nebraska
The University of Nebraska’s Peter Kiewit Institute (PKI) specializes in cross-disciplinary research and engineering solutions. In addition to having a reputation for strong technical capabilities, PKI is recognized as a pioneer in student involvement in technology research. BORDERS is partnering with the University of Nebraska to leverage necessary engineering capabilities and to build up student involvement and interest at multiple sites. Dr. Douglas Derrick at PKI, co-inventor of the AVATAR technology, remains actively involved in the ongoing technical development, validation, and transition of the AVATAR.

Discern Science Corporation
Discern Science is a startup founded by the principal investigators of this E2E project to facilitate technology transition of the AVATAR technology this includes seeking capital and negotiating IP licensing terms with the University of Arizona.

Local Business Development Team George, MacMaster, and Kenman
The Local Business Development Team will mentor and assist business plan and new product development, raising capital, supply chain and operations gap identification, and intellectual property development. These local business community team members serve only in a mentoring role and could possibly serve as future board members or investors.

Harry George, Managing General Partner, Solstice Capital
Advisor, Executive Leadership and Future Investment

Harry has more than 35 years’ experience in founding, operating and investing in successful rapid growth technology-related companies. From 1981 to 1989, Mr. George was co-founder, Director, and Vice-President of Finance for Interleaf Inc. During this time, Interleaf, a pioneer in electronic publishing, grew to be a publicly traded company with $100 million in annual revenue. Harry has been a Director of a number of private and public companies and is currently a Director of AmpliMed, Lumidigm, High Throughput Genomics, Medipacs and Syncardia.

Joann MacMaster, Director, Arizona Center for Innovation
Advisor, Business Plan Development

Joann MacMaster is a successful technology entrepreneur and executive with over 20 years of experience in leadership, strategic planning, innovation, and new product development and commercialization. Prior to assuming leadership of the Arizona Center for Innovation, Joann served
as President of Cortiva Institute, Program Director and Honors Fellow with the McGuire Center for Entrepreneurship at the University of Arizona, and Vice President for Client Services at the Tucson Technology Incubator. Her startup portfolio includes website translation, discrete event simulation, software design, network hardware and software, home automation, and strategy consulting. She has twice been an incubator client. Joann holds an MBA in International Business from Edinburgh University, Scotland.

Dennis Kenman, Co-Founder, Tucson Embedded Systems
Advisor, Small Business, Federal Contracting, Software Engineering

Dennis Kenman co-founded Tucson Embedded Systems (TES) with three fellow engineers in 1997. Since then, TES has grown to a staff of 90 employees and is a leading provider of products, services and computer intensive systems for the aerospace, defense and commercial industries. TES customers include the US Army, US Navy, Honeywell, Lockheed Martin, Northrop Grumman and Raytheon. TES products and services include mission and safety critical hardware and software systems, development, testing, and manufacturing. Dennis has a B.S. in Computer Engineering from the University of Arizona, and has over 20 years of software and systems development for mission critical and safety critical systems.

Kiosk Information Systems
Advisor, Kiosk Engineering and Channel Partner

KIOSK Information Systems (KIS) is an industry leader in design, manufacturing and support of self-service Kiosk solutions. Discern Science and the University of Arizona have worked closely with KIS to develop the existing AVATAR prototype system. KIS is an existing supplier to the Department of Homeland Security and provides the airport security kiosks known as Global Entry. As the undisputed market leader in custom solutions, KIOSK provides proven expertise in design engineering, application development, component integration, and quick-turn manufacturing for sophisticated self-service platforms.

6 Planned Transition

The first year of transition will include two major milestones. The first will be the acquisition of two senior programmers to transition the current R/D code into a commercial quality core. During this same period of time, we will partner with Kiosk Information Systems to design the commercial kiosk hardware. The second milestone for this year will be to receive a PO from CBP to develop and purchase five AVATAR systems for installation at the Nogales, Arizona SENTRI program processing center.

This transition plan is under development and will be updated to reflect the formal market analysis and business plan.
Year One
Through Discern Science, we will enter this market by selling a commercial version of the field tested AVATAR to CBP for the SENTRI program interviews. CBP has expressed interest in at least five AVATAR systems at each of the nine enrollment centers. Based on our product and service pricing, this initial market entry into the SENTRI program has revenue potential of $5 million in product sales and $1.3 million in annual services.

Year Two
CBP’s next expressed priority is to implement the AVATAR technology into the NEXUS program that is nearly identical to SENTRI, but services the northern border. With 24 enrollment locations, expansion into this market provides a revenue potential of $12.4 million in product sales and $3.6 in annual services. Discern will expand its product sales into the NEXUS program based on the SENTRI codebase developed in year one.

Year Three
The next area of concern to CBP is the increase in air travelers in the next 10 years. CBP operates an existing trusted traveler program called Global Entry, which is similar to SENTRI and NEXUS, but for international air passengers. Discern will integrate the AVATAR within their 25 Global Entry Enrollment centers, working directly with their current kiosk hardware provider Kiosk Information Systems. The Global Entry enrollment market has an estimated revenue potential of $12.9 million in product sales and $3.8 in annual services.

This year is a milestone for market penetration/expansion and public awareness for Discern though deployment in airports and usage by the general public. International airports contain very basic self-service Global Entry kiosks, more similar to ATMs than the AVATAR, that collect basic biometric and entrance data from international flight arrival passengers with trusted traveler status. Discern, working with Kiosk Information Systems, will either replace or upgrade the Global Entry kiosks to the AVATAR system. Considering only the 50 busiest American airports, the priority locations for CBP, the estimated potential revenue is $45 million in product sales and $13.5 million in annual services.

Year Four
The concern over insider threats has grown in the wake of the Fort Hood tragedy. Incorporating improved technology for detecting hostile intent has become a priority for the DoD. Discern Science founders have been involved in DoD’s efforts to identify emerging technologies to assist this effort. In March, the founder gave a briefing on the AVATAR technology and its applicability to detecting insider threat to representatives from every branch of DoD at a tabletop exercise on behavioral analysis and technology. The Army has requested that the AVATAR be demoed at to an upcoming industry day
and we are in discussion with the Navy to begin a field trial for the technology. Based on the roadmap for improved technology and infrastructure, the DoD will be ready to install the AVATAR systems for access entry in four years. Discern is currently working with DoD to ensure that the AVATAR will be completely seamless and compatible with their new infrastructure (e.g., biometric databases, personnel records). This year will focus on expanded sales to established programs and developing an access entry product for DoD.

Year Five
A stand-alone version of the AVATAR system, based on the DoD access entry system, will be developed for sales to the private sector. This system will provide advanced screening for building or event entrants, and for new employee hire interviews. Additionally, CBP is interested in using the AVATAR to automatically collect data and track visa entries into the U.S. For example, I-94 visas are issued to Mexican nationals entering the U.S., but these individuals are not tracked upon re-entering Mexico. The most recent estimates suggest that 60 percent of illegal immigrants in the U.S. are people who entered legally, but overstayed their visit. A more comprehensive and accurate process to track visa overstays are critical for effective immigration enforcement. To address this need, Discern will develop and sell an AVATAR system that will issue I-94s to people entering the U.S. thereby relieving congestion at the border, and will conduct exit interviews and track overstays. Based on volume at the 20 busiest ports of entry, this has potential revenues of $40 million in product sales and $12 million in annual services.

7 Initial Funding Arrangements
Efforts to transition BORDERS’ research to commercial applications require additional transition funding for use in developing commercial products and supporting services. Efforts to develop these funding resources have focused on three areas:

- Small Business Innovation Research (SBIR) - We will continue to seek funding through the SBIR program.
- Regional and federal economic development and related grants – Discern Science was a Semifinalist for the first of two Arizona Innovation Challenge awards for the AVATAR technology and will continue to compete in future rounds
- Angel and Venture Investment – The University of Arizona and Discern Science have continued with local investors from Desert Angels, Tucson’s regional investor group. Additionally, meetings are scheduled with Solstice Capital and other regional venture capital firms.

8 Project Team

<table>
<thead>
<tr>
<th>Individual</th>
<th>Organization Represented</th>
<th>Discipline or specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Jay Nunamaker</td>
<td>University of Arizona</td>
<td>Information Systems, Computer Science</td>
</tr>
<tr>
<td>Dr. Judee Burgoon</td>
<td>University of Arizona</td>
<td>Deception, Communication and Social Psychology</td>
</tr>
<tr>
<td>Dr. Aaron Elkins</td>
<td>University of Arizona</td>
<td>Social Psychology and MIS</td>
</tr>
<tr>
<td>Dr. Nathan Twyman</td>
<td>University of Arizona</td>
<td>MIS and Criminal Justice</td>
</tr>
<tr>
<td>Dr. Douglas Derrick</td>
<td>University of Nebraska, Omaha</td>
<td>Computer Science and MIS</td>
</tr>
</tbody>
</table>
9 Education Component

A critical component of BORDERS’ educational program is the participation of students in research within this project. Through their involvement with this research, students across many disciplines are becoming familiar with DHS’ mission and needs and gaining expertise in the HS-STEM and immigration-related disciplines. As a result of this unique experience, they will be well positioned to serve as DHS professionals upon graduation.

Number and Types of Students Funded
Fifteen students

Level
Undergraduate, Masters and Doctoral students

Immersion Program
Students are immersed in the research and transition process, specifically all students embed at locations where the AVATAR is field tested. For example, during testing at the Nogales POE, there was always at least one student on site observing operations daily. This will be repeated for the next phase of the field testing. Additionally, we will have increased engagement with headquarters to complement relationships developed at the local level through regular and extended visits to Washington DC by key project personnel.

Internships
BORDERS developed two significant internship programs that are expected to continue in the future. Undergraduate students from the University of Arizona’s Zimmerman Scholars program have been hired to support BORDERS’ research for both in-school and summer work.

Additionally, one faculty and two student researcher will be spending 10 weeks in the summer of 2012 with BORDERS as a part of the Minority Serving Institutions (MSI) Summer Research Team Program at DHS.

Post-Graduation Work
BORDERS employs two post-doctoral researchers at the University of Arizona and encourages placement in DHS or national labs after graduation.

Evaluation

By student
Graduate students, specifically in the doctoral program, are rigorously evaluated on their contribution to the center. Every year there is a formal evaluation completed by the department to assess their contribution to teaching, research, and service. Additionally, all students complete coursework and must maintain at least a 3.0 GPA to remaining in good standing. Before graduating, Ph.D. students must complete a comprehensive written exam, minor discipline coursework and test, oral exam, and finally submit and defend a dissertation.

By end user
We currently have no educational end users to evaluate.
10 Research Processes

Theoretical Basis
There are at least six major effects of deception or malintent currently identified in scientific literature. These six effects are not directly observable but they create effects that are observable. These six effects include arousal, decision processing, fear of consequence, guilt, self-regulation, and story creation. As an example, fear is not directly observable, but a certain type of facial expression or vocalic factor may result from fear.

The effects of deception are not mutually exclusive, nor are they exclusively deception-specific events. Contextual factors such as interviewer demeanor, technique, and realism and environment isolation, familiarity, and culture are examples of important factors that must also be considered for a model of credibility assessment.

The next-generation AVATAR system will include additional sensors for the detection of cues to deception. Each sensor needs to be tested in laboratory and field environments for reliability, validity, accuracy, and technical feasibility.

Hypotheses Tested/Questions Answered
Several research questions and associated hypotheses will be examined with regard to each sensor and cue. Example research questions include the following:

- How much improvement does a given sensor add to the credibility assessment ability of the next-generation kiosk?
- How well can an individual “beat the system” when employing countermeasures?
- How can speech recognition in the AVATAR be improved?
- How should an automated screening kiosk best be integrated with the existing SENTRI trusted traveler screening process?

Immersion Activities
Students and postdoctoral researchers will be heavily immersed in research on this project, including theoretical development, sensor acquisition and testing, experimentation in the laboratory and the field, and data analysis and reporting.

Data Needed
Data required for this project will be generated via experimentation and field test at the Nogales Port of Entry. As the AVATAR system expands to other venues, site-specific field test data will be required. Tucson Sector OFO has facilitated on site testing of the AVATAR in support of the Trusted Traveler interview process.

Data Collection Methods
Data will be collected via laboratory experimentation at the University of Arizona or partner sites, as well as through field tests at stakeholder sites.

Analytical Approaches
Analysis of experiment data will focus on statistical modeling such as structural equation modeling and multilevel regression modeling, and/or machine learning algorithms such as support vector machines and neural networks. Field test data will undergo similar quantitative analysis, as well as qualitative analyses, which will be extremely important for system integration, acceptance, and to guide future research.
11. Baseline Measures

Metrics for Gauging Performance of Screening Process

In order to determine if process improvements and developed screening technology improve screening at the border, metrics must be identified to measure performance. These metrics were developed based on the information gathering at the POE case study sites and from our existing measurements for assessing classification systems. These metrics can be used before and after implementation to assess and quantify improvement. The metrics are discussed below.

End users’ performance

We will compare improvement on the metrics both aided and unaided by the AVATAR to calculate improvement to officer job performance.

Reduced Security Risk and Vulnerabilities

Accuracy

Classification accuracy refers to the ability to correctly categorize someone as a potential threat or non-threat during the screening process. Precision and recall are two widely used statistical techniques for evaluating the accuracy of a classification task (e.g., classifying a person as a potential threat). We will explain both of these techniques in detail below.

Definitions

Let \( C \) be the set of all elements classified, \( P_t \) be the set of all true positives, \( P_f \) be the set of all false positives, \( N_t \) be the set of all true negatives, and \( N_f \) be the set of all false negatives. We then define precision, \( p \in [0, 1] \), and recall, \( r \in [0, 1] \), below in the following manner.

\[
\text{Precision} = \frac{|P_t|}{|P_t| + |P_f|}.
\]

A precision score of 1.0 indicates that every person flagged as a potential threat was actually a threat, and a score of 0.0 indicates that no one who was flagged is an actual threat.

A limitation of the screening recall static is determining “the total number of people who should have been flagged as a threat”, or \(|P_t| + |N_f|\). However, the base rate can be estimated by randomly schedule several screening days where everyone is sent to secondary screening. During these more thorough evaluations, one can determine the base rate for the given samples. With enough random
samples, one can generalize the base rate to the population. This not optimal, but is one method to get around determining a base rate which may not be otherwise calculable.

Often, an inverse relationship exists between precision and recall. For example, one can increase recall by categorizing everyone as a threat (resulting in a perfect recall score); however, in this scenario, precision will be very low. Likewise, one could increase precision by not categorizing anyone as a threat (resulting in a perfect precision score); however, in this scenario, recall would have a score of 0. Hence, precision and recall are rarely discussed in isolation. Rather a combined statistic is often used measuring the harmonic mean of precision and recall, referred to as the F-statistic,

$$F = 2 \frac{p \cdot r}{p + r}.$$

**Benefits**

We will also collect metrics of total time saved (officer hours, interviews, document collection) and increase to job and technology satisfaction. Discussed in the market analysis are financial benefits and ROI benefits to stakeholders. These will be further refined to reflect how much money was saved as a function of interviews and process automation provided by the AVATAR.

**Efficiency**

**Metrics - Screening Throughput Time**

Throughput time is a common operations statistic to analyze critical processes. It refers to the average time that a unit requires to flow through an entire process. It is recognized as particularly important in service organizations because people do not like to wait. In the context of screening, throughput time refers to the time required for a person to pass through the entire screening processes from entry point to exit point.

Screening throughput times should be compared in pre- and post-system implementation. The throughput time after the implementation of the system, \( t_A \), should be equal to or faster than the throughput time prior to implementation, \( t_P \). Hence, success of screening throughput time is observed when \( t_P \geq t_A \).

**Qualitative Measures**

The effectiveness of this project will be evaluated across four areas: Research Productivity, Scientific Tools and Techniques, Stakeholder Interaction/Outreach, Education, and Transition. Metrics from these areas, listed below, have been collected at BORDERS to date and will be utilized as a baseline to gauge the effectiveness of this project.

- **Research Productivity**
  - Publications
  - Journal quality articles submitted (not yet published)
  - Other articles submitted (non-journal quality, invited, etc.)
  - Scholarly conference presentations
  - Conference proceedings
  - Outreach presentations (non-technical groups, general public)

- **Scientific Tools and Techniques**
  - Data sets generated (from experiments)
  - Data sets acquired (from DHS or other sources)
  - Prototypes developed
  - Experiments conducted that needed IRB approval
  - Experiments conducted that did NOT need IRB approval
- Mathematical/simulation models produced
- Software packages produced

**Stakeholder Interaction/Outreach**
- Field studies conducted
- Meetings with Federal, State or Local Officials (non-DHS)
- Meetings with DHS officials
- Requests for assistance from DHS
- Requests for subject matter expertise
- Congressional testimonies

**Education**
- Students supported
- Students graduated
- Courses or course modules developed
- Certificate programs developed
- New degree programs developed

**Transition**
- Prototypes installed at stakeholder sites
- Policy briefs
- Prototypes moving towards transition/commercialization
- Projects leading to contracts/MOAs with commercial sector

### 12 Effectiveness Measures

All of the metrics collected as baseline will be compared against actual and post-implementation to determine effectiveness and improvement to stakeholder process. One standard method of quantifying success is calculation of the F-statistic.

**Metrics - Monitoring Success**

The screening F-statistic can be calculated for both pre-system implementation time periods and post-system implementation time periods. If the post-system implementation F-statistic is higher than the pre-system implementation F-statistic, we will consider the system a success in improving the classification accuracy of the screening process. We can also compare more granular precision and recall scores to help understand precisely how the system influences categorization accuracy.

### 13 Types of Research Results to date

**Papers**


**Patents**

The University of Arizona has been awarded one provisional patent for the AVATAR Kiosk and related inventions. The provisional patent provides for broad coverage of all features of the AVATAR. Work continues on the final patents and is expected to be completed by the end of 2012.
Software Products

- Structured Programming for Linguistic Cue Extraction (SPLICE)
- AVATAR (Integrated Automated Interviewing, Sensor Fusion, Risk Assessment, Biometrics Authentication, Speech Recognition, and Document Scanning Software)

14 Expected Research Results

Papers
Journal and conference papers on the technology, science, and technology transition methodology and case studies.

Technology
We will develop improved automation capabilities for our stakeholders, more advanced additional risk assessment (additional sensors and interview protocols), imposter detection, document collection, biometric authentication, and mobile credibility assessment using tables or cell phones.

Patents
By the end of 2012 the provisional patent will be converted into a series of 5 full patent applications. The University of Arizona’s Office of Technology Transfer is taking a lead role in prosecuting these patent applications.

Copyrights
Not applicable.

15 Testing and Evaluation Plan

Validation Process
Once our final metrics are developed, we will collect baseline metrics pre and post implementation of the AVATAR to determine improvement and effectiveness.

How?
BORDERS continues to execute on a plan for field testing of the AVATAR Kiosk in 2012. During phase 1 of this plan, the AVATAR was installed at the SENTRI office at the Nogales Port Of Entry in support of the Trusted Traveler program. At the end of phase 1, the system was removed and updates and improvements based on the testing are under development. During the summer of 2012 BORDERS will move to phase 2 of the testing plan. The upgraded system will be reintroduced to SENTRI office the Trusted Traveler program for continued field testing and evaluation.

Who?
The field tests have been conducted in conjunction with CBP through their SENTRI office in support of the Trusted Traveler program. Participants in the testing process include both the CBP officers and the applicants to the Trusted Traveler program. CBP officers are tasked with conducting in-person interviews of Trusted Traveler applicants to seeking authorization to access pre-approved, low risk and dedicated lanes and kiosks at U.S. Ports of Entry.
Safety Act
We will evaluate the relevance of the Safety Act to the AVATAR technology.

16 Market Assessment

Plans
The market for this technology is in its infancy. Currently, a formal market analysis is underway in tandem with the development of a business plan.

Initial customers or early adopters are the Department of Homeland Security and the Department of Defense. Since December 2011, we have conducted the first phase of a field trial with the U.S. Customs and Border Protection (CBP) to automate the SENTRI program interviews at the Nogales, Arizona Enrollment Center. At this location, CBP conducts interviews to determine the eligibility of Mexican citizens seeking Trusted Traveler status, which allows expedited quicker entry into the U.S. following an initial background check. CBP requested a customized version of the AVATAR that can conduct with the large number of pending SENTRI application interviews and allow the limited number of officers to engage in higher-level duties. The SENTRI program is one of three CBP Trusted Traveler programs that will be automated with the AVATAR technology over the next four years. CBP is interested in purchasing a commercial, large-scale implementation of the AVATAR we develop this technology into a commercial product.

The market opportunity for our credibility assessment and automated interviewing technology is enormous, as it includes any government agency or private company that conducts costly interviews or credibility assessment tasks. The initial market for the next four years is primarily government agencies that require security screening and automated interviewing capability, specifically the Department of Homeland Security and Department of Defense. A standalone (not requiring excessive customization or integration development) access entry AVATAR will be marketed and sold to the private sector beginning in year five.

In total, considering only CBP’s existing security processes and programs in need of automation, the total estimated revenue potential for the SENTRI, NEXUS, and Global Entry programs is $115.6 million in product sales and $34.2 million in annual services. The DoD has at least 500 priority military bases that would require an average of 10 AVATAR systems installed and supported. The estimated revenue for these product sales would be $500 million with $150 million in annual services.

There is currently no product marketed towards the private sector that provides intelligent and rapid screening. But, one indicator of the demand for advanced security products is the polygraph market which is estimated at $3.6 billion in annual revenue.

Who?
The market for this technology is in its infancy. Initial customers or early adopters are the Department of Homeland Security and the Department of Defense. Since December 2011, we have conducted a field trial with the U.S. Customs and Border Protection (CBP) to automate the SENTRI program interviews at the Nogales, Arizona Enrollment Center. At this location, CBP conducts interviews to determine the eligibility of Mexican citizens seeking Trusted Traveler status, which allows expedited quicker entry into the U.S. following an initial background check. CBP requested a customized version of the AVATAR that can conduct with the large number of pending SENTRI
application interviews and allow the limited number of officers to engage in higher-level duties. The SENTRI program is one of three CBP Trusted Traveler programs that will be automated with the AVATAR technology over the next four years. CBP is interested in purchasing a commercial, large-scale implementation of the AVATAR after Discern develops this technology into a commercial product.

**How?**

Our AVATAR technology is currently being operated and tested by our first customer, CBP. The remaining barrier to selling this product is the development needed to transition the current R/D stage technology into a commercial product. Once a commercially viable software and technology core is completed, we can solicit a PO from CBP for the initial integration development, kiosk hardware/software, and additional services such as training, support, and annual licensing fees. Our primary marketing strategy for acquiring new customers is extensive outreach through government networks and briefings, technology demos, and word of mouth. A major milestone for new customer adoption will occur in year three when the AVATAR system has maximum public exposure and awareness with the general public.

After developing the software customized to each customer program (e.g., SENTRI), each AVATAR kiosk installed contributes to a rapid return on investment, typically within the first year, from reduced labor costs through automated document scanning, interviewing, and credibility assessment. In addition to financial savings, CBP and DoD can reallocate their human capital to activities more related to improving homeland security and defense than processing applications, interviews, and document scanning. This reallocation of human resources can improve security and employee morale. We will address the validity of this question in a current publication we are authoring that describes our field test and post-test interviewing that provided positive feedback and improved job satisfaction.

Product and service pricing was updated from the previous application to reflect total costs of software, services, hardware. One officer can manage up to five AVATAR kiosks via a wireless iPad application. Based on this typical use case the ROI for our customers is detailed below.

CBP (Officer costs est. $250k annually) first two years of SENTRI program installation.

- Year One ROI (Including One Time Development Cost, 5 Units) = \( \frac{1,250,000 - 1,150,000}{1,150,000} = 9\% \)
- Year Two ROI (Including Annual License Fees for 5 Units) = \( \frac{1,250,000 - 400,000}{400,000} = 213\% \)

DoD (Army Access Entry Guard costs $1 million annually) first year of two base installations.

Year One ROI (Including One Time Development Cost, 20 Units) = \( \frac{16,000,000 - 5,500,000}{5,500,000} = 190\% \)

**When Started and Completed**

We started the market analysis when we started Discern Science and started seeking external transition funding. The process is evolutionary and will likely not complete as we enter new markets or revise our product pricing and supply chain. For example, we envisage having at least a 60% gross
margin to support increasing R&D expenses. This will require constant reevaluation of market conditions and costs over the life of the company and product.

**17 Intellectual Property Considerations**

**Federal Government**
This research has been supported by multiple federal government grants. The major federal contributions were listed on the initial provisional patent application and will be further aligned with the specific part of the AVATAR supported, as opposed to the entire system. For example, the sensor investigation was supported by NCCA, but not the research into the appearance of the AVATAR or interface.

**University Investigator**
The university investigators are listed as inventors on technology patents. A licensing agreement is under way with the university to license the technology.

**COE**
The University of Arizona’s Office of Technology Transfer has assisted BORDERS in obtaining a provisional patent for the AVATAR technology and has entered into a license option agreement with Discern Science to transfer the subsequent IP to the firm for future commercialization. The University of Arizona’s Center for Management of Information has agreed to partner as a subcontractor to Discern Science Corporation on the previously referenced Army SBIR Solicitation.

**18 Funding for Transition**

**Federal Agency**
Discern Science will continue to pursue SBIR grants and local and state small business funding opportunities such as the Arizona Innovation Competition, of which Discern Science was a semifinalist in 2012.

**FEMA/UASI Grants**
FEMA has not been engaged for direct technology transition funding, but we are currently them engaging for research and development funding and field trial support.

**Private Sector**
Discern Science has been actively seeking private equity. This has resulted in refined market analysis and acquisition strategies as we refine our pitch to potential investors.

**19 Transition to DHS Component/Other Federal Agencies**
The co-inventors of the AVATAR and integrated automated interviewing and credibility assessment technology have partnered together as co-founders of Discern Science Corporation. DSC will license the Center’s key intellectual property and aggressively pursue commercialization of the Center’s research. Key to this process is the secure outside funding to advance extensive commercial potential of the technology. The team’s first effort is to complete a proposal response to the current
Army SBIR Topic Number A12-060 titled “Standoff Counter Human Deception Detection Device”. The topic’s stated objective is to “develop a standoff device which efficiently assesses psychophysiological characteristics to covertly determine truthfulness/creditability of subjects undergoing questioning.” Three of the four citations referenced in the solicitation are from the University of Arizona with Dr. Jay Nunamaker, Dr. Judee Burgoon, and Dr. John Allen (professor of Psychology). We believe the Center’s past success in the ground breaking research in this area is recognized in this solicitation and will position the team to be successful in our proposal.

**U.S. Customs and Border Protection, Office of Field Operations**

CBP’s Office of Field Operations has a vested interest in the AVATAR program because a system of automated screening kiosks can serve as a force multiplier during a time when demand for enrollment in the SENTRI program is projected to accelerate. AVATAR can make the process more efficient while at the same time alerting agents to potential risk factors based on behavioral cues.

**Federal Law Enforcement Training Center**

FLETC incorporates avatar technology in their training programs. BORDERS’ AVATAR will incorporate dynamic responding based on behavioral cues during an interview. This functionality has relevance to FLETC’s current operations.

**Understanding Acquisition Process**

BORDERS is engaging with stakeholders, particularly with CBP, to understand and document how to move from research partners to sales of a product. BORDERS and Discern Science have also enlisted mentors from the business community that specialize in transition from research and development into large government product sales.

**Incorporating into Acquisition Planning**

Our acquisition planning, as describe in our market analysis above, evolves as we learn more information about the process and acquire new partners. Are next step is establish an official mentor in government acquisitions to potentially become a board member in Discern Science.

**Analysis of Technology’s Effect on Component Operations**

We held interviews and debriefs with all officers participating in the field trial. From their feedback we learned what worked and what did not. This feedback has been incorporated into an iterative development cycle that we use to improve the AVATAR. For example, officers at CBP indicated that the risk assessment should be sorted differently and the AVATAR needs to ask more questions. We have added these features and improved the officer users experience and reduction in their workload. We also collect metrics on how much time is saved by having the AVATAR conduct interviews.

**20 Transition to State and Locals/International**

Our first market of entry with the AVATAR is the federal government. However, we will engage local and state government to assess the market potential and stakeholder needs.
21 Transition to Private Sector

**Licensing**
We have just filed a provisional patent for the AVATAR invention. The next stage is to identify multiple individual patents covered in the larger provisional patent. After these patents are determined, licensing arrangement negotiations with the University of Arizona will continue. Our strategy is to ensure the licensing agreement is favorable to sublicensing our technology to another company or value added reseller or transferring the licensing rights entirely through the sale of Discern Science.

**Commercialization questionnaire filled out**
We have not completed this questionnaire yet.

22 Documentation, Operations & Maintenance, Updates

**Plan**
We have started partnering with supply chain partners needed to provide post-sale service and support to customers. Additionally, we developed an initial pricing model (targeting a 60% gross margin) to account for operational expenses, support, and continual research and development costs. We are modeling our initial service license model around the current CBP Global Entry program kiosk/service contract.

**Institutional Arrangements**
We have no formal institutional arrangements other than assembling mentors, described above in the transition partners section, who may likely serve in more formal capacity in the future. We will likely begin a formal partnership with key supply chain partners (e.g., Kiosk Information Systems) to ensure product availability and support when we begin product and service sales.

23 Transitioning to First Responders
We will determine our strategy following engagement with first responder stakeholders.

24 Legal Issues and Attorney Engagement
We are investigating the legal and liability implications of our technology and the transition process. For example, how do we legally pivot from research and development partner to vendor? We currently have legal counsel for Discern Science who has primarily supported incorporation and patent/licensing agreements with the university.

25 Case Study and Post-Project Evaluation
We have and will continue to document our field trial with the AVATAR and CBP all the way through to a sale of a product. To this end, we will work closely with DHS S&T and complementary disciplines
(e.g., management, economics, law) to publish multiple case studies and lessons learned and begin establishing a methodology for scientific technology transition to government and DHS stakeholders.
Background

The AVATAR system is designed to enable non-invasive, automated, rapid screening of people at border crossings, airports and other settings. The system includes a computerized agent programmed to ask questions and a bank of sensors to interpret the body movements, vocalics, pupillometry and eye tracking of the person being screened. It has been funded for four years through the BORDERS COE.

As the Center’s E2E project, the research team will put on an AVATAR workshop to review our work to date and discuss where the research may go in the future. For this workshop, BORDERS will host a 4-5 day workshop for a broad range of multi-disciplinary Subject Matter Experts (SMEs) and end-users: The format will include plenary sessions, smaller working groups and panel discussions.

Objectives

The purpose of this workshop is three-fold:

1. BORDERS PIs will discuss the body of research, including previous leveraged grants that have led up to the AVATAR sensor system as it exists today. This will include the most promising developments, as well as current deficiencies
2. Participants will discuss possible directions for the project should go in the future.
3. By the end of the workshop, participants will identify areas of investigation to be pursued and/or accelerated, and what additional resources are required to do so.

Suggested Participants

The following is a list of potential participants for this workshop. We will work closely with our stakeholders and Program Manager to determine the most appropriate set of individuals to invite for this workshop.

DHS Programs

- Office of Technology, Innovation and Acquisition – CBP
- Office of Field Operations – CBP
  - Admissibility and Passenger Programs
- Office of Border Patrol – CBP

Note: This workshop is being funded from two sources: (1) funds that were restricted in YR 4 and have been carried over into YR 5; and (2) YR 5 funding.
- Strategic Planning, Policy & Analysis
  - Office of Internal Affairs, CBP
  - US-VISIT – CBP
  - HSARPA – S&T
  - FLETC
  - Director of Research & Development Partnerships, S&T
  - Support to the Homeland Security Enterprise and First Responders, S&T
  - Office of National Labs, S&T
  - TSA
  - Coast Guard
  - FEMA
  - Secret Service

**Academic Experts**

**Table 2: AVATAR Academic Experts**

<table>
<thead>
<tr>
<th>Collaborator</th>
<th>Affiliation</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Hsinchun Chen</td>
<td>University of Arizona</td>
<td>Artificial Intelligence, Information Systems</td>
</tr>
<tr>
<td>Dr. Arun Ross</td>
<td>West Virginia University</td>
<td>Biometrics</td>
</tr>
<tr>
<td>Dr. Bojan Cukic</td>
<td>West Virginia University</td>
<td>Biometrics</td>
</tr>
<tr>
<td>Dr. Larry Hornak</td>
<td>West Virginia University</td>
<td>Computer Science, Biometrics, Bioengineering, Computer Vision</td>
</tr>
<tr>
<td>Senya Polikovsky</td>
<td>Tsukuba University Computer Vision and Image Media Laboratory</td>
<td>Computer Science, Computer Vision, Bioengineering</td>
</tr>
<tr>
<td>Dr. Yoshinari Kameda</td>
<td>Tsukuba University Computer Vision and Image Media Laboratory</td>
<td>Computer Science, Computer Vision, Bioengineering</td>
</tr>
<tr>
<td>Dr. Jonathan Gratch</td>
<td>USC Department of Computer Science</td>
<td>Computer Science, Virtual Interactions</td>
</tr>
<tr>
<td>Dr. Anil Bharath</td>
<td>Imperial College</td>
<td>Computer Vision, Bioengineering</td>
</tr>
<tr>
<td>Dr. Dmitri Metaxas</td>
<td>Rutgers University Center for Biomedical Imaging and Modeling</td>
<td>Computer Vision, Data Analytics</td>
</tr>
<tr>
<td>Dr. Maja Pantic</td>
<td>Imperial College</td>
<td>Computer Vision, Virtual Interactions</td>
</tr>
<tr>
<td>Name</td>
<td>Affiliation</td>
<td>Field</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Dr. Joseph Valacich</td>
<td>University of Arizona</td>
<td>Information Systems</td>
</tr>
<tr>
<td>Dr. Thomas Meservy</td>
<td>Brigham Young University</td>
<td>Information Systems</td>
</tr>
<tr>
<td>Dr. Doug Vogel</td>
<td>City University of Hong Kong</td>
<td>Information Systems</td>
</tr>
<tr>
<td>Dr. Matthew Jensen</td>
<td>University of Oklahoma</td>
<td>Information Systems</td>
</tr>
<tr>
<td>Lt Col Mark DiCarlo</td>
<td>DoD Physical Security Equipment Action Group</td>
<td>Insider Threat</td>
</tr>
<tr>
<td>George Randall</td>
<td>Applied Research Associates</td>
<td>Insider Threat</td>
</tr>
<tr>
<td>Tom Monaco</td>
<td>Applied Research Associates</td>
<td>Insider Threat</td>
</tr>
<tr>
<td>Tom Whittle</td>
<td>DoD Physical Security Equipment Action Group</td>
<td>Insider Threat</td>
</tr>
<tr>
<td>Dr. Jeff Hancock</td>
<td>Cornell University</td>
<td>Linguistics</td>
</tr>
<tr>
<td>Dr. Sandiway Fong</td>
<td>University of Arizona</td>
<td>Linguistics</td>
</tr>
<tr>
<td>Bruce M. Coull, M.D.</td>
<td>University of Arizona, Department of Neurology</td>
<td>Neurology</td>
</tr>
<tr>
<td>Dr. John G. Hildebrand</td>
<td>University of Arizona Department of Neuroscience</td>
<td>Neuroscience</td>
</tr>
<tr>
<td>Dr. Frank M. Marchak</td>
<td>Veridical Research and Design</td>
<td>Oculometrics, Psychology</td>
</tr>
<tr>
<td>Dan Baxter</td>
<td>Department of Defense</td>
<td>Polygraph</td>
</tr>
<tr>
<td>Marty Oelrich</td>
<td>American Polygraph Association</td>
<td>Polygraph</td>
</tr>
<tr>
<td>Dr. John Rohrbaugh</td>
<td>Washington University</td>
<td>Psychiatry, Bioengineering</td>
</tr>
<tr>
<td>Dr. David McNeill</td>
<td>Chicago Department of Psychology Center for Gesture and Speech Research</td>
<td>Psychology</td>
</tr>
<tr>
<td>Name</td>
<td>Institution</td>
<td>Field</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Dr. Jeff Stone</td>
<td>University of Arizona</td>
<td>Psychology</td>
</tr>
<tr>
<td>Dr. John Allen</td>
<td>University of Arizona</td>
<td>Psychology, Neuroscience</td>
</tr>
<tr>
<td>Dr. John Kircher</td>
<td>University of Utah</td>
<td>Psychology, Bioengineering, Polygraph, Oculometrics</td>
</tr>
<tr>
<td>Dr. Gary Bente</td>
<td>University of Cologne Department of Psychology</td>
<td>Psychology, Communication</td>
</tr>
<tr>
<td>Dr. Clifford Nass</td>
<td>Stanford University</td>
<td>Psychology, Communication, Virtual Interactions</td>
</tr>
<tr>
<td>Dr. Jeremy Bailenson</td>
<td>Stanford University</td>
<td>Psychology, Communication, Virtual Interactions</td>
</tr>
<tr>
<td>Dr. Mike Woodworth</td>
<td>University of British Colombia Centre for the Advancement of Psychological Science and Law</td>
<td>Psychology, Linguistics</td>
</tr>
<tr>
<td>Dr. Mary Peterson</td>
<td>University of Arizona</td>
<td>Psychology, Oculometrics</td>
</tr>
<tr>
<td>Dr. Andrew B. Dollins</td>
<td>National Center for Credibility Assessment</td>
<td>Psychology, Polygraph</td>
</tr>
<tr>
<td>Dr. Dean Pollina</td>
<td>National Center for Credibility Assessment</td>
<td>Psychology, Polygraph</td>
</tr>
<tr>
<td>Dr. James J. Blascovich</td>
<td>UCSB Department of Psychology</td>
<td>Psychology, Virtual Interactions</td>
</tr>
<tr>
<td>Dr. Danilo Mandic</td>
<td>Imperial College</td>
<td>Signal Processing, Computer Science</td>
</tr>
<tr>
<td>Dr. Dale Tunnell</td>
<td>Forensitec</td>
<td>Signal Processing, Criminology, Psychology, Polygraph</td>
</tr>
<tr>
<td>Dr. Bjorn Schuller</td>
<td>Munich University of Technology</td>
<td>Virtual Interactions</td>
</tr>
</tbody>
</table>

**Expected Outcomes**

The purpose of this AVATAR workshop will be to identify areas of investigation to be pursued and/or accelerated, and what additional resources are required to do so.
Biometric Identification: Research Directions

Bojan Cukic, Arun Ross – West Virginia University
Bojan.Cukic@mail.wvu.edu; arun.ross@mail.wvu.edu

Project Abstract

The ability to positively confirm the identity of people crossing international borders has always been of paramount importance. DHS has been at the forefront of the deployment of biometric systems. Current biometrics at border crossings achieve reasonably prompt, nonintrusive and accurate identification of travelers. Nevertheless, given the ever growing size of biometric datasets (visa applicants, watch lists, etc.) the question is whether current technology will be able to keep up with emerging operational needs.

In year 5, this project will investigate future directions in biometric research and analyze the impact research advances are likely to have on the use of biometrics by DHS.

Significance to DHS

Ability to accurately identify individuals is one of the fundamental requirements for the Department of Homeland Security. While state-of-the-art systems and deployment address immediate needs at border crossings and law enforcement, it must be expected that individuals with harmful intent will elevate their sophistication in exploiting the vulnerabilities of biometric technology. To effectively counter such emerging threats, research must address the scientific underpinnings of biometrics and map the findings towards operational concepts of interest to the agency.

We propose to analyze research challenges of biometrics research and project potential emerging applications for DHS end-users.

Research Description

The past two decades has seen a substantial increase in biometrics activity accompanied by the deployment of biometric systems in diverse applications ranging from laptop access to border control systems. The inclusion of biometric evidence in military and criminal courts necessitates a careful examination of the scientific basis for biometric recognition. In particular, there is an urgent need to systematically review the scientific literature to determine if some of the common assumptions made about biometric traits with respect to criteria such as universality, uniqueness, permanence, measurability, performance, acceptability and circumvention, is borne out in the academic literature. Thus, the purpose of this study is to:

(a) Identify gaps in existing research and the implications on operational system risks; and
(b) Provide recommendations for further research and deployment scenarios.
Methodology

This study will have two tasks. In Task 1, we will create an indexed bibliography of relevant biometrics literature that describes the science behind individual biometric traits such as face, fingerprint, iris and system engineering implications. In Task 2, a report summarizing the state-of-the-science in biometrics and recommendations for future research will be drafted. Initially, the study will cover face, fingerprint and iris. If time permits, it will be expanded to include DNA and voice.

Student Involvement

The project will involve one PhD student who will be performing literature review as a part of dissertation work.

Transition Strategy

The results of this short-term study will be a technical report and an indexed list of research literature. The report will be widely distributed within the sponsoring agency and in the biometrics and border security research communities.

YR 5 Milestones

The proposed Year 5 milestone reflects the reduced funding from DHS, as well as the intention to concentrate only on research tasks of the highest sponsor’s interest.

Table 3: YR 5 Milestones

<table>
<thead>
<tr>
<th>Task</th>
<th>YR5 Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Technical Report: Research challenges in biometrics</td>
</tr>
<tr>
<td>B</td>
<td>Indexed biography of relevant biometric research literature</td>
</tr>
</tbody>
</table>
Localization and Tracking of Vehicles, Cargo and Persons

Demoz Gebre-Egziabher – University of Minnesota, Twin Cities Campus
gobre@aem.umn.edu

Note: On December 31, 2012 if stakeholder assessments currently underway do not lead to DHS decisions to pursue GPS-based technologies in the future, funds will be restricted. Only 50% of funds devoted to this project can be utilized over the first six months.

Project Abstract

The overall objective of the work in this project is to develop solutions for accurate, cost effective and reliable tracking and localization of designated vehicles and cargo entering the country via the borders. The solutions developed use, to the maximum extent possible, existing technologies and are therefore cost effective. The solution developed for vehicle tracking leverages the wide-acceptance of GPS as a solution for fleet tracking. It adds to this advanced signal processing techniques to ensure that designated vehicles cannot spoof or deceive tracking efforts, thereby, providing assurance that a vehicle has (or has not) traveled along a designated route. The cargo tracking solution does the same for individual pieces of cargo (separate from the vehicle) that may be moved from one vehicle to another in the process of transit.

Significance to DHS

Solutions for accurate tracking of vehicles and cargo are an enabler for many smart and efficient border applications. The vehicle tracking thrust deals with developing solutions for determining the position coordinates of vehicles whose motion needs to be known at all times. This is an indispensable part of many CONOPS being designed to streamline and the inspection processes at Ports of Entry (POE). If GPS based tracking solutions are used as part of the solution to ensure cargo/container security, the work done in this project will be key to developing requirements for such devices.

Research Description

The work in Year 5 will focus on two objectives: The first objective will be to collect data with the GPS authenticator developed as the solution to vehicle tracking in Year 4. The data collected will be used to validate the performance of the GPS authenticator. In particular, the data will be used to determine whether the missed detection and false alarm rates of the GPS authenticator are consistent with analytical predictions. We will use data collected from tests at the University of Minnesota. We will also try to coordinate with potential DHS customers to collect field data to confirm whether the system will perform as intended in environments in which it will eventually operate.
The second objective will be to develop and test methods for ensuring that a GPS authenticator/cargo tracking system attached to a cargo container remains with that particular container (i.e., prevent swapping of detectors from one container to another). The planned work will involve two graduate research assistants (at 25% effort each).

Methodology

In our discussions with DHS stakeholders, it has been determined that as far as cargo tracking is concerned, the focus should be on tracking cargo containers. Thus, we have adapted the same solution for both cargo and vehicle tracking. The solution is a GPS-based one which has been the work in prior years has led to a development of a prototype for a GPS authenticator (a spoof-resistant addition to GPS). The approach developed satisfies both the vehicle and cargo tracking problems.

Thus, we plan to perform analysis and simulation and document the results of a trade study showing the performance of such a system in detecting anomalous vehicle and cargo trajectory. A key part of these studies will be to demonstrate what the trade-offs are involving increased system reliability and accuracy (false alarm rate and missed detection rates). To this end, we plan to collect as much position data as possible locally in settings which represent the system’s eventual operating environment. The data will be used to determine whether false alarm rates and missed detection rates are actually consistent with theoretical prediction.

Related Studies

There is only one other research project that we are aware of (from Stanford University) working on a similar idea to the one discussed here. However, their published work in this area is not as advanced in maturity as the work at the University of Minnesota. For example, several issues that are significant to practical (“real world”) implementation of the GPS-based cargo/security devices have been addressed in the University of Minnesota work but not in the others.

Field Studies

We will continue our discussions with the APEX Secure Transit Corridors team at S&T to determine the feasibility/location/timing of a field study.

Government Data

Government data will not be needed for this project.

Student Involvement

A total of 2 graduate students (research assistants) will be involved with the project in Year 5. The majority of the day-to-day work will be carried out by 2 graduate research assistants. They develop algorithms, construct hardware, carry out tests, post-process data and write technical reports and papers. In addition, during the summer of 2011 we will involve an undergraduate research assistant to assist with the planned construction and testing.


**Engagement Plan**

On May 17, 2012 in a teleconference with Jonathan McEntee (DHS S&T, HSARPA/APEX-Secure Transit Corridors), the issue of transition of the GPS authentication work was discussed; in particular, the issue of how to transition the results of the GPS tracking and authentication research to DHS end users. Mr. McEntee indicated that currently DHS S&T is gathering data to determine what kind of technologies beyond the “ISO-bolt” would make sense to use in dealing with issue of cargo container security/integrity. The purpose of the data collection is to determine, in part, what types of technologies would be beneficial to and increase the efficiency of CBP. The data will be used, in part, to perform cost-benefit analysis of various cargo container security/integrity technologies.

Whether or not GPS (GNSS) will be one of those technologies used in the cargo security/integrity problem is still to be determined. We plan to keep abreast of the results of this work being conducted by the HSARPA/Apex-Secure Transit Corridors Program and by remaining in contact with DHS S&T (Mr. McEntee) and apprising them of our progress.

**Engagement with Stakeholders**

Whether or not GPS (GNSS) will be one of those technologies used in the cargo security/integrity problem is still to be determined. We plan to keep abreast of the results of this work being conducted by the HSARPA/Apex-Secure Transit Corridors Program and steer our research in a direction that will help answer question regarding GPS that may arise in relation to the study being performed.

**Scientific Collaboration**

We will continue to publish scientific papers and present at conferences. We have new research and testing results that form the core of one conference and one archival journal publications. Our plan is to present the conference paper at a security related conference.

**Transition Strategy**

We are awaiting the results of the study to determine who the final end user of our research results will be. In addition, last year we became aware of recent patents awarded to and activities by private companies which deal with an approach very similar to the one we are pursuing for vehicle tracking (Zanio LLC and Coherent Navigation, Inc). We have had discussions with these companies to determine how to further pursue transition of our prototype and ideas along with theirs to border security applications.

**YR 5 Milestones**

Milestones for the YR 5 are given below. The overarching objective of the work in YR 5 is collect data that will allow confirming whether the field performance of the GPS authenticator is consistent with performance predicted from simulations and analysis. Another important objective of the work is adapting the GPS authenticator developed for vehicle tracking to cargo tracking. Later in YR6 the cargo tracking solution based on this authenticator will be validated in the same way the vehicle tracking solution is proposed to be validated in YR 5.
Table 4: YR 5 Milestones

<table>
<thead>
<tr>
<th>Task</th>
<th>YR 5 Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Develop analytical and simulation models to quantify the false alarm and missed detection rates of the GPS authenticator</td>
</tr>
<tr>
<td>B</td>
<td>Collect field data from the authenticator operating in various environments and subjected deliberate faults</td>
</tr>
<tr>
<td>C</td>
<td>Use collected data to confirm analytical predictions of false alarm and missed detection rates match experimentally observed data</td>
</tr>
<tr>
<td>D</td>
<td>Write a White paper on the performance of the GPS authenticator</td>
</tr>
<tr>
<td>E</td>
<td>Develop a method for using the GPS authenticator for cargo tracking.</td>
</tr>
</tbody>
</table>

Metrics

Table 5: YR 5 Metrics

<table>
<thead>
<tr>
<th>Project Metrics</th>
<th>Min. required</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Scientific Research Metrics (50%)</td>
<td></td>
</tr>
<tr>
<td>A. Tools and Techniques</td>
<td></td>
</tr>
<tr>
<td># data sets generated (from experiments)</td>
<td>1</td>
</tr>
<tr>
<td># data sets acquired (from DHS or other sources)</td>
<td></td>
</tr>
<tr>
<td># prototypes developed</td>
<td>1</td>
</tr>
<tr>
<td># experiments conducted that needed IRB Approval</td>
<td></td>
</tr>
<tr>
<td># experiments conducted that did not need IRB Approval</td>
<td></td>
</tr>
<tr>
<td># mathematical/simulation models produced</td>
<td></td>
</tr>
<tr>
<td># software packages produced</td>
<td></td>
</tr>
<tr>
<td>related leveraged funds, non-DHS ($)</td>
<td></td>
</tr>
<tr>
<td>B. Research Productivity</td>
<td></td>
</tr>
<tr>
<td># journal quality articles submitted</td>
<td>1</td>
</tr>
<tr>
<td># other articles (invited, non-peer reviewed, etc.)</td>
<td></td>
</tr>
<tr>
<td># publications</td>
<td></td>
</tr>
<tr>
<td># conference proceedings</td>
<td>2</td>
</tr>
<tr>
<td># conference presentations</td>
<td>2</td>
</tr>
<tr>
<td># briefing slides produced</td>
<td>2</td>
</tr>
</tbody>
</table>

II. Stakeholder/ Outreach Metrics (15%)
<table>
<thead>
<tr>
<th># field studies conducted</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td># meetings with Federal, State, or Local Officials</td>
<td></td>
</tr>
<tr>
<td># requests for assistance</td>
<td></td>
</tr>
<tr>
<td># requests for subject matter expertise</td>
<td></td>
</tr>
<tr>
<td># congressional testimonies</td>
<td></td>
</tr>
<tr>
<td># media appearances</td>
<td></td>
</tr>
</tbody>
</table>

**III. Education Metrics (10%)**

<table>
<thead>
<tr>
<th># students on project</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td># courses developed</td>
<td></td>
</tr>
<tr>
<td># certificate programs developed</td>
<td></td>
</tr>
<tr>
<td># students graduating with certificates</td>
<td></td>
</tr>
</tbody>
</table>

**IV. Transition (25%)**

<table>
<thead>
<tr>
<th># of DHS champions</th>
<th>2 (identified and in current discussion)</th>
</tr>
</thead>
<tbody>
<tr>
<td># prototypes installed at stakeholder sites</td>
<td></td>
</tr>
<tr>
<td># policy briefs</td>
<td></td>
</tr>
<tr>
<td># prototypes moving towards transition/commercialization</td>
<td>1</td>
</tr>
<tr>
<td># projects leading to contracts/MOAs with commercial sector</td>
<td></td>
</tr>
<tr>
<td>additional funding from S&amp;T sources ($ non-grant contract)</td>
<td></td>
</tr>
<tr>
<td>additional funding from DHS sources, non-S&amp;T ($ - i.e., BOAs)</td>
<td></td>
</tr>
</tbody>
</table>
Project Abstract

The Checkpoint Study project has been initiated to help Customs and Border Protection - Office of Border Patrol (CBP-OBP) assess the effectiveness of traffic checkpoint operations for the public good. The key goals of the project are to evaluate and address 1) checkpoint data integrity, consistency and accuracy, 2) measures of checkpoint impacts on local communities and 3) effectiveness metrics and models, as pointed out in the GAO Report No. GAO-09-824. We will continue to work closely with OBP through the duration of the project.

Significance to DHS

The goals and objectives of the project are:

- Assess the current data collection protocols along with the effectiveness measures and models at a large cross-section of CBP checkpoints.
- Research and develop checkpoint data oversight protocol with a focus on data accuracy, consistency, and quality.
- Design and develop performance measures, metrics and models for checkpoint effectiveness and community impacts.
- Develop a managerial tool to aid CBP officers in, among other things, operations planning, resource allocation, incorporating intelligence reports and analyzing trends.

These objectives will allow DHS to: make improved operational decisions regarding resource allocations, address concerns by the GAO, react to negative impacts to the communities where checkpoints reside, and showcase positive impacts to the community and to the larger theater of border security.

Research Description

Phase I: Development, presentation, and approval of a management plan
Phase 1 has been completed.

Phase II: Data consistency, integrity, and accuracy
We successfully assessed and evaluated the data collection and analysis protocols in existence at the various CBP checkpoints during the site visits. We will continue to focus on the consistency, integrity and accuracy of the data collected by the CBP. Information was provided by CBP in the form of Checkpoint Activity Report (CAR) module data and BPETS and E3 data during YR 4. This data has helped the team gain greater insights into the operations of checkpoints. The team is formulating a variety of recommendations to improve data collection processes and training procedures/protocols.
at checkpoints. Overall, the recommendations entail both preemptive and evaluative strategies to improve data oversight protocols. The final report will be presented during YR 5.

**Phase III: Community impacts**
Using the information gained from site visits, data provided by CBP and other studies, we have assessed the impact of checkpoints on the surrounding communities. The impact study is multifaceted, taking into account the various social and economic factors. The outcome of this study will lead to well-defined metrics and models and a repeatable process for impact analysis. Such impact analysis will help the CBP in conducting impact studies when planning and constructing new checkpoints. The report for this phase will be finalized and presented in YR 5.

**Phase IV: Performance models and measures**
Utilizing the data and experience gained from Phases II and III, we will finalize a performance framework that accurately represents checkpoint effectiveness. This overarching framework will encapsulate the various nuances of checkpoint performance with a variety of measures and models. The team will finalize analytical procedures and tools that will help CBP in evaluating the utility of checkpoints in effectively dealing with various illegal activities such as drug smuggling, human trafficking, etc. In addition, these intuitive measures will help CBP in easily communicating the effectiveness and utility of checkpoints to the general public and lawmakers. During this phase, we will also finalize a checkpoint data oversight protocol. This protocol will outline best practices for ensuring and evaluating data integrity and consistency at CBP. This oversight protocol will result in consistent performance measures that can be compared across checkpoints and time. A final report and presentation for this phase will be delivered in YR 5.

**Phase V: Managerial Tool**
We will leverage the performance measures and models from Phase IV and the insights gained from site visits to finalize the final prototype of a managerial/simulation tool that will aid Border Patrol agents in operations planning, information analyses, trend analyses and resource allocation. The tools will be user-friendly in terms of transition, training and actual use. The tools will be delivered in YR 5.

**Methodology**

Based on the final report for the site visits, final data analysis will focus on completing and presenting the project’s objectives and deliverables, e.g., data integrity, metrics, resources and types of checkpoints for modeling. From the checkpoint visit detailed observations, we will finalize our documentation and validate checkpoint operations to understand where data integrity checks would be appropriate. We have compared the processes at the different checkpoints to identify inconsistencies and will provide recommendations on how to ensure data integrity and consistency. We will provide a final report of preemptive and evaluating recommendations that OBP can use to improve data oversight protocols.

We will also finalize our analysis of the various purposes of checkpoints and how current and proposed measures help evaluate these purposes. This will be accomplished by presenting intermediate results to OBP stakeholders in order to receive feedback and refine our recommendations for the final project deliverable. Our final report will include a definition of what it means for a checkpoint to be effective, the different goals of operating checkpoints, and how to evaluate checkpoints for effectiveness based on those specific goals.
To finalize our efforts for Phase III (Community impacts), we will conduct the final analyses on quantitative and qualitative data for several local communities near the I-19 checkpoint. The data collected is related to events surrounding or concerns about illegal immigrants/smuggling. The data for the quantitative categories are: local 911 calls, local calls to the Border Patrol hot line, school lockdowns, high-speed chases, changes in both residential and commercial real estate values, the number of media reports on violence in the border region, and the number of statements by public officials about dangers in the border region. For the qualitative categories, we will conduct the final analysis on data from meetings with Tucson resort owners, and from community officials, chambers of commerce representatives, and key stakeholders in the checkpoint region. Judy Gans, Program Manager for Immigration Policy at the Udall Center for Studies in Public Policy, and her graduate intern will be conducting the final analysis of the data.

The Office of Border Patrol provided us with sanitized data from E3, BPETS, and CAR systems to aid in the creation of metrics and models of checkpoint effectiveness. Based on historical checkpoint data, we will finalize deliverables including advanced statistical, machine learning, and data mining techniques to develop metrics and models assessing checkpoint operations and their impact/effectiveness. The final analysis will be completed in Year 5.

Using the data from OBP, we will refine and present visualization tools that can be used to discover historic patterns of illegal traffic, apprehensions, and seizures. A taxonomy, or categorization, of checkpoints will be finalized and presented to OBP stakeholders.

**Student Involvement**

Under the guidance of the principal investigators, both undergraduate and graduate students will be involved in all steps of the projects proposed in this work plan. At least 15 students at the University of Arizona will be involved in this project in some way.

**Transition Strategy**

A prototype of the managerial and/or simulation tools developed for evaluating checkpoint effectiveness will be demonstrated and provided to Border Patrol.

**YR 5 Milestones**

The data requested from CBP for this project was received during YR 4. Researchers on this project have been working to process and analyze the data and a final analysis of the data will be completed during YR 5. Furthermore, a final report including all of the specified deliverables for this project will be compiled and prepared jointly with UTEP. Finally, the prototype of the management/simulation tool will be presented to and handed off to OBP.
Table 6: YR 5 Milestones

<table>
<thead>
<tr>
<th>Task</th>
<th>YR 5 Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Analyses: Final analyses of data</td>
</tr>
<tr>
<td>C</td>
<td>Transition: A final prototype of the management/simulation tool will be transitioned to OBP</td>
</tr>
</tbody>
</table>

**Metrics**

This supplemental project will be judged based on the quality of the final report to Office of Border Patrol.
Background

In order to develop a coherent immigration and border security research agenda, and to make its immigration research portfolio more relevant to DHS stakeholders, BORDERS will convene an immigration workshop that brings together DHS stakeholders and leading immigration researchers. The goal is to build a research agenda based on the new realities confronting DHS and develop new projects for the Center. Based on our partner base and extended network, we have defined our expertise as “Immigration Enforcement, Policy and Population Dynamics.

This workshop will be held on October 10-11, 2012, at Georgetown University’s Institute for the Study of International Migration. It will bring together DHS stakeholders and immigration researchers to identify the top priorities in immigration research today. This “by invitation only” workshop will be open to select academics who will work closely with stakeholders to identify the critical challenges that DHS faces and the ways BORDERS’ network of researchers can address these issues through new research projects.

Objectives

The objective of this workshop is to bring DHS stakeholders together with world class immigration scholars to share operational requirements. Selected academics (4) will be asked to present the state of current research in their area of expertise (honorarium and travel costs provided). Through a facilitated session, participants will identify the top research questions to be issued in a Request for Proposals by BORDERS in late 2012. The received proposals will be reviewed by a panel of experts and the awards will announced in early 2013.

The outcome for this workshop will be the identification of explicit agreed upon topics in immigration research that will guide BORDERS in issuing a call for proposals for new projects.

Workshop Program

Below is a draft agenda for the 1.5 day workshop. Speakers and participants have not yet been invited or confirmed.
### Table 7: Proposed Agenda, Immigration Workshop

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 – 9:30am</td>
<td>Opening remarks – Alan Bersin, DHS Assistant Secretary of International Affairs</td>
</tr>
<tr>
<td>9:30-10:15am</td>
<td>DHS stakeholders – Tiffany Lightbourn, Chief of Research &amp; Evaluation: U.S. Citizenship and Immigration Services</td>
</tr>
<tr>
<td>10:15-10:30am</td>
<td>Break</td>
</tr>
<tr>
<td>10:30-11:15am</td>
<td>Michael Hoefer, Director: Office of Immigration Statistics</td>
</tr>
<tr>
<td>11:15-12:00pm</td>
<td>ICE Policy - TBD</td>
</tr>
<tr>
<td>12:00-1:00pm</td>
<td>Lunch</td>
</tr>
<tr>
<td>1:00-1:45pm</td>
<td>US – VISIT - TBD</td>
</tr>
<tr>
<td>1:45-2:30pm</td>
<td>Researcher 1 (TBD): Population Dynamics</td>
</tr>
<tr>
<td>2:30-2:45pm</td>
<td>Break</td>
</tr>
<tr>
<td>2:45-3:30pm</td>
<td>Researcher 2 (TBD): Immigration Enforcement</td>
</tr>
<tr>
<td>3:30-4:15pm</td>
<td>Researcher 3 (TBD) : Immigration Policy</td>
</tr>
<tr>
<td>4:15-5:00pm</td>
<td>Researcher 4 (TBD) : U.S.–Mexico and U.S.-Canada Policy</td>
</tr>
<tr>
<td>9:00-10:15am</td>
<td>Facilitated discussion: where are the gaps in the research? What new needs have DHS stakeholders identified?</td>
</tr>
<tr>
<td>10:15 -10:30am</td>
<td>Break</td>
</tr>
<tr>
<td>10:30-11:45</td>
<td>Break-out groups – by research areas to formulate new research questions</td>
</tr>
<tr>
<td>11:45-1:00pm</td>
<td>Group discussion on research questions; announcement of RFP</td>
</tr>
</tbody>
</table>

### Potential Participants in Immigration Workshop

**DHS Stakeholders**
- Michael Hoefer – OIS
- Tiffany Lightbourn – USCIS
- CBP - TBD
U.S. Scholars
Participants may be chosen from the list below:

Demographers
- Frank Bean, University of California Irvine (demography/immigration statistics): A widely recognized leading expert on demographic trends and border issues
- Jeffrey Passel, Pew Hispanic Center (demography/immigration statistics): Generates the most reliable estimates of undocumented migration
- Philip Martin – University of California, Davis
- Guillermina Jasso, New York University
- Agustín Escobar Latapí – CIESAS
- Fernando Riosmena - University of Colorado - Boulder

Economists
- Gordon Hanson, University of California San Diego (economics): Leading Mexican migration expert, subcontracted research project with DHS
- Philip Martin, University of California Davis (rural economics): Labor migration specialist with comparative and US expertise on unauthorized work
- Pia Orrenius, Federal Reserve, Dallas (economics): Generalist on impact of immigration, recent book and its recommendations influential
- Giovanni Peri, University of California Davis (economics): Recent leader on workforce impacts, argues immigrants are natural "complements"
- George Borjas, Harvard University (Kennedy School, economics): Pioneer in the field, holds traditional proposition that increased supply lowers wages
- Richard Freeman, Harvard University (economics), Dir. Labor Studies Program, NBER: Globalization militates against worker shortages, places downward pressure on wages
- Jeffrey Williamson, Harvard University (economics): Leading scholar on historical trends in economic migration
- Anna Maria Mayda, Georgetown University (economics): Public opinion/lobbying
- Bryan Roberts, Nathan Associates, (economics): Recent work on the return of Mexicans to Mexico

Sociologists
- Douglas Massey, Princeton University (sociologist): Pioneer in Mexico surveys, critical of enforcement, argues migration has stopped
- Nestor Rodriguez, University of Texas Austin (sociologist): Interests include Guatemalan migration, removals, unaccompanied minors, and the ethical and human rights issues of border enforcement.
- Jacqueline Hagan, University of North Carolina at Chapel Hill (sociologist): Collaborators with Rodriguez on enforcement/removals, novel research on return, skills
Policy and legal experts

- David Martin, University of Virginia (law): Former DHS General Counsel and noted authority on immigration law
- Marc Rosenblum, Congressional Research Service (political science): Congressional experience, has worked on E-Verify and other enforcement issues
- Muzaffar Chishti, Migration Policy Institute and NYU School of Law (law): State and local enforcement, profiling, security and immigration
- Hamutal Bernstein, German Marshall Fund (political science): Public opinion and state and local policies on integration of immigrants
- Doris Meissner, Migration Policy Institute: former Commissioner of the US Immigration and Naturalization Service (INS), currently directs MPI’s US immigration policy work
- Randy Capps, Migration Policy Institute: areas of expertise include immigration trends, the unauthorized population, immigrants in the US labor force, and children of immigrants
- Michael Fix, Migration Policy Institute: immigrant integration, citizenship policy, immigrant children and families, the education of immigrant students, the effect of welfare reform on immigrants, and the impact of immigrants on the US labor force.
- Louis DiSipio, University of California, Irvine

Statistical experts

- Elizabeth Grieco, Dir. Foreign-Born Population, US Census (demography/immigration statistics): Familiar with wide range of data, former DHS statistician
- Joseph Chamie or Hania Zlotnik,Dirs. (former) UN Population Division or Bela Hovy, UNPD: (demography/immigration) - Hovy is not as familiar with US data, but all are excellent on global trends
- Jean-Christophe Dumont, Dir. or Georges Lemaître, Division for International Migration, OECD: Leading experts on US and international data and immigration trends (esp. unauthorized)

U.S. - Mexico Scholars

- Carla Pederzini, Universidad Iberoamericana (demography): Expert in migration trends
- Wayne Cornelius – University of California San Diego
- David Fitzgerald – University of California San Diego
- Manuel García y Griego – University of New Mexico
- Someone from INM e.g. Salvador Berumen Sandoval
- Víctor Aurelio Zúñiga García (Universidad de Monterrey)
- Silivia Nunez/ Monica Campos/ Elaine Levine – CISAN
U.S. – Canada Scholars
- Deborah W. Meyers, Director of Canadian Affairs at DHS Office of Policy

Criminal Justice
- Charles Katz, Assistant Professor Arizona State University: Studies gangs and the response to gangs in the United States, Caribbean, and Central America
- Kitty Calavita – University of California, Irvine

Milestones

<table>
<thead>
<tr>
<th>Sub-task</th>
<th>Milestones</th>
<th>Schedule (by month 2012-2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.</td>
<td>Invitations</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Workshop preparations</td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Workshop</td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>Request for Proposals</td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>Proposal Review</td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>Proposals Selected</td>
<td></td>
</tr>
</tbody>
</table>
Project Abstract

Immigration processes and policies continue to be the subject of much political and scientific debate. While immigration now accounts for one-third of U.S. population growth, the U.S. has never had a nationally representative survey of immigrants and their children. In perhaps no other area of public policy is there such a large gap between information needs and existing data. The New Immigrant Survey’s (NIS), a longitudinal study partially funded by the Department of Homeland Security and the Department of Health and Human Services, was developed to examine these issues. Its main objective is to provide a public use database on new legal immigrants to the United States and their children that will be useful for addressing scientific and policy questions about migration behavior and the impacts of migration.

This project will use this database to support statistical and quantitative analyses on immigration and its impacts. In addition, it will provide research that compares the NIS with comparable major U.S. longitudinal surveys, thus facilitating comparisons of immigrants and the native-born. This will be accomplished by funding accomplished immigration researchers through a competitive award process, administered by BORDERS.

Significance to DHS

The United States Citizen and Immigration Service (USCIS) is concerned with better understanding the path to citizenship for newcomers to the U.S. This project, funded through the Office of Policy and Strategy’s Research and Evaluation Division at USCIS, will provide the agency with new data and analysis that sheds light on this area of research. A better understanding of the path to citizenship for legal immigrants to the U.S. will provide critical insights into a population that accounts for one-third of our nation’s growth.

Research Description

Little is known about the origins of legal immigrants, other than their countries of birth or last residence. We currently know little about their pre-immigration labor market experiences and the ability of immigrants to translate those experiences into labor market success in this country. A key to a more coherent picture of the American migration experience is knowing why immigrants choose to migrate to the U.S. and the factors that make this decision permanent or temporary. We also need a better understanding of the factors affecting the assimilation of immigrants and their children.
Through this project, we will enlist leading and promising researchers to utilize this data in statistical and quantitative analyses of immigration. Four awards will be given based on the innovativeness and quality of the proposed research and use of NIS data, including faculty awards of $30,000 each and young researcher awards (postdoctoral fellows or doctoral students) awards of $12,000 each. Examination of the transition from temporary to permanent citizenship will assist USCIS in addressing important scientific and policy questions about migration behavior and the impacts of migration. The research findings of this project, therefore, will provide a clearer understanding of this critical gap in data that influences U.S. immigration policy.

In Year 4, BORDERS announced 2 faculty and 3 young researcher awards. The remaining funding, approximately $72,000, will be awarded in Year 5.

Methodology

Awards and Eligibility
This peer-reviewed competition is open to researchers in any social science or social science-related department in the U.S. The Request for Proposals (RFP) will be distributed to individuals and institutions identified by BORDERS and USCIS including researchers, academic departments, immigration listervs, professional organizations and conferences, think tanks, etc.

Award Criteria
Research must focus on one (or more) of the following proposed research areas:

1. Citizenship. Examine the transition from temporary to permanent citizenship, including the process of finding a home and becoming financially successful;

2. Integration. Evaluate the integration of immigrants in the American society, as well as their children;

3. Families. Assess the differences that occur within immigrant lifestyles pre- and post-immigration, and how social networks of families serve as support, as well as the eventual role of family reunification in the immigrant experience;

4. Surveys. Compare the NIS survey instruments with comparable instruments used in the major U.S. longitudinal surveys, thus facilitating comparisons of immigrants and the native-born.

5. Economics. Evaluate employment situations, labor force participation, occupational attainment, income determination and/or social assimilation of immigrants either prior to their arrival in the United States. Compare employment and wage differences between native citizens and immigrants.

Application Package

Interested applicants should submit the following application materials:

Identify research area addressed (1-4 in above section)

- Proposal (5 page limit, 12 point, Times New Roman font, single spaced, 1 inch margins) including:
  - Abstract (250 words)
  - Overview and Research Objectives
  - Contribution to the Field
• Methodology
• Applied Relevance and Significance
• Two letters of recommendation
• Budget and budget justification
• CV (2-page NSF style, including 5 most relevant publications)

Award Recipient Requirements (through funding)
• Produce a research report and/or publication
• Produce a research brief for policymakers
• Present findings to DHS sponsors in Washington, DC or present at a BORDERS meeting in Tucson, AZ

Student Involvement
The award will be open to young researchers (postdoctoral fellows or doctoral students) as well as faculty. This will give up-and-coming student researchers the opportunity to conduct important immigration research using the NIS database.

Transition Strategy
At the end of the performance period, the policy briefs will be circulated to UCSIS, the stakeholder.

YR 5 Milestones
In the fall of 2012, BORDERS will once again put out a call-for-proposals. The process was extremely successful for the issuance of the 2012 awards, and we will accordingly follow the same timetable as the 2012 BORDERS Awards in Immigration Research.

<table>
<thead>
<tr>
<th>Subtask</th>
<th>Deliverables</th>
<th>Schedule (month)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Jun-12</td>
</tr>
<tr>
<td>a</td>
<td>Identify target audience for RFP distribution</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Announcement/RFP distribution</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Establish peer review committee and process</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Submissions due</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Peer review</td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Recipients selected</td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>Awards announced</td>
<td></td>
</tr>
</tbody>
</table>
Metrics

This supplemental project’s success will be judged by the quality of the applications that the Request for Proposal generates, and the ensuing research produced by the NIS data.
Project Abstract

The Legal Arizona Workers Act requires all employers in Arizona to use E-Verify to screen newly hired employees. This law has been in effect since January 1, 2008, yet as of July 2010, only a fraction of Arizona employers had enrolled and only a fraction of new hires had been screened with E-Verify. Using data from the USCIS transactions database, this project proposes to examine the profile of companies using E-Verify in two states: Arizona where its use is mandated by state law, and Nevada where no such requirement exists in state law. The proposal is in two phases. Phase I is to be completed in year one of the effort and would inform implementation of Phase II in a subsequent year. Both are included here for completeness, although a budget and concrete plan for Phase II cannot yet be developed as these depend on the findings of Phase I.

Phase I

Phase I of this project is to develop a profile of employers in Arizona that have enrolled in E-Verify in order to identify whether there is a pattern of enrollment by NAICS industry code, size as measured by number of workers, and/or size as measured by dollar volume of sales. Information on the industry and size of Arizona employers that have enrolled in E-Verify would, at the same time, generate information on the industry and size of employers that have not enrolled in E-Verify in spite of a legal requirement to do so. The same data will be analyzed for Nevada as a control state in order to develop a profile, by NAICS industry code and size, of employers who choose to use E-Verify absent a legal requirement to do so.

In addition to examining extent of enrollment, as outlined above, this project proposes to examine intensity of use of E-Verify by companies in Arizona and Nevada once they have enrolled in the program. Company data, aggregated by NAICS code, on the average number of E-Verify screenings per month would be compared with Bureau of Labor Statistics data on monthly employment by NAICS code for Arizona and Nevada in order to see how well they track.

Significance to DHS

This research is important to the administrators of the E-Verify system in that it will identify possible needed areas of improvement in the E-Verify system in the face of increased mandatory use. The research will provide information on company attributes associated with limited enrollment in E-Verify across industry types and size of employer, and explore possible steps than might address those factors. These continued improvements to the E-Verify system are important input to policy discussions of immigration reform relating to the impacts on industries, employers, and individual workers of electronic verification at the worksite and the role of electronic verification of authorization to work as part of worksite-focused immigration enforcement.
Research Description

This project would work with data provided by USCIS on company E-Verify enrollment in Arizona and Nevada including company name, NAICS code, date of enrollment, and number of E-Verify screenings per month from time of enrollment to the present. These company names and NAICS codes would be cross-referenced with state and private data sources such as Dunn and Bradstreet to determine company size, verify its industry code, and profile the number and size of other employers in a given NAICS code in each state. Aggregating within NAICS codes for each state, trends in the number of monthly E-Verify screenings would be compared to trends in monthly employment data from the Bureau of Labor Statistics in order to measure the extent of their correlation.

Once the analysis is completed, the project team will meet with appropriate representatives from USCIS and other stakeholders within DHS to determine whether Phase II should be undertaken and to specifically define the questions to be addressed in Phase II.

Methodology

This project would work with data provided by USCIS on company E-Verify enrollment in Arizona and Nevada including company name, NAICS code, date of enrollment, and number of E-Verify screenings per month from time of enrollment to the present. These company names and NAICS codes would be cross-referenced with state and private data sources such as Dunn and Bradstreet to determine company size, verify its industry code, and profile the number and size of other employers in a given NAICS code in each state. Aggregating within NAICS codes for each state, trends in the number of monthly E-Verify screenings would be compared to trends in monthly employment data from the Bureau of Labor Statistics in order to measure the extent of their correlation.

Once the analysis is completed, the project team will meet with appropriate representatives from USCIS and other stakeholders within DHS to determine whether Phase II should be undertaken and to specifically define the questions to be addressed in Phase II.

Student Involvement

Student research assistants will be involved in working with the PI to collect and analyze data and summarize findings in a written report.

Transition Strategy

A written report of results will be prepared along with a PowerPoint presentation for each state for use by USCIS to present the results of the study.
YR 5 Milestones

The Year 4 milestones for this project as laid out in the original project proposal are listed below. USCIS has not yet provided us with the data from the transactions database on E-Verify use in Arizona and Nevada. As soon as we receive this data, we will perform statistical analysis of that data.

Meanwhile, we are assembling the relevant company employment data listed in Tasks B, C, and D on Arizona and Nevada from the Bureau of Labor Statistics and other sources. A status report on data assembly and analysis will be submitted to BORDERS by June 30, 2011.

<table>
<thead>
<tr>
<th>Task</th>
<th>YR 5 Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Collect data from USCIS on company enrollment in E-Verify for Arizona and Nevada including company name and NAICS code;</td>
</tr>
<tr>
<td>B</td>
<td>Cross reference USCIS company information with Dunn and Bradstreet and other data sources in order to identify company size as measured by revenue and number of employees;</td>
</tr>
<tr>
<td>C</td>
<td>Using Dunn and Bradstreet and other data sources, identify the number of companies in Arizona and Nevada by NAICS code and size;</td>
</tr>
<tr>
<td>D</td>
<td>Gather relevant employment data from Bureau of Labor Statistics for Arizona and Nevada</td>
</tr>
<tr>
<td>E</td>
<td>Perform statistical analysis on data items A, B, C, and D</td>
</tr>
<tr>
<td>F</td>
<td>Prepare written report and PowerPoint presentation for each state of results</td>
</tr>
<tr>
<td>G</td>
<td>Meet with USCIS and other DHS stakeholders to discuss results, determine whether Phase II is to be undertaken, and specifically identify the research questions to be addressed in Phase II.</td>
</tr>
</tbody>
</table>

Metrics

This supplemental project will be judged based on the quality of the final report submitted to USCIS.
Post-apprehension Survey of Illegal Immigrants

Elyse Golob & Jay Nunamaker – University of Arizona
dgolob@borders.arizona.edu, jnunamaker@borders.arizona.edu

Project Abstract

The Post Apprehension Survey project has been initiated by the DHS Office of Policy/Office of Immigration Statistics (OIS) in develop more accurate estimates of both the annual flow and the probability of apprehension of illegal immigrants along the southwest land border illegally. These measures will be quantifiable, objective, and consistent across all involved locations. Furthermore, our objective is to develop and implement surveys that minimize the data collection burden on personnel from different agencies (i.e., the US Border Patrol and other components of US Customs and Border Protection (CBP), and Immigration and Customs Enforcement (ICE) who would be involved in the post-apprehension data collection.

Significance to DHS

Despite significant efforts, the total number of aliens who attempt to cross the border is unknown. This project will assist the DHS Office of Policy/OIS in developing more accurate estimates of both the annual flow and the probability of apprehension of illegal immigrants. In the short term, the BORDERS center will draw on their methodological and border expertise and decades of experience in survey building to assist DHS in developing a quality post-apprehension survey of illegal immigrants. As a long term goal, this survey will help to create a more standardize sampling model that may be used going forward to effectively estimate a variety of phenomena of interest.

Research Description

The Post Apprehension Survey project is divided into six phases:

**Phase 1 – Conduct stakeholder interviews (Complete)**
Interviews were conducted with stakeholders from Customs and Border Protection (OBP and OFO), ICE and OIS.

**Phase 2 – Develop sampling plan and questionnaire (In Progress)**
Based on the information gathered in phase one, a preliminary sampling plan and survey was developed. Based on continuing discussing with CBP and OIS, the survey has gone through several rounds of refinement and is nearing completion. To bring phase 2 to a conclusion, the survey will be translated into plain “street” Spanish by translators hired by the University of Arizona.

**Phase 3 – Conduct field test of survey and finalize sampling plan**
During phase three, approximately fifty apprehended illegal aliens will be interviewed by Spanish speaking interviewers hired by the University of Arizona. The results of phase three will help to identify both logistical issues as well as problems with survey items, if any. As a deliverable from phase three, we will construct a finalized survey and sampling plan.
Phase 4 – Survey data collection
Primary data collection is scheduled to begin near the each of Q2 2012. During this phase, we will use the revised survey and sampling plan devised in phase three to conduct interviews of 500-1,000 apprehended illegal aliens. This data will be aggregated and analyzed by researchers at the University of Arizona.

Phase 5 – Preliminary report of findings
The data collected in phase four will be summarized by researchers from the University of Arizona and shared with interested parties at CBP and OIS. Leveraging our shared expertise, we will identify areas of interest to be further analyzed and summarized in the final report.

Phase 6 – Final report and recommendations
As the final deliverable, a report summarizing the results, methodology, and recommendations of the study will be provided to DHS.

Methodology
This study will draw on the Center’s significant experience in survey research. The research team is currently in the process of developing a survey alongside representatives from CBP and OIS.

Once the initial survey and sampling method are finalized, a field test surveying approximately fifty apprehended illegal aliens will be conducted. At the conclusion of the field test, researchers will reconvene with CBP and OIS to review the results and make necessary adjustments to the sampling plan and survey items.

Primary data collection will begin around the end of Q2 2012. During primary data collection, 500-1,000 apprehended illegal aliens will be surveyed. The results will be aggregated and analyzed and a final report prepared for presentation to DHS.

Student Involvement
Doctoral students from the University of Arizona will be involved heavily in crafting the survey and analyzing the results. Additional graduate students from the University of Arizona are being sought to act as Spanish speaking interviewers.

Transition Strategy
The final product from this project will be a report that will be provided to DHS. In this report, we will summarize our findings as well as the methodology used so it may be considered for expansion to other sites on a recurring basis.
YR 5 Milestones

Year 5 deliverables for the Post Apprehension Survey of Illegal Immigrants project include completion of preliminary survey and sampling methods, a field test, completion of primary data gathering, and a final report summarizing our findings and recommendations.

Table 10: YR 5 Milestones

<table>
<thead>
<tr>
<th>Task</th>
<th>YR5 Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Finalization of survey items and sampling method</td>
</tr>
<tr>
<td>B</td>
<td>Completion of field test</td>
</tr>
<tr>
<td>C</td>
<td>Completion of primary data gathering</td>
</tr>
<tr>
<td>D</td>
<td>Presentation of final report and recommendations</td>
</tr>
</tbody>
</table>
Appendix A: BORDERS Engagement Plan

Jay Nunamaker & Elyse Golob – University of Arizona
jnunamaker@borders.arizona.edu, egolob@borders.arizona.edu

Goal of Engagement Plan

This engagement plan details BORDERS’ efforts to improve the relevance of the Center’s activities to its stakeholders and ensure that we meet the following 3 overarching goals:

- Become a national resource for border security and immigration research
- Transition our research products and prototypes into the field and commercial market
- Become financially self-sufficient beyond the seed funding provided by the Office of University Programs

To achieve these goals, we will implement specific plans to more closely integrate our Center’s research with the needs of its stakeholders.

BORDERS Approach to Engagement

Our Engagement Plan approach is based on the following strategic objective: to better understand the requirements and challenges of our stakeholders. A key element of sustaining and embedding an innovative project is to communicate with stakeholders effectively and to understand their program’s challenges and needs as early on as possible. Understanding our stakeholder’s challenges will allow us to tailor our research to the specific needs of DHS.

It is therefore critical to identify what each stakeholder group wants to achieve and to ensure that our research products are adapted by stakeholders in the short, medium and long term. At the same time, we recognize that due to limited financial and personnel resources, we have to carefully balance the articulated needs from different stakeholders.

Definitions

**Engagement**

Engagement is one form of stakeholder relations along a spectrum of possible interactions that include activities such as monitoring developments, message delivery, media outreach, educating/informing and collaborating (see Figure 1). Through stakeholder engagement, the Center initiates open, two-way dialogue seeking understanding and solutions to issues of mutual concern.

The desired outcome is to understand user needs and outcomes and develop ideas that benefit both the stakeholder and the Center’s research portfolio. It should also provide significant opportunities to further align research with governmental needs and expectations to help drive long-term sustainable return on investment.

**Stakeholder Relations Continuum**
**Stakeholders**
We define a *stakeholder* as the source of user needs/outcomes and the recipient of research outputs conducted by the Center. A stakeholder can be an agency or entity that is affected by the Center’s activities, or has an effect on our projects. They include federal, state and local agency leaders and operational personnel; legislators, community leaders, academics, industry, and the general public. While we consider all stakeholders important, their prioritization may change depending on the specific project and factors such as influence, knowledge, credibility and legitimacy.

**Strategy, Plan and Process**
A *strategy* is a carefully devised course to move from where we are now (A) to where we want to be (B). BORDERS strategic goals are threefold, and are listed above.

A *plan* is how we will move from (A) to (B), i.e., achieve our strategic goals in a manner that provides an acceptable balance of risk and reward.

A **process**, in contrast, is a defined way of doing a task. It can be a linear in nature – do A, then do B, then do C – or it can have branches – do A, then B, and then C or D depending on the outcome.

**University Program Support**
Since stakeholder engagement involves time, resources and commitment, a commensurate level of support is required from The Office of University Program, as well as supplemental funding from stakeholders for directed research. Without this support, efforts will be inadequate or wasted, despite the best intentions of the Center leadership. In addition, a lack of support (and the resulting inability to significantly engage) may result in stakeholders becoming distrustful of the Center which can severely damage our overall efforts.

**Plans and Processes for Increased Engagement with DHS Headquarters**

**Stakeholder Prioritization**
Stakeholder prioritization is one of the fundamental building blocks of our engagement plan. To most effectively utilize our core competencies and expertise to benefit DHS, we have identified our top 3 targeted stakeholders as:

- CBP/ICE: US-VISIT
- ICE: Secure Communities
- Secretary’s Office: Blue Campaign
Quarterly Visits to Targeted Stakeholders
BORDERS Executive Director, Elyse Golob, will plan to visit Washington, DC on a quarterly basis in order to meet with program officers and build relationships with the stakeholders identified above, in addition to developing an in-depth understanding of their current needs and challenges.

Outcomes
The expected outcome from our engagement plan will be 3 short research proposals per program (total: 9 proposals). The end-goal for these proposals will be developing new projects for follow-on funding through BOAs.