

# **BTI** Institute

**Borders • Trade • Immigration**

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A Department of Homeland Security Center of Excellence

**Borders, Trade and Immigration Institute**

**Work Plan – Year 4**

**21 August 2018  
APPROVED**

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# 1. INTRODUCTION

This document describes the work plan for the Borders, Trade, and Immigration (BTI) Institute, a Department of Homeland Security (DHS) Center of Excellence (COE), led by the University of Houston (UH), for Budget Period IV (7/1/2018 – 6/30/2019). The work plan will focus on those efforts that are funded through a Cooperative Agreement (2015-ST-061-BSH001) awarded by DHS Science and Technology (S&T) Office of University Programs (OUP). This plan details our activities to include research and education, personnel, including our core staff, our advisory group, transition and communication efforts, and our work groups and councils that enable the BTI Institute to fulfil our mission. Additionally, this document details the Institute’s management efforts and key areas of emphasis. A plan for execution of each project with detailed work plans and budget information is also included.

Taking into context the results of the BTI Institute’s Biennial Review, the BTI Institute has developed an Engagement Strategic Plan (separate document) to address recommendations and/or suggestions from the Biennial Review Summary Report. This Strategic Plan will be added as an addendum to the Year 4 Work Plan on a later date, and a copy provided to the S&T Program Manager, Office of University Programs.

## 1.A. Background

The BTI Institute was established as a COE by DHS S&T OUP in July of 2015 with UH designated as the lead university. The Institute has grown the consortium to include researchers from 16 universities, one industry partner, and one non-profit think tank partner.

The Institute was specifically funded to “conduct research and education to enhance the nation’s ability to support DHS and other agencies’ border security and immigration mission goals, including securing the border; facilitating lawful international trade and travel; effectively enforcing our immigration and customs laws; granting immigration and citizenship benefits; promoting an awareness and understanding of citizenship; and ensuring the integrity of our immigration system.”<sup>1</sup> The overarching goal of the Institute is to “address the nation’s challenges as they relate to border control, customs, trade and travel facilitation, security and enforcement.”<sup>2</sup>

## 1.B. Mission

The BTI Institute’s mission is to conduct research, develop innovative solutions, and provide educational materials to enhance the nation’s ability to secure our borders, facilitate legitimate trade and travel, and ensure the integrity of our immigration system.

Through a multi-disciplinary team of national and international experts, the BTI Institute will deliver transformational technology-driven solutions, data-informed approaches, and professional development and education opportunities for today’s Homeland Security

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<sup>1</sup> FOA Number [DHS-14-ST-061-COE-002A](#), p. 10

<sup>2</sup> FOA Number [DHS-14-ST-061-COE-002A](#), p. 11

Enterprise, and trans-disciplinary education for the next generation of homeland security experts.

## **1.C. Vision**

The BTI Institute's vision is to strengthen homeland security, social, and economic development as a world leader in research and education for transnational flows.

## **1.D. Research and Education Themes**

### **1.D.I. Research Themes**

**THEME 1.** Enhance the U.S. Border Management Operations

- Promote International Partnerships for Prevention, Deterrence and Facilitation
- Improve the ability to prevent, deter, and counter the illegal activities of Transnational Criminal Organizations (TCOs)
- Improve the safety, efficiency and operational effectiveness of U.S. Border Operations

**THEME 2.** Enhance the Ability to Secure and Facilitate Transnational Flows of People

- Promote Prevention and Deterrence of Unauthorized Transnational Flows of People
- Facilitate Legitimate Travel

**THEME 3.** Enhance the Ability to Secure and Facilitate Transnational Flows of Goods

- Promote Deterrence of Unauthorized Transnational Flows of Goods
- Facilitate Legitimate Trade

**THEME 4:** Enhance the Ability to Promote the Integrity of the Immigration System within the U.S. Border

- Improve the understanding of the characteristics of the immigrant population in the U.S
- Improve the understanding of economic and societal impact of the immigrant population in the U.S
- Promote best practices in the administration of immigration
- Promote Immigrant Integration

**THEME 5:** Enhance the Ability to Secure and Facilitate Transnational Flows of Data and Financial Capital

- Promote Prevention and Deterrence of Unauthorized Transnational Flows of Data and Financial Capital
- Facilitate Transnational Flows of Data and Financial Capital

### **1.D.II. Education Themes**

**THEME 1:** HSE Education

**THEME 2:** HSE Training

**THEME 3:** HSE Professional Development

## **1.E. Personnel**

The BTI Institute core personnel comprises its Director and six full-time staff members whose effort is partially supported by OUP funding.

### **1.E.I. Director/PI: Anthony Ambler, Dean, College of Technology**

As a senior member of the leadership team at the University of Houston, Dean Ambler has direct access to the most senior administrators and leadership of the University to assure timely allocation of resources to support the BTI Institute activities.

The Director has overall technical and operational responsibility for this award, and is an ex-officio member the BTI Institute's Research Committee. The Director actively engages DHS leadership, provides presentations, reports, and periodic updates to agency leadership. The Director builds close professional relationships with executives and senior representatives from the following component Agencies: Customs and Border Protection, Immigration and Customs Enforcement, U.S. Citizenship and Immigration Services, DHS Office of Policy, and other Homeland Security enterprise stakeholders.

The Director is responsible for everything that occurs or fails to occur in ensuring the successful outcome of research and educational projects. The Director will participate in project kick-off meetings, monitor and oversee project progress, assist in the engagement of project champions, as well as review work plans and milestones, transition plans, progress reports, and annual reports. The Director will provide timely guidance and facilitate the support of BTI Institute staff and partner institutions to ensure an appropriate mix of interdisciplinary skill sets and partners to ensure the success of the research project.

### **1.E.II. Core Staff**

#### **1.E.II.a. Executive Director: Kurt L. Berens**

The BTI Institute's Executive Director oversees the planning and administration of the Institute according to the strategic direction set by the Director of the BTI Institute. The Executive Director oversees, coordinates, and implements management activities related to: annual work plan development, execution, and reporting and annual report preparation. He also manages the Institute's process for selecting and awarding new partners. The Executive Director assists the Research Committee in project management. The Executive Director also oversees the strategic engagement of DHS operational components, both at the leadership and field levels. To this effect, he cultivates and maintains communication channels to aid the Director in identifying and planning appropriate projects that address component needs. The Executive Director also provides weekly updates to PM OUP on current projects, new initiatives, and emerging issues and opportunities.

The Executive Director is responsible for creating and implementing a quarterly Action Plan integrating monthly key high-level tasks and anticipated monthly outcomes across BTI functional areas (Research, Education, Communication, and Transition). The execution of this plan will be discussed with the OUP Program Manager during weekly meetings and focus on the progress the leadership is making to accomplish the tasks and outcomes over the program year and any obstacles that may arise.

<b>Executive Director Projected Division of Effort – Y4 Work Plan</b>		
<b>%</b>	<b>Activity</b>	<b>Notes</b>
60%	Administration & Execution <ul style="list-style-type: none"> <li>- Quarterly Action Plan</li> <li>- Reporting</li> <li>- FY5 Core Work Plan Development</li> <li>- FY4 Annual Report</li> <li>- OUP Data call</li> <li>- Budget</li> </ul>	
10%	Research & Development <ul style="list-style-type: none"> <li>- PI meeting and Showcase</li> <li>- BOA project(s) initiation and execution</li> </ul>	
10%	Education & Training <ul style="list-style-type: none"> <li>- TBD</li> </ul>	
10%	Customer Outreach & Communication <ul style="list-style-type: none"> <li>- DHS Outreach</li> <li>- Engagement</li> <li>- Strategic Partnerships</li> </ul>	
10%	Transition	

**1.E.II.b. Project Manager, Education and Workforce Development: TBN1**

The Project Manager for Education and Workforce Development develops and manages education and workforce development activities, such as Internships, Summer Research Visitor Teams, and Brown Bag sessions and regularly scheduled or special meetings.

<b>Project Manager, Education and Workforce Development Projected Division of Effort – Y4 Work Plan</b>		
<b>%</b>	<b>Activity</b>	<b>Notes</b>
10%	Administration & Execution <ul style="list-style-type: none"> <li>-Support Director, Executive Director activities</li> </ul>	
5%	Research & Development <ul style="list-style-type: none"> <li>-PI Meeting and Showcase</li> </ul>	
70%	Education & Training <ul style="list-style-type: none"> <li>-Service Academy Cadet internships</li> <li>-Summer MSI Research Teams</li> </ul>	
10%	Communications <ul style="list-style-type: none"> <li>-Assist Manager, Communications with Research and education activities</li> </ul>	
5%	Transition <ul style="list-style-type: none"> <li>-Support transition activities related to education activities</li> </ul>	

**1.E.II.c. Project Manager, Research: TBN2**

The Project Manager for Research provides administrative support to the Research Committee and executive leadership, including: education, communications, and transition activities; proposal review; work plan development; PI meeting; quarterly review meetings; reporting; and closeout. The Project Manager, Research supports the Research Committee and the BTI management team in managing and reporting research project activities.

<b>Project Manager, Research Projected Division of Effort – Y4 Work Plan</b>		
<b>%</b>	<b>Activity</b>	<b>Notes</b>
10%	Administration & Execution -Support Director, Executive Director activities	
70%	Research & Development -Support Research Committee -PI Meeting and Showcase	
5%	Education & Training -Support Project Manager, Education activities	
5%	Communications -Outreach and Strategic Partnerships (conferences, customers) -Marketing, EMMA -Newsletter, social media, website, HSUP	
10%	Transition -Support transition activities	

**1.E.II.d. Manager, Communications/Operations: Philip J. Boedeker**

The Manager of Communications and Operations leads the BTI Institute's communication team and efforts. In coordination with the Executive Director, the Manager, Comm/Ops will implement the communication strategy for the Institute as detailed in Section 2.G. Communications. The Manager oversees and guides the efforts of the Information Technology Support. In addition to designing, resourcing, and executing the communication strategy for the Institute, the Manager also assists in operational aspects of the Institute to include the planning and execution of special events, conferences, and workshops.

<b>Manager, Communications / Operations Projected Division of Effort – Y4 Work Plan</b>		
<b>%</b>	<b>Activity</b>	<b>Notes</b>
10%	Administration & Execution -Support Director, Executive Director activities	
10%	Research & Development	



	-PI Meeting and Showcase	
10%	Education & Training -Support Project Manager, Education activities	
60%	Communications -Outreach and Strategic Partnerships (conferences, customers) -Marketing, EMMA -Newsletter, social media, website, HSUP, backgrounders	
10%	Transition -Support transition activities	

**1.E.II.e. Coordinator, Special Projects: Barbara E. Dwyer**

The Coordinator for Special Projects provides support for the BTI staff in the areas of education: Internships, Summer Research Visitor Teams, workforce development, and Brown Bag Sessions and regularly scheduled and/or special meetings.

<b>Coordinator, Special Projects Projected Division of Effort – Y4 Work Plan</b>		
%	Activity	Notes
15%	Administration & Execution -Support Director, Executive Director management activities	
20%	Research & Development -Assist Project Manager, Research and Manager of Communications and Operations with travel & logistics for PI Meeting and Showcase	
40%	Education & Training -Support Project Manager, Education initiatives and related workshop activities	
20%	Communications -Assist Manager Communications with logistics for PI meeting & Showcase	
5%	Transition -Support transition activities	

**1.E.II.f. Administrative Assistant: Virginia Yessenia Hernandez**

The Administrative Assistant provides support for the BTI staff in the areas of employee travel, contracts, personnel actions, financial transactions, budget, and event scheduling.

<b>Administrative Assistant Projected Division of Effort – Y4 Work Plan</b>		
%	Activity	Notes
60%	Administration & Execution -Support Director, Executive Director activities -contract support (travel, expense reimbursement)	

	-financial transactions (procurement)	
10%	Research & Development -Coordinate travel to PI Meeting and Showcase	
10%	Education & Training -Support Project Manager, Education in workshop activities -event scheduling and logistics	
10%	Communications -Assist Manager, Communications in Outreach and Communications logistics (conferences, customers)	
10%	Transition -Support transition activities	

## 1.F. Committees

In addition to core personnel, the Institute has expanded its knowledge base and influence through different mechanisms, including include a research committee, retention of available subject-matter experts, and various network groups. These mechanisms are detailed below.

### 1.F.I. Research Committee

The BTI Institute Research Committee is responsible for providing advice and specific recommendations to the BTI Institute Director on the quality and promise of research and education projects and recommending improvements where possible to project principal investigators. In addition, the Research Committee will facilitate, monitor and measure scientific progress, engage stakeholders to keep projects aligned with the DHS missions, and facilitate and assist with transition to the user.

The Research Committee Chairman is George Zouridakis, Ph.D., Associate Dean for Research and Graduate Studies. Dr. Zouridakis has a broad-based technology background. In his role as Associate Dean for Research in the College of Technology he has interacted with many, if not a majority, of the leading researchers across campus. Dr. Zouridakis, therefore, can access a wide range of expertise on an *ad hoc* basis. He will also canvas the community of experts across the United States to recruit talent and expertise for potential research efforts. The Research Committee currently consists of the following additional members; Richard C. Willson, Ph.D., Huffington-Woestemeyer Professor, and Luca Pollonini, Ph.D., Assistant Professor. The BTI Institute Director is an *ex-officio* member. The Committee will identify and recruit additional core members with subject matter expertise in the natural sciences and social sciences, as needed. Depending on the scientific expertise needs of the Committee, the Chair may invite additional members to serve on the Committee on an *ad hoc* basis. The Research Committee will hold regularly scheduled meetings on the second Tuesday of each month. The BTI Institute Director may request additional meetings if needed. Additional information on the Research Committee and how it will manage research projects can be found in Section 2.D. below.

### 1.F.II. External Advisory Board

The BTI Institute's External Advisory Board (EAB) consists of approximately eight to ten public leaders with significant expertise in border and coastal security, immigration, and trade issues. EAB members are selected for their knowledge in relevant domains; access to world-class

networks; and sterling professional reputations to enhance the BTI Institute’s image and build its foundation for future success.

The BTI Institute’s External Advisory Board serves to assist BTI Institute leaders in planning, research, technology, and market development. Its members work to:

- Provide strategic advice to the Director;
- Actively assist the BTI Institute in achieving its goals;
- Provide links between the BTI Institute and its strategic and operational environment;
- Act as a sounding board to BTI Institute leadership as to its future development; and
- Enhance the visibility of the Institute nation-wide

**Composition:** The members of the EAB are:

- David Aguilar, former acting commissioner, U.S. Customs and Border Protection
- Tom Atkins, retired U.S. Coast Guard Rear Admiral, former acting assistant Secretary of Defense for Homeland Defense and Global Security
- Gustavo Mohar Betancourt, former undersecretary for Migration, Population and Religious Affairs at the Interior Ministry in Mexico
- Maria Luisa Boyce, former senior advisor for Trade and Private Sector Engagement to the Commissioner of U.S. Customs and Border Protection; director for the Office of Trade Relations
- Sheriff José Francisco Martinez, Sheriff, Val Verde County; chairman of the Southwest Border Sheriff’s Coalition
- Luc Portelance, former president and executive vice-president of the Canada Border Services Agency
- Jon Spaner, retired U.S. Coast Guard Captain (O6); former sector commander and captain of the Port of San Diego, CA
- Julie Myers Wood, former head of Immigration and Customs Enforcement

The meetings planned for year four are an in-person meeting in the fall (November) and one, with the possibility of an additional as needed, telephonic meeting.

## 2. Administration and Execution

The BTI Institute will administer tasks relating to the planning, execution, and reporting of activities as mandated by the terms and conditions of the cooperative agreement.

### 2.A. Milestones

ID	Description	Effort Period
M.1	Submit work plans for projects selected by DHS	Sep 2018
M.2	Negotiate work plan, budget and contract implementation for each project	ongoing

M.3	Submit quarterly Action Plan	Quarterly
M.4	Submit Annual Report	July 1, 2018 + 60 days
M.5	Hold Annual PI meeting	April 2019
M.6	Respond to Annual OUP data call	Mar 2019
M.7	Submit draft Annual Work Plan & incremental funding request	Mar 2019
M.8	Modify/submit Final Annual Work Plan & budget	Apr 2019

## 2.B. Outputs

ID	Description	Responsibility	Effort Period
D.1	BTI Annual Report	Lead: Director, Assist: ExecDir	July 1, 2018 + 60 days
D.2	Submit draft Annual Work Plan	Lead: Director, Assist: ExecDir	By Mar 2019
D.3	Revise Final Annual Work Plan	Lead: Director, Assist: ExecDir	By May 2019

## 2.C. Performance Metrics

ID	Description	Quantitative Performance Target	Effort Period
P.1	BTI Institute establishes strong, effective dialogue with PM, OUP	Conduct customer survey	Biannually
P.2	Annual Report accurately and succinctly captures BTI activities for the program year 3.	Acceptance by OUP PM by due date and approved no later than +30 days	Aug 2018
P.3	Approved FY5 work plan and budget	Approved by OUP PM prior to next program year	Mar-Jun 2019
P.4	BTI Institute regularly and actively collaborates on initiatives and research with other DHS Centers of Excellence and Federal Research Laboratories	Three projects and/or initiatives in which BTI Institute collaborates with other COE and Federal Research laboratories	Ongoing

## 2.D. Research and Development

## **2.D.I. Project Development**

This process explains how the BTI Institute identifies, coordinates, conducts and competes new projects of interest to DHS.

### **2.D.I.a. Understanding CBP Knowledge Gaps and Developing Solutions**

The Research Committee will conduct preliminary research into the CBP programs noted below and travel (Aug-Nov 2018) to Washington, DC to meet with CBP HQ program customers to document requirements/challenges for the following programs:

1. CBP OFFICE OF TRADE - Automated Commercial Environment (ACE); Centers of Excellence and Expertise (Centers); Intellectual Property Rights (IPR); Forced Labor
2. CBP OFFICE OF FIELD OPERATIONS – Biometrics (Air and Land Entry/Exit); Agriculture Programs and Trade Liaison (APTL); Admissibility and Passenger Programs (APP); Cargo and Conveyance Security (CCS); C-TPAT
3. USBP STRATEGIC PLANNING AND ANALYSIS DIRECTORATE PROGRAMS  
(Specific programs to be provided)

Once the Research Committee has concluded its research, including interviews with CBP program offices, they will present their findings to BTI leadership and DHS in Washington, DC. After the Committee identifies challenges faced by these programs, the Research Committee will develop two Project Proposals for each office or program noted above to address knowledge gaps. Each proposal will identify relevant subject matter experts to conduct research to address knowledge gaps; clearly articulate the objective or purpose of the research and include a literature review; clearly discuss the research method or approach; and, identify all outcomes and outputs. The Committee will review all research proposals for scientific merit and subsequently forwarded to DHS for mission relevancy review. (Dec 2018- Mar 2019)

### **2.D.I.b. Work plan development**

The Committee will develop work plans, in collaboration with the principal investigator, for proposals DHS would like to pursue. The BTI Research Committee convenes when new projects are approved by DHS to facilitate the onboarding process. In this effort, the Research Committee reviews draft work plans, helps to identify potential issues, and ensures that the PI is adequately supported by the BTI Institute staff and the various offices of the University of Houston (e.g., university technology transfer offices, sponsored research offices, communications, etc.) that are necessary to achieve the project's research objectives. The Research Committee also provides feedback to the Project PIs on stakeholder engagement, logic model development (tasks, milestones, and outputs), and meaningful performance metrics that will be used to quarterly assess by the Committee the scientific progress of the work.

The BTI Institute's Research Committee provides feedback on the work plan formulation proposed by the project Principal Investigator (PI) in advance of the OUP Program Manager's review. It ensures that the work plans clearly identify a Homeland Security Enterprise problem or need and that the proposed method or approach to address the need has high scientific merit. It may also assist in identifying committed customer(s) and end-users.

The Research Committee will be decisively involved in advising and ensuring that each project's transition plan, developed as an integral part of the project's work plan, identifies transition pathways. The Research Committee will also identify the manner (mechanisms) and timing of engagement of the project PI and staff with the project Champion, potential customers, and active end-users, throughout the duration of the project.

#### **2.D.I.c. Evaluating scientific progress and mission relevancy of research**

Once the projects commence, the Research Committee will monitor research progress through four mechanisms:

1. Quarterly reviews and preparing assessments and annual reports to the BTI PI, conducting site visits to DHS headquarters;
2. Site visits to performers (PIs, sub-awardees, etc.);
3. Deliverable sharing via an online platform; and
4. Quality tracking of resulting peer-review publications.

Based on these monitoring mechanisms and assessments, the Research Committee will intervene when necessary during the course of the budget year to steer project R&D on a productive path. The Research Committee also prepares quarterly and annual project evaluations and recommendations that will be submitted to the BTI Institute Director and OUP PM.

Additionally, project activity progress will be evaluated in the context of the timeline and delivery schedule of the anticipated milestones/deliverables proposed in the work plan. Moreover, progress will be measured and assessed based on the agreed upon performance metrics documented in each project work plan. For any deviations noted, the PI must provide justification with corrective action(s) to the Research Committee, along with the results of the corrective action. If the project has a protracted deviation from the original timeline and corrective action has proven unsuccessful in restoring progress at, or near, the originally proposed timeline, a meeting with the PI, Project Champion, and Research Committee will convene at the earliest opportunity. If resolution is not deemed possible, the Research Committee will notify the BTI Institute Director who will make a final determination, in conjunction with the OUP Program Manager, regarding the path forward.

In the event that outside influences result in the project losing relevance to the HSE Mission, the project will be immediately under consideration for termination. Upon merit review, the Committee will develop draft work plans, in some cases in collaboration with performers, for proposals DHS would like to pursue.

The Research Committee will have the following responsibilities to oversee project completion:

- Reviewing Project Proposals for scientific merit (evaluation)
- Engaging Research teams to develop work plans by:
  - Clearly articulating objective/purpose
  - Strengthening Research Method/Approach
  - Co-developing key research milestones
  - Developing mutually agreeable performance metrics to evaluate scientific progress of research

- Clearly identifying outcomes/outputs
- Co-developing transition approach (from research to user)
- Socializing draft work plan with DHS Project Champion
- Monitoring Approved work plan for scientific progress and homeland security alignment (See Project timelines)
- Facilitating researcher/champion engagement, as needed (See Project Plan, generally quarterly at roundtable sessions)
- Producing quarterly progress assessment reports to BTI Director and OUP PM for each project
- Conducting formal annual site visits (or inviting to UH) of performers to evaluate progress
- Assisting BTI Director with Annual Report (Jul-Aug)
- Assisting BTI Director with next Draft Work Plan (Jan-May 2019)

#### **2.D.I.d. Quarterly Reporting**

The project PIs will provide to BTI Institute quarterly progress reports with updates documenting items such as progress in the tasks, milestone completion, transition planning, challenges encountered, and requests for assistance. The reporting format will include a copy of the power point presentation based on a template provided by BTI. Specific information to be provided:

- 1) PI name(s); Institution(s); project start date; projected completion, project personnel
- 2) Problem statement
- 3) Objectives
- 4) Methods
- 5) Results
- 6) Challenges
- 7) Updates to the Mission Model Canvas

The project PI will also provide a quarterly snapshot of the project using a summary of the project strengths, weaknesses, opportunities, and threats (SWOT analysis).

The BTI Institute's Research Committee will convene to evaluate the reports, evaluate the progress, and provide feedback and corrective action, if needed. Each report will assign a primary reader to lead the committee's discussion during the meeting. The committee will meet with the project PIs by teleconference three times a year, and provide written feedback. The Research Committee will also evaluate the effectiveness of the stakeholder engagement strategy and transition planning in order to assist project PIs in developing a pathway to transition. Additionally, it will provide guidance and recommendations on how to improve performance metrics for project activities and manage personnel activities. The biennial management review criteria will be included in the evaluation rubric that the Research Committee will use.

In that capacity, the Research Committee will provide advice and guidance to help the project PI leverage the capabilities of the UH and the BTI Institute's partner institutions in technology transfer and commercialization. The Research Committee will seek to engage relevant UH units (such as the Office of Intellectual Property Management, Center for Industrial Partnerships, Cyvia and Melvyn Wolff Center for Entrepreneurship) to assist the project PI and help ensure the success of the project.

Satisfactory progress is required in order to authorize payments. If the BTI Institute leadership deems that a project PI does not make substantial progress towards meeting the objectives set forth, the Director will notify the DHS Program Manager.

## 2.D.II. Research Committee Project Management

### 2.D.II.a. Milestones

ID	Description	Effort Period
M.1	Review and provide recommendation on Concept & White Papers submitted to BTI and make necessary edits prior to submission for DHS routing via OUP Program Manager.	Ongoing
M.2	Distribute DHS feedback to White Paper author(s). If interest, work with PI to develop a work plan for submission to OUP.	Ongoing
M.3	Review draft work plans for new projects	Jul-Aug 2018
M.4	Work plan approval by OUP	Aug 2018
M.5	Completion of Kick-Off Meetings projects approved by DHS	Sep 2018
M.6	Review updated work plans for Y5 for continuing projects	Mar 2019
M.7	Conduct teleconference with each PI and the project champion as appropriate for Committee Review of project progress	Sep 2018; Mar 2019; Jun 2019
M.8	Conduct Committee Review of written project progress reports and provide feedback. Quarterly assessment reports will be provided to the DHS OUP PM.	Sep 2018; Mar 2019; Jun 2019
M.9	Implement appropriate corrective actions in response to list of Biennial Review action items	Ongoing
M.10	Complete preliminary research of CBP programs prior to meetings	Sep 2018
M.11	Conduct meetings with CBP Office of Trade (ACE; IPR;CEE; Forced Labor)	Sep 2018
M.12	Conduct meetings with CBP Office of Field Operations (OBIM; APTL; APP; CSS; C-TPAT)	Oct 2018
M.13	Conduct meetings with USBP Strategic Planning & Analysis Directorate	Nov 2018
M.14	Present findings from meetings with customers in Washington, DC	Nov-Dec 2018

### 2.D.II.b. Outputs

ID	Description	Effort Period
D.1	Progress reports from project PIs. These quarterly assessment reports will be provided to the DHS OUP PM.	Nov 2018; Mar 2019; Jun 2019
D.2	Written review reports to PIs	Nov 2018; Mar 2019; Jun 2019



D.3	Produce Memorandum of Record (MOR) for each meeting at CBP Office of Trade (ACE; IPR;CEE; Forced Labor)	5 working days post meeting
D.4	Produce Memorandum of Record (MOR) for each meeting at CBP OFO (OBIM; APTL; APP; CSS; C-TPAT)	5 working days post meeting
D.5	Produce Memorandum of Record (MOR) for each meeting at USBP Strategic Planning & Analysis Directorate	5 working days post meeting
D.6	Provide briefing on findings from meetings with DHS program customers in Washington, DC	Nov-Dec 2018
D.7	Produce proposals based on findings from meetings with DHS program customers and meeting in Washington, DC	Jan 2018

### 2.D.II.c. Performance Metrics

ID	Description	Quantitative Performance Target	Effort Period
P.1	Project description clearly addresses a knowledge gap identified as a Homeland Security Enterprise problem or need	100% of BTI projects clearly identify and document the knowledge gap identified as an HSE problem or need	Jun 2019 & ongoing
P.2	BTI Institute ensures scientific progress of research efforts and relevancy to customers.	Quarterly meetings with the project PIs and project champions to assess progress.	ongoing
P.3	BTI Institute has established a transition strategy to ensure successful use of its research projects	Work Plan transition approach is coordinated and approved by customers/champions  BTI Institute involves partners in implementation of its transition strategy  100% of Project Transition Plans that have transition agreements with end-users	ongoing
P.4	Research Committee assists PIs in establishing project teams with optimal mix of interdisciplinary skill sets and partners	100% of projects assessed by the Research Committee for interdisciplinary skill sets and partners	June 2019 & ongoing
P.5	Initiated Project has an identified, committed customer	Customer agrees to accept background papers, studies or analyses	Jun 2019 & ongoing
P.6	Project has meaningful performance metrics	Customer agrees with performance metrics	Jun 2019 & ongoing

P.7	The Research Committee continuously engaged with the PIs	9 Monthly Conference Calls  Conduct of three (3) progress reviews and assessment  BTI Institute policy of open communication  # conference calls	ongoing
P.8	Develop project proposals for each meeting at CBP Office of Trade	Two proposals have scientific and relevancy merit each for ACE, IPR, CEE, or Forced Labor	Dec 2018
	Develop project proposals for each meeting at CBP Office of Field Operations	Two proposals have scientific and relevancy merit each for OBIM, APTL, APP, CSS, or C-TPAT	Jan 2019
	Develop project proposals for each meeting at USBP Strategic Planning and Analysis Directorate	Two proposals have scientific and relevancy merit (Programs TBD)	Feb 2019

**2.E. Transition Strategy**

The goal of transition activities within BTI is to provide project performers with seamless, timely and cost-effective pathways for exploring the potential commercial value and related market transition opportunities of early-stage technologies and products generated by their DHS-funded BTI-led projects. BTI will also provide a pathway and assistance for DHS with nascent technology transition capabilities and experience to identify transition opportunities through technology surveillance of currently funded projects. Technologies identified as having commercial viability will be examined and developed through the UH innovation ecosystem as “live IP” case studies for student/faculty E-teams (Entrepreneurial Teams) to serve customer needs while providing an opportunity to expand and eventually monetize their intellectual property portfolio.

Exploration of the market transition opportunities for intellectual property will be conducted through formal high impact, and experiential learning experiences will be open to students across all academic disciplines. The BTI Institute at UH will generate information useful in accelerating the transition of early-stage technologies and products to market, while simultaneously helping to educate and build the nation’s next generation of innovators and entrepreneurs.

**GOALS**

1. Provide support for DHS-funded research & development activities through the DHS-funded BTI Institute Center of Excellence, to facilitate transition of technology and deliverables to DHS customers.
2. To assist in the understanding of DHS-funded research & development activities to identify market opportunities for technologies that might otherwise go unnoticed.

3. Create administratively seamless pathways for project performers to cost-effectively explore market transition opportunities for deliverables generated by DHS-funded projects.
4. Based on the type of early-stage technologies and products being used as case studies, develop a range of formal, high impact experiential learning experiences for UH students in related academic disciplines.
5. Create opportunities for interested UH faculty members to partner with Federal Agencies, National Laboratories, and Industry Partners in additional follow-on funded, technology research and development activities.
6. Establish a nationally recognized, Technology Transition Fellows Program at UH for post-doctoral level scientists and engineers interested in further developing promising, commercial viable technologies and products identified by the BTI Institute.
7. Create a technology transition pipeline to Houston Exponential for promising, commercial viable technologies and products identified by the BTI Institute.
8. In conjunction with DHS and project performers' institutions, create follow-on opportunities for UH students and faculty to create "spin-off" or "spin-in" start-up companies based on commercializing IP based on the market analysis generated by the BTI Institute.
9. To partner with investors to de-risk early stage technologies and IP portfolios to attract the full continuum of capital to grow and scale BTI Institute affiliated companies.

The transition strategy is a three-sided process driven by the project Principal Investigator and assisted by the BTI Institute team, leveraging the resources of the University of Houston, and directly engaging with end-users in the DHS community to deliver pragmatic solutions for the near-term, the mid-term, and the long-term needs of the DHS. In general, there are five phases to transition:

- Phase 1 – Pre-Award: The transition team assists the project PI to develop a notional transition plan – an integral part of the project work plan.
- Phase 2 – Performance Period: Customer is identified and included in the briefings related to the project.
- Phase 3 – Post Award: Evaluation of the deliverables is performed to decide if transition is desired by the Customer.
- Phase 4 - Transition Plan Development/Approval: A viable transition plan for the Customer(s) is developed and approved, in consultation with the DHS Project Champion before the work plan is approved.

At the conclusion of Phase 4, transition may be undertaken with the assistance of the customer, when appropriate.

### **Transition Team**

Reflecting the three-sided structure of the transition strategy to ensure the continued advancement, timely adoption, and effective migration from research to use by the DHS community, each project will include representatives from the Project's Principal Investigator Organization, BTI Institute, and DHS as follows:

- Project PI's Organization
  - The principal investigator
  - Representative from the Technology Transfer Office of the project PI's organization

- Representative from the Communications Office of the project PI's organization
- BTI Institute
  - BTI Institute's Transition POC
  - The BTI Institute's Executive Director
  - Member of the BTI Institute's Research Committee assigned oversight of the project
  - The BTI Institute's Project Manager, Research (TBN)
- Representative from UH's Technology Transfer Office
  - Executive Director, Office of Technology Transfer and Innovation
- DHS
  - Project Manager, Office of University Programs
  - Project Champion
  - Customer's Transition POC (see Phase 4)

Note: The Transition Team is not limited to the agencies, organizations, and positions listed above. The BTI Institute may add partners and personnel to the Transition Team as necessary to ensure a successful transition of research to its customers.

### **2.E.I. Phase 1 – Pre-Award**

During this phase, the BTI Institute forms a Transition Team to assist the Project PI in an analysis of deliverables and the development of the work plan, of which the notional transition plan is an integral part.

#### **Phase-1 Process:**

Use-cases/needs: The transition team will assist the Project PI in identification of specific use cases/needs. This includes the identified use-cases/needs as well as those masked, hidden, or compensated for by policy, doctrine, or practices. To facilitate the identification of the use-cases/needs, provide accurate metric-verifiable codification, and share across the transition team, the codified details of the use-cases/needs are seminal to the generation of the transition plan. In addition, using existing use-cases (through CGAP or acquisition documents like a CONOPS, or planning CONOPS) will be explored.

It should be recognized that, in this phase of transition plan development, the initial use-case/need may be eclipsed or integrated into an identified/discovered broader scope and scale of applicability. In turn, that may drive or shape the near-term, mid-term, and long-term transition plans and actual project development. The dogmatic pursuit of a single use-case/need solution, within the context of a greater potential application, should only be advocated as a near-term foundational/proof of concept prolegomenon to a broader application of the solution.

*Deliverables Analysis:* The types of deliverables (tools, technology, software, knowledge product) are:

<b>Deliverable type</b>	<b>Description</b>
<b>A:</b> Algorithm	A computational science algorithm to perform a specified task
<b>B:</b> Brief	A report about an issue including detailed analysis and recommendations
<b>Co:</b> CONOPS	A document outlining a Concept of Operations

<b>C:</b> Course	The materials associated with an education or training offering
<b>D:</b> Dataset	A dataset to be used for the development, validation, and testing of an algorithm
<b>H:</b> Hardware Prototype	A hardware prototype designed to perform a specified action.
<b>P:</b> Publication (Conference or Journal)	A peer-reviewed publication in a scientific journal
<b>Pr:</b> Protocol	A protocol of operations
<b>R:</b> Report	A report about a research problem including a detailed analysis
<b>So:</b> Software	Executable and source code
<b>Su:</b> Survey	A validated instrument to conduct a survey for a set of questions
<b>V:</b> Video	A video explaining to a lay person the problem being addressed, the solution and the impact of the solution.

During the pre-award work plan development process and during the continuation of work plan development processes, the Project PI includes the answers to the following questions in the work plan:

- What is the nature of the deliverables?
- To what degree is the technology of the deliverables end-user / customer specific?
- Is the academic, industrial, or commercial environment of the technical context of the solution so volatile that a solution may be eclipsed or overtaken by evolutions in the specific or a parallel arena of development?
- What are the functional/operational requirements for the proposed deliverables as identified?
  - Are the functional/operational requirements unique to a specific end-user/customer or a spectrum of users?
  - Are there capability gaps, critical vulnerabilities that the end user may have articulated, but not yet refined into requirements?
  - How does the work relate to initial requirements (these are pre-defined Operational Requirements that are basic agent statements with an initial level of analysis at a planning workshop; not yet to be considered as Operational Requirements)?
- Are there any technical, procedural, policy, or doctrinal dependencies that exist and would need to be modified, or would be required for the end-user to adopt/acquire to use the developed solution?
- Are there alternative technologies/processes/methods/protocols/knowledge/products that could address the requirements for solving the problem?
  - What methodology was employed to survey alternatives?
  - If they exist, what are their limitations/advantages?
  - What is the comparative rate of development in the alternative technology, and is there potential for the proposed solution to be eclipsed or overtaken by the alternative technology?

- What are the means and methods used by the Project PI to engage with Project PI's organization's technology transfer office and communications office to leverage the capabilities and assets they represent?
  - Frequency and level of communication
  - Leveraging of existing contacts from the identified/discovered potential end-user(s)/customer(s) within the DHS community and allied communities
  - Partner COE, academic, industrial, and commercial contacts

**Phase-1 Outcomes:** Project PI updates the work plan with detailed descriptions answering the questions from the deliverables analysis and the notional transition plan. It should be emphasized that the notional transition plan is a dynamic document subject to modification as dictated by changes in physical, geographic, and regulatory environments of the end-user(s)/customer(s) and new manifestations of use-cases/needs. The Project Principal Investigator, assisted by the BTI Transition Team, may amend/update the written notional transition plan over time. The work plan is approved by the Project Champion and OUP and contract is signed.

## **2.E.II. Phase 2 – Performance Period**

During this phase, the transition team assists the Project PI to identify a customer for the project.

**Phase-2 Process:** All team members offer leads to the Project PI and facilitate introductions. The DHS components function/operate across a broad spectrum of physical, geographic, and regulatory environments. Use-cases/needs identified for a specific user have a high probability of being applicable to components in the original form or with minimal modification. To ensure the greatest return on investment from DHS funds, resources, staffing, and time, the broadest possible user community must be identified, and should be included.

*Customer Discovery:* Toward a comprehensive and accurate understanding of the potential customers for a project and the proposed deliverable, the user community including the DHS S&T program advocates, DHS agency advocates, DHS agency contact(s) for project acquisition, allied agency/community advocates/subject matter experts (external to the DHS, University of Houston, or BTI Institute communities), project champion(s), and potential end-user(s)/customer(s) should be surveyed with, at a minimum, the following questions:

- Who is/are the potential and most likely end-user(s)/customer(s) of proposed deliverables?
  - How, potentially, will the end-user(s)/customer(s) change in scale and scope across the near-term, mid-term, and long-term research, development, testing, and deployment of the project?
  - Are the deliverables scalable?
- What the functional/operational requirements for the proposed deliverables are as identified?
  - Are the functional/operational requirements specific to a specific end-user/customer or a spectrum of users?

- If there are significant conflicts between the optimal deliverable across a spectrum of potential end-users/customers, how will it be resolved?
- How is the optimal solution as prescribed by cost/time/resources defined?
- Are there any technical, procedural, policy, or doctrinal dependencies that exist and would need to be modified, or would be required for the end-user to adopt/acquire to use the developed solution?
- Are there alternative technologies/ processes/methods/protocols/knowledge products that could address the requirements for solving the problem?
  - What methodology was employed to survey alternatives?
  - If they exist, what are their limitations/advantages?
  - What is the comparative rate of development in the alternative technology, and is there a potential for the proposed solution to be eclipsed or overtaken by the alternative technology?

**Phase-2 Outcomes:** The Project PI writes a memorandum of record for each potential customer documenting the interaction and its outcomes and identifies one or multiple customers for the specific project. Each potential customer offers a written commitment to participate in the development of an evaluation plan for the deliverables.

### **2.E.III. Phase 3 – Post Award**

During this phase, the BTI Institute continues to evolve and implement a transition plan for the outcomes based on the customer use cases. The DHS Champion may help identify the: 1) Requirements Manager; 2) Program Manager; 3) Operational Sponsor.

**Phase-3 Process:** The BTI Institute team interviews the customer(s) to write the requirements for the specific need. BTI Institute invites the Champion to designate a Customer Transition POC. The BTI Institute performs an evaluation of the deliverables against the requirements and provides a report to the customer. Focus is placed on ensuring gaps, requirements and use cases are used to ensure and explain how the product can be evaluated against the initial problem.

**Phase-3 Outcomes:** The BTI Institute provides a written evaluation of deliverables to the Customer. The Customer(s) may designate a Transition POC(s) to assist in the development of the specific Transition Plan.

### **2.E.IV. Phase 4 - Transition Plan Development and Approval**

During this phase, the Project PI develops a specific Transition Plan.

**Phase-4 Process:** The transition plan will include:

- A clear and concise explanation for the concrete real-world use of the research and subsequent deliverables
- The deliverables as defined by the analysis, including: the specific granularity of the deliverables as developed for a committed end-user(s)/customer(s) within the DHS

community, the applicability across a larger scale and scope, and any limitations or technical, procedural, policy, or doctrinal dependencies.

- A clear and concise explanation for the transitional pathway to deploy the deliverables to end-user(s)/customer(s) within the DHS community, including the issues of:
  - The rights of intellectual property
  - Manufacturing considerations
  - As appropriate, identified sources for software, hardware, fabrication, and/or manufacturing
  - The operational and maintenance considerations, including: cost, end-user(s)/customer(s) required knowledge base
  - Test, training, and evaluation (with metrics for testing) for end-user(s)/customer(s)
  - The means and methods of engagement with and deployment to end-user(s)/customer(s)
  - Documentation of best practices and methods, and provisions of accessibility to end-user(s)/customer(s)
  - The specific initial end-user(s)/customer(s) recipients (by agency, role, and name where possible) of the deliverables and the protocol for sharing by the initial recipients to other users within the DHS and allied communities
  - The means of deployment for deliverables to specific initial end-user(s)/customer(s) recipients
  - Potential plans for publication of metrics, narratives, source code, presentations, web sites, workshops, teleconferences, emails, and face-to-face meetings and “how-to” instructions to the DHS.

**Phase-4 Outcomes:** Specific Transition Plan has been developed and approved by the Customer POC.

### **2.E.V. Assessment**

Beyond the satisfactory meeting and/or delivery of the stated task, milestones, deliverables, and performance metrics, the assessment of the transition process will be a measure of:

- The effective deployment of the deliverables to end-user(s)/customer(s)
- The level of engagement by end-user(s)/customer(s) in the use of the deliverables
- The closing of a knowledge, and/or operational capability gap/deficiency of significant importance to the Homeland Security Enterprise, and/or a change in the technology, software, database, CONOPS, visualizations, process, method, or protocol of end-user(s)/customer(s) with no major outstanding/remaining business issues
- The establishment of a “transition agreement” and protocol with the end-user(s)/customer(s) for the sustainment and maintenance of the deliverable deployment
- As appropriate, the effective and wide-spread circulation of metrics, narratives, source code, presentations, web sites, workshops, teleconferences, emails, and face-to-face meetings and “how-to” instructions to the DHS stakeholders

## **2.F. Customer Outreach and Communications**



## **2.F.I. Strategy**

The Manager, Communications/Operations will develop the BTI Institute Outreach and Communication Strategy and enact Communication Plans for this performance period by September 30, 2018 and will work closely with the DHS OUP Communications Team.

The overall strategy involves three lines of effort. Those lines are outreach, marketing, and communication. Each line of effort supports and complements the other with the overall objective of identifying research and education opportunities that result in near-term, mid-term, and long-term solutions in high priority areas denoted by DHS that address operational concerns of its components.

## **2.F.II. Outreach**

The goal of outreach is to penetrate established market space to better identify key stakeholders and develop collaboration opportunities between those with problem-sets and those that can solve those problem-sets.

The BTI Institute's outreach objectives will focus around building strategic partnerships that are focused on research to support the Department of Homeland Security and the component agencies' mission, goals, objectives and priorities.

### **2.F.II.a. Engagement Strategy**

To this end, our engagement strategy will focus on (1) establishing long-term interactive partnerships with DHS and components, (2) promoting the BTI Institute as a valued resource to stakeholders nation-wide, (3) melding academic researchers with operators in a synergistic team effort to address stakeholder needs, and (4) partnering with organizations to expand knowledge and research capabilities. The research committee will be the primary lead on engagement.

#### **2.G.II.a.i Engagement Strategy Objectives**

Objective 1: Establish long-term partnerships with DHS and its component agencies:

- Support the mission, goals, objectives and priorities of DHS and its component agencies specific to the mission of the BTI Institute
- Focus BTI Institute strategic partnerships on high priority areas identified in the Notice of Funding Opportunities (NOFO) and the DHS Board of Directors.
- Maintain and grow strong, ongoing partnerships with federal stakeholders through discussions with senior leadership.

Objective 2: Promote the BTI Institute as a valued resource to stakeholders nation-wide

- Promote BTI Institute as valued resource and force multiplier to identify and connect with prospective strategic partners along our northern and southern borders and at ports of entry
- Solicit/discern those strategic and operational concerns faced by our strategic partners that impact U.S. border security operations, international trade, and the integrity of our nation's immigration system in order to propose potential research and educational/workforce development solutions

Objective 3: Meld academic researchers with operators in a synergistic team effort to address stakeholder needs in border security, trade and immigration

- Engage top researchers from institutions of higher education, non-profits, and private industry in collaboration with champions and end-users designated by our strategic partners to address specific high priority R&D to provide solutions to operators
- Develop specific approaches including workshops and serving to coalesce teams that address all aspects of a complex problem including technical, transition to applications, and educational
- Establish working groups of researchers and operators for high priority areas of unmet need within the scope of the BTI Institute to identify complex issues
- Partner with private corporations and organizations to transition solutions to complex issues

Objective 4: Partner with organizations to expand the Institute's knowledge, research and capabilities

## **2.G.II.a.ii Engagement Strategy Key Actions**

### **Targeted Engagements**

*Executive Leadership of Federal Agencies.* The Director, Executive Director, and/or Research Committee will conduct periodic visits to the Executive Leaders of DHS component agencies to provide awareness of the BTI Institute's capabilities and to solicit guidance as to potential research and education opportunities. Notes will be taken and summarized in the Annual Report.

*Periodic Meetings with Program Managers.* The BTI Institute will visit federal program managers at their agencies' headquarters in Washington D.C., as well as seek to host visits of agency representatives to the BTI Institute at the University of Houston. Notes will be taken and summarized in the Annual Report.

**Conferences** *PI Meeting and Showcase (June 2019).* The BTI Institute's annual Research and Education Showcase is intended to provide an opportunity for BTI Institute research partners to showcase their projects through poster displays, video demonstrations, printed flyers, live simulations and other techniques to an audience of potential customers. A showcase will be hosted in Washington, D.C. to locate our researchers in a venue that provides the highest probability of customer interaction and lead generation.

While the PI Meeting is focused on current customer interaction and collaboration across the BTI Institute research network, the Research and Education Showcase is focused primarily on discussing the accomplishments over the past year, creating potential customer leads, identifying needs beyond current research projects, and developing a wider stakeholder network. The Showcase is conducted in conjunction with the PI Meeting to save cost and maximize our researchers' exposure through multiple venues and audiences.

Additionally, students involved with each project will present the research posters and detail the technology demonstrations.

*Other select national conferences.* Based on opportunity & mission relevance the Institute has identified other key conferences that would tailor to our stakeholders. BTI will have a presence at these meetings either through a booth and/or plenary or other formal presentation.

Borders, Trade, and Immigration Institute Conference Schedule 2018-2019		
Announced Dates	Conference	Location
August 2018	Trade Symposium – US Customs and Border Protection	Atlanta, GA
September 2018	US/Canada Border Conference	Detroit, Michigan
October 2018	International Conference on Border Studies	Edinburg, TX
February 2019	Border Security Expo	San Antonio, Texas
June 2019	American Association of Exporters and Importers (AAEI)	Washington, DC
June 2019	BTI Institute Research and Education Showcase	Washington, DC

### **2.F.III. Marketing**

The goal of marketing for BTI Institute will be brand and trust building by utilizing fact sheets, publicity materials and other collateral. The BTI Institute fact sheet is a double-sided one pager that gives a highlight of Institute activities and research. This sheet is distributed at multiple functions throughout the year.

An effective means of brand development is through the use of trade show banners the Institute has designed and will purchase to use during conferences when attending as an exhibitor. Branded directionals will be created, in addition to distributing logo pens, coins and other consumable promotional items. Using industry standard promotional materials, the BTI Institute will be established as a recognized brand.

### **2.F.IV. Communication**

The goal of communication will be customer engagement. By keeping our customer informed of developments within the BTI Institute research efforts as well as remain responsive to their needs, our partners will successfully deliver desired products.

Our communication objectives support and complement the outreach objectives.

Our first communication objective is to cultivate our current network of stakeholders to strengthen partnerships and expand collaborative opportunities. The stakeholders we currently have are interested or impacted by the research and education activities we conduct. The Chairman of the Research Committee, in conjunction with the Director and the Executive Director of BTI, will meet with key stakeholders in CBP to stay abreast of the dynamic environment and the constantly evolving landscape affecting the HSE Mission. In-person meetings will be followed up with distribution of a written summary, memorandum of record or equivalent and action items will be resourced until completion or suspense by DHS directive. Supplementing the interim between face-to-face meetings, teleconference meetings will solidify the relationship with the customer. In this manner, we will enhance our ability to respond to

Homeland Security Enterprise needs, better understand those needs, and therefore, better transition deliverables that meet those needs.

The second is to identify and engage specific audiences to develop stakeholders that can further enhance our information dissemination network. This will allow us to quickly reach an interested audience through a known, trusted third-party. By expanding our reach, we can better inform and educate a wider audience on our research and education activities, capabilities, and outputs.

The third communication objective will aim to increase awareness among the Homeland Security Enterprise interested public. This public is broad and impossible to tailor; therefore, we will utilize broad media engagement including local media engagements to increase awareness of our activities.

In addition to the communication objectives and in conjunction with the transition strategy, we will make targeted communication efforts to publicize our transition efforts both as an Institute and for our individual PIs. Tactics will include highlighting our transition partners and marketing our researcher's deliverables.

#### **2.F.IV.a. Methods**

Newsletter – a quarterly communication to our stakeholders that gives updates to the events, activities, and research taking place through the BTI Institute. Highlights will include new projects, project milestones, student research, and educational events.

Backgrounders – Information papers based on our research findings that provide the public, media outlets and other interested parties with factual information on relevant topics.

Social Media – engagement platforms that allow for information dissemination and customer conversation. No cost.

Website – Online presence with a page dedicated to each research project, initiative and news story. Server hosted by the University of Houston. No cost.

HSUP website and Project Reporting system – website and system hosted by the Office of University Programs that includes relevant information and fact sheets on each COE.

#### **2.F.IV.b. Resources**

Email Marketing – EMMA - An email database that allows for mass communication to our entire email distribution list.

Stock Photography – Adobe Stock - Access to thousands of licensed images for collateral creation.

Contacts and Follow Up – Pipedrive (cloud-based sales software company) - monitor potential customers from first meeting through BOA development to transition.

#### **2.F.V. Plan and Tasks**

A summary of the Communication Plans (with specificity as to communication channel or tool) that will contribute to reaching the objectives of the above strategies is captured in the action plan below. These tasks are associated with milestones and deliverables.

### 2.F.V.a. Milestones

ID	Description	Effort Period
M.1	Development of the Institute Communication Strategy. Identify the best methodology to engage our target audiences, cultivate relationships, and produce our planned objectives/deliverables	Sep 2018
	Create and distribute Monthly Updates on BTI Institute activities to BTI Institute Team, PIs, External Advisory Board members, and list serve. Scheduled, regular updates that report the activities of the Institute	Monthly
M.2	Create and distribute the BTI Institute Quarterly Newsletter. A publicly consumable, 'newsworthy' report of the activities, accomplishments, highlights and features	Quarterly
	Create all publicity materials (e.g. media releases, talking points, information papers, photographs, backgrounders, fact sheets, videos) for projects and activities	Quarterly and ongoing
M.4	Twelve articles posted on LinkedIn to promote the activities of the BTI	Jun 2019
M.5	Conduct analysis of BTI communications strategy, plan, and activities to be provided to OUP PM	Oct 2018
M.6	Update of Project Reporting System through HSUP	Quarterly

### Outputs

ID	Description	Effort Period
D.1	Develop and post 12 issues of BTI Institute Monthly Updates	Published and disseminated within 3 days of the end of the month
D.2	24 articles posted in social media (LinkedIn/Twitter)	Not less than two per month
D.3	Four issues of BTI Institute newsletter	Quarterly
D.4	Analysis and creation of BTI communications strategy, plan, and activities	Ongoing
D.5	One OUP and one BTI Institute fact sheet with relevant quotes, data, and impact statements	Updated ongoing; quarterly review

D.6	Provide a quarterly status report and assessment of progress/ accomplishments to BTI Executive Director and DHS OUP PM.	Quarterly
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**2.F.V.b. Performance Metrics**

ID	Description	Quantitative Performance Target	Effort Period
P.1	Four issues of Institute newsletter	Newsletter reach as reflected in click rate and open rate, both to be above industry average (20% and 6%, respectively)	Quarterly
P.2	Ongoing task: Website	Assessing website traffic to the projects through number of unique visits and average number of page visits: 100 unique visitors, accessing more than two pages per visit	Ongoing
P.3	Ongoing task: Social media	Number of social media members engaged with the Institute (such as number of followers, retweets, likes) to reach an equivalent to that of recently-established peer COEs (150 impressions on LinkedIn; Increase Twitter followership by 10%)	Ongoing
P.4	Ongoing task: News story	All newsworthy events have story posted within 24 hours of event.	Ongoing

**2.G. Education and Training**

The BTI Education and Workforce Project Manager will develop and carry out the BTI Institute’s Education and Training Initiatives Program (ETIP) work plan. The BTI Institute’s ETIP plan is designed with the primary goals (i) training, seminars and workshops critical to HSE, and (ii) establish a pathway for post-secondary students to pursue a career path with HSE. The BTI Institute is able to meet workforce training needs and support skill development with high quality, timely workforce development offerings to address critical needs of current HSE employees. The BTI Institute can build connections through educational course offerings, trainings, and internships to facilitate interest in HSE careers with post-secondary students.

The specific BTI Institute objectives will be to facilitate course development, course offerings, and internship programs. Engaging with HSE to provide opportunities that will directly benefit HSE, including the BTI Institute’s research and education activities, capabilities, and outputs that are tailored to their needs. Key strategies involve face-to-face workforce development courses that can be transitioned to online offerings. The purpose will be to strengthen the HSE relationship, support HSE employees, and develop a long-term relationship between HSE departments and agencies, and BTI Institute.

A major component aim will be to recruit and train current and future workforce participants in areas related to the BTI Institute’s mission. Through ETIP, the BTI Institute will use a mixture of workforce development, and internship programs to educate audiences, especially those from diverse backgrounds, to engage in content areas and professional development related to HSE. Through these programs, the BTI Institute seeks to expand knowledge in the areas of HSE culture and operations, knowledge of borders, trade and immigration as well as joint border management related content, and leadership. This outreach is designed to motivate participants to pursue education, research, and career opportunities in HSE fields.

Another component of the ETIP is to expand the value that the BTI Institute brings to HSE through engagement of a post-secondary audience. The specific objective will be to increase awareness of issues across a variety of disciplines. The general strategies for this audience will be to develop academic courses related to borders, trade, and immigration as well as joint border management for degree seeking students. This will be accomplished through academic course development and offerings.

**2.G.I.a. Milestones**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
M.1	Develop ETIP events (training, seminars and workshops) critical to HSE	ongoing
M.2	Create a path for post-secondary students to pursue a career in HSE	ongoing
M.3	Facilitate career development for current DHS personnel	ongoing

**2.G.I.b. Outputs (TBD)**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
D.1	Conduct six ETIP events	Nov 2018 Mar 2019 May 2019
D.2	Develop Cross-Border Fellowship Program	ongoing
D.3	Award Scholarships for students pursuing advanced degrees in HSE	Mar 2019

**2.G.I.c. Performance Metrics (TBD)**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
P.1	Distribute reports and evaluations from ETIP events to OUP	Dec2018 April 2019 June 2019
P.2	Submit DHS approved Cross Border Fellowship Program to OUP	Mar 2019

### 3. BTI Institute Projects

- 1) Ioannis A. Kakadiaris, University of Houston, "EDGE: The 'Eye in the Woods' Image-based Human Detection and Recognition System"

#### Abstract

Trail cameras can provide images of people crossing locations where cameras have been placed. EDGE aims to analyze trail camera images to detect the presence of people, detect and recognize faces that can be matched to known crossers, count the number of people, and detect carry-load (gun, bag) to characterize individuals. The **innovativeness** of the work lies in the fact that it will utilize existing source infrastructure, (i.e., the network of trail cameras), and analyze both daylight visible (VIS) and nighttime near infrared (NIR) images. The **originality** of the objectives of this work is that it will create (i) an integrated approach to image-based analysis for human crossing detection and (ii) a system that will provide meta-information to help the operators understand human crossing on the larger scale, reveal interdependencies between actors and places and derive possible patterns of movement and detailed activity parameters, such as carry load. The proposed system will be designed on top of a scalable private cloud-driven prototype to facilitate quick and straightforward uptake for **transition to industry level settings**. It is anticipated that the research outcomes of the EDGE project will result in successful detection and recognition of person-of-interest and provide data-driven accurate insight to the whereabouts and activity patterns of human crossers.

#### 1. Introduction and Rationale

In the last decade, a number of human surveillance databases have been created and published (e.g., Sface [1], NIRFace [2], CASIA NIR-VIS 2.0 [3], and [4]). However, these databases were captured indoor under controlled conditions, and they contain limited number of subjects. Another group of databases focusing on pedestrians include Caltech [5], GM-ATCI [6], and NICTA [7]. However, these databases focus on detecting pedestrians in urban environments. To detect human crossings and suspicious action in non-urban environments, we propose to create a system for the identification of human crossers using existing sources, that is trail cameras under both daylight and night time. Creating an outdoor database that contains images captured under both daylight and night time is challenging due to: (i) the affection of weather, (ii) the availability of volunteers, (iii) the accuracy of participant actions and (iv) the limitation of human resources for data annotation. Most published databases are captured either in a controlled lab condition with limited number of participants or in a surveillance area (in the city or in a campus) where they do not control the people crossing cameras. The proposed system will effectively analyze images from trail cameras and identify the individuals, aiming to reveal the insights of identified crossers' numbers, locations, frequency of operations and modus operandi. Detailed image analysis for face detection and recognition under uncontrolled acquisition conditions (weather, lighting, distance of subjects, partial visibility) aims to result into meaningful and holistic overview of identified crossers and their characteristic conditions (carry / non-carry weapon and other load, direction, timing).

**Intellectual merit:** The project will develop new research capabilities, advancing the knowledge and understanding of crosser detection and movement direction analysis, proposing new methods



for pedestrian detection from VIS and NIR images, and evaluation of cross-domain facial matching for VIS and NIR images.

**Student success:** In addition to the graduate students funded to work on the project, it is expected that this effort will contribute to the summer research experience of two undergraduate students per year from the UHCS REU program. Also, it will contribute to the knowledge of local high-school students with a focus on STEM disciplines, since we plan to host visits, with an estimated total involvement approx. 100 people/year based on the outreach events that we organize.

## 2. Project Goal and Objectives

**The goal of the project** is to create a system to automatically detect and match human subjects from trail camera image. The **specific objectives** are the following: **(1)** Deploy a private cloud-based software system for analyzing the image data received from trail cameras and a database and information retrieval API for storing all data and meta-data; **(2)** Evaluate state-of-the-art algorithms and develop as needed algorithms to classify and tag the acquired images (VIS and NIR) by: (i) human presence or no human presence and (ii) if human presence is detected, classify whether or not the image is usable for face recognition (Module 1); **(3)** Acquire, curate and annotate images by trail cameras (VIS and NIR) in non-urban environments; **(4)** Evaluate state-of-the-art algorithms and develop as needed algorithms to perform face recognition using VIS images and evaluate algorithms for NIR-based Face Recognition (Module 2); **(5)** Develop and implement an algorithm to extract (for each image tagged to have human presence) the following information: (i) direction of movement of the individual or group, and (ii) carry-weapon / carry-load / no-carry (Module 3); **(6)** Evaluate the proposed system, modules and algorithms.

## 3. Methodology

An iterative design methodology will be applied across all objectives to ensure that the annotation framework, the analysis modules, the APIs and the database are implemented according to the functional requirements described in the objectives and will be elaborated by the design team.

**Objective 1:** The private cloud-based infrastructure for the design, testing, integration and validation of the modules of EDGE will be set up on the CBL servers using GPU-accelerated software services and CBL image and data analysis modules. This integrated environment will offer testing and validation capabilities for the project team to successfully, store, analyze and annotate the trail camera images. Additionally, the quality assurance metrics, validation and testing activities for the system integration will be developed.

**Objective 2:** The following will be performed to achieve this objective: (a) create a pedestrian detection algorithm by retraining SSD network (source code available) on Caltech-USA database and achieve close (no more than 5% of increment of error) to the current state-of-the-art accuracy for both visible and NIR images; (b) improve human head localization accuracy in pedestrian

detection by training the deep network structure model to employ new bounding box annotations; (c) integrate the algorithms to the annotation system and design semi-automatic annotator interface. The first step in the analysis of images acquired by a trail camera is to identify the presence of human(s). Building on recent success of deep network approaches, we propose an integrated method for human detection, and detection and localization of their facial region.

*Human detection:* Our system will be built upon a state-of-the-art deep neural network architecture [8], namely ‘SSD: single shot multi-box detector’. It will exploit multiple layers for prediction and achieve real-time performance in a 300x300 inputs. The network structure is depicted in Fig. 2. We expect to obtain similar performance as the authors introduced in [9]. Then, we will extend

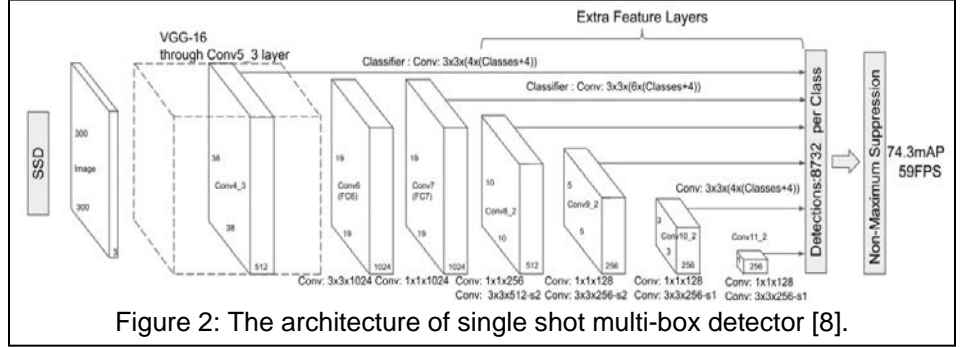


Figure 2: The architecture of single shot multi-box detector [8].

this architecture to detect human pedestrian in NIR images and improve its performance. In training, ground truth bounding box information needs to be assigned to specific outputs in the fixed set of detector outputs – anchor boxes. Once this assignment is determined, the loss function and back propagation are applied end-to-end. Training also involves choosing the set of default boxes and scales for detection as well as hard negative mining and data augmentation strategies. Let  $x_{ij}^p = \{1, 0\}$  be an indicator for matching the  $i^{\text{th}}$  default box to the  $j^{\text{th}}$  ground-truth box of category  $p$ . In pedestrian detection, we have one bounding box category. In the matching strategy above, we can have  $\sum_i x_{ij}^p \geq 1$ . The overall objective loss function is a weighted sum of the location loss  $L_c(x, c)$  and the confidence loss  $L_l(x, l, g)$ :

$$L(x, c, l, g) = \frac{1}{N} (L_c(x, c) + L_l(x, l, g)) \quad ,$$

where  $N$  is the number of matched default boxes. If  $N=0$ , we set the loss to 0. The localization loss is a smooth  $L_1$  loss between the predicted box ( $l$ ) and the ground truth box ( $g$ ) parameters. Similar to Faster R-CNN, we will regress to offsets for center ( $cx, cy$ ) of the default bounding box ( $d$ ) and for its width ( $w$ ) and height ( $h$ ).

$$L_l(x, l, g) = \sum_{i \in Pos} \sum_{m \in \{cx, cy, w, h\}} x_{ij}^k \text{smooth}_{L_1}(l_i^m - \hat{g}_j^m)$$

$$\hat{g}_j^{cx} = (\hat{g}_j^{cx} - d_i^{cx}) / d_i^w \quad , \quad \hat{g}_j^{cy} = (\hat{g}_j^{cy} - d_i^{cy}) / d_i^h \quad , \quad \hat{g}_j^w = \log\left(\frac{g_j^w}{d_i^w}\right)$$

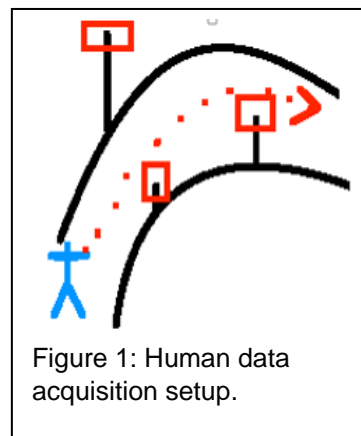
$$\hat{g}_j^h = \log\left(\frac{g_j^h}{d_i^h}\right) \quad .$$

The confidence loss is the soft-max loss over multiple classes confidence ( $\mathbf{c}$ ):

$$L_{conf}(\mathbf{x}, \mathbf{c}) = -\sum_{i \in Pos} x_{ij}^p \log(\hat{c}_j^p) - \sum_{i \in Neg} \log(\hat{c}_j^0) \text{ where } \hat{c}_j^p = \frac{\exp(c_i^p)}{\sum_p \exp(c_i^p)}$$

*Head localization and face detection:* Having obtained the bounding boxes of human, the positions of heads need to be obtained for further analysis. As reported in [10], current algorithms may not have such high accuracy to localize the head accurately in all the image frames. Inspired by facial key-point localization [11], for fast processing, we will extend the aforementioned architecture with deconvolutional layers, construct a U-Net architecture [12], and output a feature map  $\varphi$  that indicates the position of head. The outputs of SSD will be transformed into a probabilistic map  $\omega$  where each pixel indicates the probability of the appearance of human body. This probabilistic graph will be used as an attention map as [13], and dot multiplied with the generated feature map  $\varphi$  to determine the final position of human's head. Note that a traditional face detector can also help to obtain the head position if the detector is fast and accurate enough to satisfy our needs. In our preliminary study with the headhunter face detector [14], we have found it to be robust in most cases. In our dataset, UHDB31, in the setting of resolution of 128x128 (the mean face ROI is 65), the headhunter face detector can detect at least 94% of the face region. In the setting of resolution of 256x256 (mean face ROI is 134), the headhunter face detector can detect at least 95% of the face region. We will evaluate the use of this detector for the data acquired in Objective 1. We will include state-of-the-art commercial face detectors that can be acquired for a no fee license.

**Objective 3:** Data will be acquired on the University of Houston campus and will involve volunteers recruited from existing faculty, staff, and students. The University of Houston is an urban campus but includes several areas with dense foliage of trees that would be suitable for data collection. We propose to acquire data in an identified region with reasonably dense foliage. Recruited volunteers will be asked to walk along an outlined trail, as shown in Figure 1. Trail cameras will be mounted on existing trees or on tripods such that multiple views can be captured along the trail. Cameras will be mounted at a height similar to deployment settings. Volunteers will participate in two capture sessions, one during day time and another at night time. Repeated acquisition sessions will involve the volunteers in walking along with trail. We will also acquire 2D and 3D mugshots of each of the volunteers to serve as the watchlist. The annotation process will be semi-automatic and will leverage existing methods for human detection and the detections will be approved or edited by the annotators. The annotation tasks will include outlining a bounding box for human, bounding box for face, and landmark annotation.



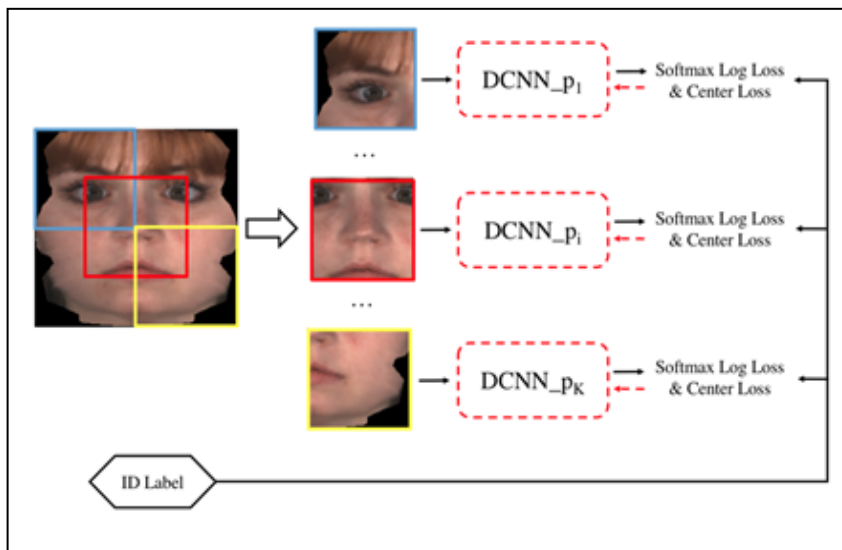
**Objective 4:** Face recognition in images is a great challenge that EDGE aims to resolve by advancing the domains of 3D-aided pose normalization and template generation. Each of the

proposed modules will be developed for VIS and NIR images. Cross-domain matching is a critical component to facilitate matching across the two image modalities.

*3D-aided pose normalization:* Several recent works have demonstrated the benefits of 3D-aided pose normalization in improving the visible face recognition performance against pose variations. In VIS-NIR face recognition, however, 3D information is seldom exploited. In practical applications, such as night-time video surveillance, it should be expected that facial images with non-frontal pose will prevail. As a result, 3D-aided pose normalization is promising in improving the VIS-NIR face recognition performance in practical applications. The proposed 3D-aided pose normalization algorithm will be based on one of our previous work as described in Kakadiaris *et al.* [15]. It consists of four sub modules, namely facial landmark detection, 3D facial shape reconstruction, 3D-2D pose estimation, and 3D-aided texture lifting. Among these sub modules, facial landmark detection is critical as it is required for 3D face reconstruction and 3D-2D pose estimation. As demonstrated in Reale *et al.* [16], facial landmark detector trained on visible facial images works well on NIR images. As a result, we will use our proposed facial landmark detector (UH-GoDP) as described in Wu *et al.* [11]. For 3D facial shape reconstruction, we will use our proposed 3D face reconstruction algorithm (UH-2FCSL) as described in Dou *et al.* [17], which only requires facial landmarks, and thus is compatible with NIR facial images. For 3D-2D pose estimation and 3D-aided texture lifting, we will use the same algorithms as described in our previous work [15].

*Cross-domain matching:* We will evaluate the state-of-the-art algorithms in detail to determine whether there is a need to develop a new algorithm.

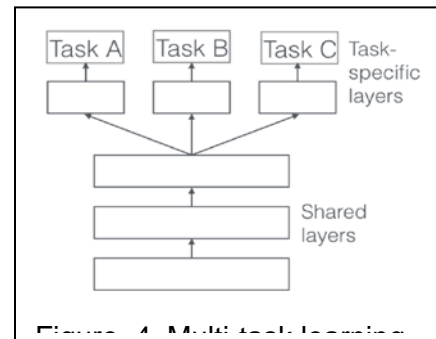
*Pose-robust template generation:* Pose variation in facial images causes self-occlusion, which can be estimated but cannot be resolved through 3D-aided pose normalization. It can degrade severely the face recognition performance if not properly handled. We will employ the UH-DPRFS algorithm, proposed in our previous work [18], to solve the self-occlusion in facial images and create pose-robust facial signature. We propose to segment the lifted facial texture of the VIS/NIR image into multiple overlapping local patches.



For each local patch, we will estimate its self-occlusion encoding by computing the ratio of self-occluded image pixels. If it is not self-occluded, it will be fed into the ST-CNN and the DCNN trained on visible facial images to extract the feature. In this way, for each VIS/NIR facial image, an ensemble of deep features extracted from all the non-occluded local facial patch is created, which we call pose-robust facial signature. The benefits of the proposed pose-robust facial signature are twofold. First, the ensemble of local feature is more discriminative than a single feature, as we will train multiple DCNNs, each for a local patch. Second, the explicit self-occlusion

encoding facilitates the matching of two pose-robust facial signatures, as only local features that are non-occluded in both signatures will be compared.

**Objective 5:** Below we present the approach to extraction of meta-information from the analyzed images. Having detected an individual in an image, meta-data can be useful in analysis of trajectories or activities using location, time or type of load, providing unique insight into the network of trafficking in the areas of coverage by the trail cameras. Towards this direction, we will leverage the recent progress of learning multiple tasks at the same time by developing novel architectures trained on a vast number of images of humans. An illustrative example of a multi-task learning architecture is depicted in Fig. 4. Given an image of a human as an input, feature representations are first extracted in the shared layers. These representations are shared across all tasks. Then for each visual attribute of interest (task A can be “carrying load”, task B can be “carrying weapon” color) task-specific feature representations are learned. By learning tasks that are related to each other we can model their co-occurrence and make better predictions. Such architectures, will first extract meaningful feature representations that are going to be shared across all tasks (i.e., attributes to be predicted) and then separate branches will learn attribute-specific features that will be fed to a classifier that will predict the presence or not of the attribute of interests. This will allow us to model the co-occurrence of attributes. For example, we will learn if the human is carrying a load or not, and if there’s a weapon visible or not. We argue that task similarity and thus the sequence in which attributes should be learned is not binary but resides on a spectrum. In the same way that humans learn with different curricula depending on the task, the process of finding a curriculum that is beneficial for all tasks cannot have an optimal single solution. Transferring knowledge between related tasks is not beneficial as during the joint multi-task learning training the parameter sharing plays that role. Additionally, transferring knowledge between attributes that do not co-occur (or they are semantically completely different) has an adverse effect on the performance. A difficulty that arises with some of these visual attributes is that their presence/visibility in images can be limited. For example, detecting the presence of a weapon in an image is a very challenging task. The reason for that is that in most of the available images there is no-carry and only in a few there is a carried weapon that is visible even from a human’s perspective. This creates a highly imbalanced problem in which the class of interest (carry-weapon) is a rare scenario in the available images. Novel techniques that will sample instances of the minority class will be implemented. Moreover, the use of meta-data will enable faster and more accurate classification of future images by training a DNN with more features, all derived from the EDGE analysis. Due to the presence of imbalanced data using the classification accuracy as an evaluation metric is not sufficient. The reason for this is that if our training set consists of images in which “no weapon” is true for 90% of the cases then a classifier that always predicts “no weapon” will be 90% accurate. Thus, the recall of the system and the area under the ROC curve will also be measured and reported to ensure that the proposed system works well.



**Objective 6:** Evaluation and performance metrics. Human detection (objective 3), will be evaluated on Caltech-USA database [19] (VIS) and our own database (NIR) in terms of the human detection/localization. We will employ the new tags annotated by the authors of [20]. By default, an IoU threshold of 0.5 will be used for determining True Positives in these datasets. The evaluation metric will be log average Miss Rate on False Positive Per Image. Facial feature

extraction (objective 3) will be evaluated on Caltech-USA database [19] (VIS) and our own database (NIR) in terms of the head localization accuracy. We will first tag the human's head either manually or based on an automatic head detector, then we will evaluate our algorithm with the new head labels. By default, an IoU threshold of 0.5 will be used for determining True Positives in these datasets. The evaluate metric is ROC curve. State-of-the-art cross-domain matching (objective 4) will be evaluated on the CASIA HFB database [21] for facial landmark detection and 3D facial shape reconstruction accuracy and the CASIA NIR-VIS 2.0 database [3] for the performance of ST-CNN. We will compare the Rank-1 identification rates with state-of-the-art academia algorithms and commercial-off-the-shelf (COTS) systems that the project team can access.

**Student Engagement:** The project will provide multiple opportunities for graduate student engagement. Five graduate students at the University of Houston will be assigned to assist in carrying out the tasks listed in Section 4.1 as part of their research assistantships. Tasks will be assigned based on the specific research topics each student is pursuing in preparation of his Ph.D. dissertation. This will allow each student to advance in pursuing his degree based on his work for this project.

## 4. Project Management

### 4.1. Tasks

T.1	Task title: Deploy private cloud-based infrastructure, design, testing and validation (Objective 1).  Task description: This task relates to the design and development of the EDGE backend framework for coherent monitoring (collection, parsing, processing, searching/ querying) and archival tool-chain.	Start	End
		1	6
		Deliverables	
		D.1	
T.2	Task title: Produce interactive exploration, demonstration video, and report for T.1 (Objective 1). Task description: Hold meeting with stakeholders to discuss report and demonstrate live the current software version (via screensharing and video recording). Set up a temporary cloud copy of software and data for stakeholders if they want to access and use cloud services.	Start	End
		1	6
		Deliverables	
		D.1	
T.3	Task title: Image annotation Modules (Objective 2).  Task description: The image annotation modules will use state-of-the-art algorithms to detect humans and point of interest using improved human head localization and points of interest classification.	Start	End
		1	9
		Deliverables	
		D.2	
T.4	Task title: Produce report for T.3 (Objective 2).	Start	End
		1	9
		Deliverables	
		D.2	

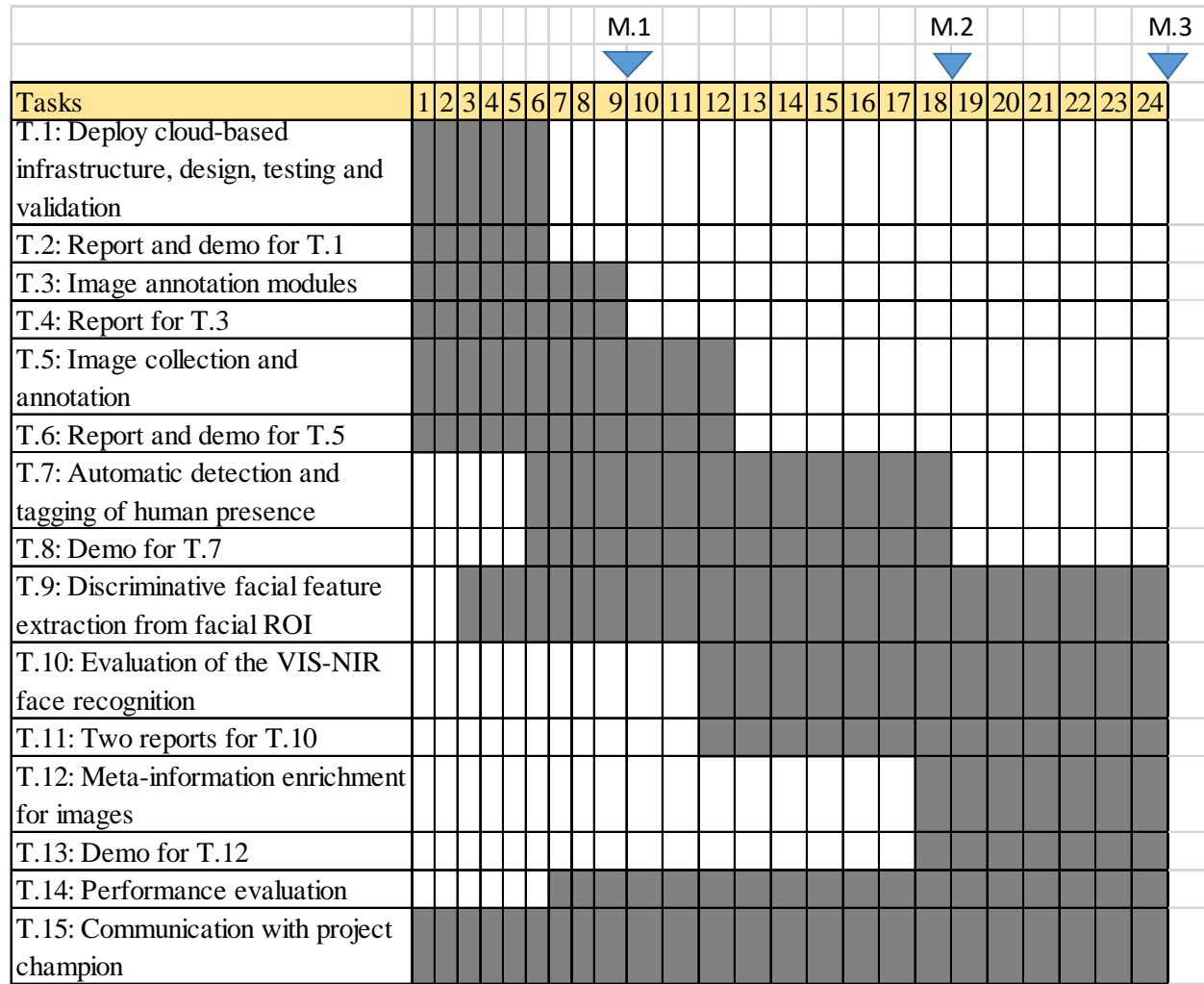
T.5	Task title: Image collection and annotation (Objective 3).  Task description: This task collects VIS and NIR images using appropriate cameras and annotates the features discussed in the methodology section.	Start	End
		1	12
		Deliverables	
		D.3	
T.6	Task title: Produce interactive exploration, demonstration video, and report for T.5 (Objective 3). Task description: Hold meeting with stakeholders to discuss report and demonstrate live the current software version (via screensharing and video recording). Set up a temporary cloud copy of software and data for stakeholders if they want to access and use cloud services.	Start	End
		1	12
		Deliverables	
		D.3	
T.7	Task title: Automatic detection and tagging of human presence (Obj. 1 & 4).  Task description: This task will create the APIs to leverage the private cloud storage system meta-information and classify new images for human-presence based on the image visual attributes and soft biometrics. It aims to effectively leverage co-occurrence of attributes that demonstrate high correlation.	Start	End
		6	18
		Deliverables	
		D.4	
T.8	Task title: Produce interactive exploration and demonstration video for T.7 (Objectives 1 and 4). Task description: Hold meeting with stakeholders to discuss report and demonstrate live the current software version (via screensharing and video recording). Set up a temporary cloud copy of software and data for stakeholders if they want to access and use cloud services.	Start	End
		6	18
		Deliverables	
		D.4	
T.9	Task title: Discriminative facial feature extraction from facial ROI (Obj. 4 ).  Task description: This task will propose new and extend existing methods to achieve facial pose normalization with 3D-aided facial texture lifting and pose-robust facial signature generation by aggregating pose-aware local deep facial features extracted with deep neural networks.	Start	End
		3	24
		Deliverables	
		D.5	
T.10	Task title: Evaluation of the VIS-NIR face recognition (Obj. 4 & 6).  Task description: This task evaluates the implemented facial landmark detection algorithm (UH-GoDP) on the VIS and NIR images and the 3D face reconstruction. In addition, state-of-the-art NIR Face Recognition algorithms will be evaluated in detail by month 18, and updated evaluations by month 24.	Start	End
		12	24
		Deliverables	
		D.6	
T.11	Task title: Produce two reports for T.10 (Obj. 4 & 6) at 18 and 24 months after project start, respectively.	Start	End
		12	24
		Deliverables	
		D.6	
		Start	End

T.12	Task title: Meta-information enrichment for images (Objective 5).  Task description: This task aims to create an automated method for enriching meta-information to images. The images will be processed on the private cloud system, identifying their point of interest and automatically annotating them with information from the modules implemented in tasks 7-10.	18	24
		Deliverables	
		D.7	
T.13	Task title: Produce interactive exploration and demonstration video for T.12 (Objective 5). Task description: Hold meeting with stakeholders to discuss report and demonstrate live the current software version (via screensharing and video recording). Set up a temporary cloud copy of software and data for stakeholders if they want to access and use cloud services.	Start	End
		18	24
		Deliverables	
		D.7	
T.14	Task title: Performance evaluation (Objective 6).  Task description: The EDGE system will be evaluated extensively with both public benchmarks and our curated database.	Start	End
		7	24
		Deliverables	
		D.8	
T.15	Task title: Communication with project champion (All Objectives).  Task description: The project team will formally communicate every three months with the project champion to address issues in design, customer feedback and user acceptance, data availability and the plans for the system transition after project ends.	Start	End
		1	24
		Deliverables	
		D.8	



## 4.2.

## Gantt Chart



## 4.3.

## Deliverables (MAS = Month after start)

ID	Description	Type*	MAS
D.1	EDGE Private cloud infrastructure	R, I, V	6
D.2	Image annotation algorithms and performance analysis	R	9
D.3	Image collection and annotation report	R, Pr, I,V	12
D.4	Detection and tagging of human presence in images	S, A, P, I, V	18
D.5	Processing of the head region-of-interest (ROI) for VIS-NIR images	S	24

D.6	Evaluation of cross-domain face recognition for VIS-NIR images	R	18, 24
D.7	Meta-information enrichment for images	S, I, V	24
D.8	Quarterly reports on communication with project champion	R, B	quarterly

\*Type of deliverable: **A**: Algorithm; **B**: Brief; **P**: Publication (Conference or Journal); **Pr**: Protocol; **R**: Report; **S**: Software (executable and source code); **V**: Video, **I**: Interactive exploration of the code and results

#### 4.4. Milestones

ID	Description	MAS	Means of verification
M.1	Image annotation module ready	9	Testing on existing databases
M.2	Robust pedestrian detection algorithm-based system is ready and tested	18	Improved human head localization accuracy and minimized sensitivity to background noise
M.3	EDGE integrated system is validated and tested	24	Tested on real data with improved accuracy on trafficker identification

#### 4.5. Performance Metrics

Research and Innovation KPIs		MAS	Means of verification
KPI-RI-1	Achieve >70% inter-annotator agreement for image annotation	9	T.3 Evaluation
KPI-RI-2	Achieve pedestrian detection accuracy within 5% of state-of-the-art both for VIS and NIR images	18	T.6 Evaluation
KPI-RI-3	Achieve more accurate face recognition Rank-1 rates than COTS	24	T.10 Evaluation
Dissemination KPIs (HSE, scientific community, public)		MAS	Means of verification
KPI-D-1	One event showcasing the EDGE technologies	15	T.15 Reporting
KPI-D-2	Two high impact publications	24	T.15 Reporting
KPI-D-3	Reference annotated dataset for VIS and NIR images	15	T.15 Reporting

#### 4.6.

#### Decision Points

ID	Performance Target (criteria for "go" decision)	Decision Date	Drop dead date
P.1	Successful backend implementation	6	9
P.2	State-of-the-art detection and analysis algorithms achieved	13	15
P.3	Fully working prototype for end-to-end analysis implemented	16	18

### 5. Transition Plan and Stakeholder Engagement

As per OUP, "Transition is defined as the process and eventual transfer of ownership and operation/maintenance of a product or system: Transfer of responsibility for a product or system from a research and development organization to a receiving activity, with subsequent integration of the product or system into the receiving activity's operations. For purposes of this definition, the term "operations" can include any phase of an acquisition program, capability development, or equivalent."

The transition plan will be updated and enriched at every meeting with the Project Champion (Mr. Arun Vemury, S&T, with domain knowledge support from Mr. Patrick Stewart, USBP – cf. Task T.15) to identify specific methods that the software will be tested by the USBP Enforcement Division in collaboration with DHS S&T University Programs office.

The CBL Team will employ a transition model sensitive to the unique needs of key stakeholders and the environment within which OUP operates. Specifically, the CBL Team will be using the ideas and concepts of the Mission Model Canvas (MMC) pioneered by Alexander Osterwalder and Steve Blank (<https://steveblank.com/2016/02/23/the-mission-model-canvas-an-adapted-business-model-canvas-for-mission-driven-organizations/>). This model provides a mission-oriented framework that measures success through benefits achieved, cost management, deployment, and stakeholder support. This is a transition away from a revenue-based business model.

The transition strategy employed by the CBL Teams will consist of a customer-centric process driven by the Project Principal Investigator and assisted by the CBL team, directly engaging with the Project Champion and any Stakeholders that he designates. Appendix C details the MMC that will be used to guide this process, which was developed by the PI on Phase 1 of this project. The CBL Team will also hold stakeholder meetings (one every six months) to track progress in developing the cloud hosted software deliverables, allow the stakeholders to explore the algorithm (either and to solicit feedback from the Project Champion and any Stakeholders that he designates. The meetings will be held using screensharing software to allow the research team to demonstrate software capabilities to remote participants. If the stakeholders are allowed to access and use cloud services, the research team will set up a temporary cloud copy of software and data for demonstration purposes. The demonstration videos will be part of the following deliverables from Section 4.3:

ID	Description	MAS
D.1	Interactive Exploration & Demonstration video: Cloud-based backend framework	6
D.3	Interactive Exploration & Demonstration video: Image annotation module	12
D.4	Interactive Exploration & Demonstration video: Detection of human presence in images	18
D.7	Interactive Exploration & Demonstration video: Tagging of human presence in images	24

## 6. Programmatic Risks and Mitigation Plans

ID	Description of Risk	Tasks	Severity*	Proposed mitigation measures
R.1	Miscommunication with project champion	T.15	high	Clarification information request

\*Severity to completion of the project: high; medium; low

## 7. Key Personnel Qualifications Synopsis

Dr. Ioannis A. Kakadiaris is an expert in biometrics, computer vision, data analysis, pattern recognition, and biomedical image analysis.

## 8. Available Resources, Facilities, and Leveraged Funding

All resources and facilities that will be used are located at the Computational Biomedicine Lab, University of Houston, <http://cbl.uh.edu>

## Appendix A. Literature Review

**Related to Objective 3:** Human detection, also known as the pedestrian detection in computer vision research, is the first and most fundamental step for human recognition. The output of human detection are bounding boxes indicate the locations of each individual in the captured image. Zhang *et al.* [22] identified the main challenges in human (pedestrian) detection: (i) localizing overlapping human in the crowd, (ii) discriminate human with vertical background structure, and (iii) detecting far away, small human bodies. To address the first challenge, Tian [23] proposed a deep learning method that consists of extensive part detectors. Each detector can detect human by observing only a part of a proposal. Hence, the method can detect individual human under heavy occlusions. Lee [24] proposed a method that models each detection using its quality and similarity to other detections. The method overcome the drawbacks in non-maximum suppression, and more sensitive to individuals under overlapping conditions. To tackle the second challenge, Mao *et al.* [25] proposed a method that exploited extra semantic context (e.g., edge map, segmentation map) for human an detection, which provides the detectors with additional detailed information. For the third challenge, to detect the small human, Liu *et al.* [26] proposed an efficient single-shot detector that outputs of multi-scale convolutional bounding boxes, which achieves high-accuracy using relative low resolution inputs. Zhang *et al.* [9] employ a flexible boosted forest on the high resolution feature maps of a VGG-16 networks [27] to increase the sensitivity to small human bodies and facilitate hard negative mining. Currently the majority works of human detection are based on visible lights, there are few works [28] [29] based on NIR, these approaches are able to detect human at night.

**Related to Objective 4:** Extensive research has been conducted to alleviate the gap between the two modalities, resulting in a number of works that can be categorized into three categories, namely synthesis-based, projection-based, and feature-based approaches. In the first category, NIR facial images are transformed to synthesize VIS images that can be matched directly via VIS face matcher. Representative works in this category consists of Chen *et al.* [30] that employed the locally-linear embedding of NIR local patch to synthesize the corresponding VIS local patch based on a collection of VIS-NIR training pairs, Pengfei *et al.* [31] that learned a probabilistic statistical model of the mapping between the two modalities, and Juefei-Xu *et al.* [32] that trained a coupled-dictionary model of the two modalities such that the dictionary coefficients of the NIR image can be used directly to reconstruct the corresponding VIS image. **The major limitation** of such methods is that they require well-registered pair-wise VIS-NIR facial images for training, which is not feasible due to the limited amount of available training data. Yi *et al.* [33] employed canonical correlation analysis (CCA) to derive the common subspace model of the two modalities, Huang *et al.* [34] that proposed a discriminative spectral regression (DSR) approach to map VIS/NIR images into a common discriminative subspace, and Yi *et al.* [35] that employed Restricted Boltzmann Machines (RBMs) to derive a common subspace that features a non-linear mapping from VIS or NIR images to the their corresponding subspace representations. Feature-based approaches treat the modality gap as complex illumination variations and propose to address the discrepancy by using effective illumination invariant features. Among these approaches, Gong *et al.* [36] proposed a feature learning framework to derive a learned descriptor that maximize the correlation between the two modalities, Liu *et al.* [37] proposed Light Source Invariant Features (LSIFs), which is also a learned feature to bridge the gap between VIS and NIR images, and Zhu *et al.* [38] proposed a hand-crafted logarithmic Difference of Gaussians (Log-DoG) feature to alleviate the illumination effect and noise while preserving the discriminative information. He *et al.* [39] proposed employing deep neural networks (DNN) to derive a common

subspace for both modalities. To overcome the limitation of inadequate training data, they proposed using a large set of visible facial images to initialize the DNN weights and using a relative small set of VIS-NIR image pairs to fine-tune the DNN. Similarly, Liu *et al.* [8] also proposed using visible facial images to initialize the DNN. To better exploit the limited VIS-NIR training data and improve the discriminative capability of the network, they proposed using triplets of VIS and NIR images to fine-tune the DNN. Wu *et al.* [40] proposed a Max-Feature-Map (MFM) activation function for convolutional neural networks (CNN) to improve the network generalization capability and robustness to noisy labels in large scale training databases. By training on millions of visible facial images, they achieved comparable performance in VIS-NIR face recognition compared with [8] [39]. Similarly, by using a DNN trained on visible facial images, a cross-spectral hallucination module that transform facial image from the NIR spectrum to visible spectrum, and a low-rank embedding of the DNN features, Lezama *et al.* [41] also achieved VIS-NIR performance on-par with [8] [40] [39]. Compared with visible face recognition, VIS-NIR face reconstruction introduced an additional adverse factor, which is the modality discrepancy between the visible spectrum and the NIR spectrum. As demonstrated in [13, 40] such a heterogeneity between the two modalities can be alleviated by image synthesis that transforms NIR image to VIS image [40] or robust feature extraction and embedding with deep neural networks trained on a large set of visible facial images [13] Although such methods achieve promising performance on public benchmarks, their performance **may degrade in practical deployment due to variations in image quality, resolution, and facial pose.**

**Related to Objective 5:** Effectively predicting the corresponding visual attributes of a human given an image remains a challenging task. The first to investigate the power of visual attributes were Ferrari and Zisserman [42]. They used low-level features and a probabilistic generative model to learn attributes of different types (e.g., appearance, shape, patterns) and segment them in an image. Kumar *et al.* [43] proposed an automatic method to perform face verification and image search. They first extracted and compared “high-level” visual features, or traits, of a face image that are insensitive to pose, illumination, expression, and other imaging conditions, and then trained classifiers for describable facial visual attributes (e.g., gender, race, and eyewear). A verification classifier on these outputs is finally trained to perform face verification. In the work of Scheirer *et al.* [44], raw attribute scores are calibrated to a multi-attribute space where each normalized value approximates the probability of that attribute appearing in the input image. This normalized multi-attribute space allows a uniform interpretation of the attributes to perform tasks such as face retrieval or attribute-based similarity search. Finally, attribute selection approaches have been introduced [45] [46] [47] which select attributes based on specific criteria (e.g., entropy). Zheng *et al.* [48] formulated attribute selection as a submodular optimization problem [49] and defined a novel submodular objective function. Following the deep learning renaissance in 2012, several papers [50] [51] have addressed the visual attribute classification problem using ConvNets. Part-based methods decompose the image to parts and train separate networks which are then combined at a feature level before the classification step. They tend to perform well since they take advantage of spatial information (e.g., patches that correspond to the upper body can better predict the t-shirt color than others that correspond to other body parts). Zhang *et al.* [52] proposed an attribute classification method which combines part-based models in the form of poselets [53], and deep learning by training pose-normalized ConvNets. Gkioxari *et al.* [50] proposed a deep version of poselets to detect human body parts which were then employed to perform action and attribute classification. Finally, visual attributes have been employed recently for re-identification [54] [55], pose estimation [56], 3D pose tracking [57], attribute mining and

retrieval for clothing applications [58] [59], zero-shot visual object categorization and recognition [60] [61], image annotation and segmentation [62], as well as surveillance [63].

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## Beneficiary / End User Profile: Jobs

- DHS strategy officials: Analysts
- Enforcement Systems Division: Dispatchers

## Beneficiary / End User Profile: Desired Gains

- A method that will **accurately** identify individuals in **real-time** to enable the dispatchers to alert the agents dispatched in the field

## Beneficiary / End User Profile: Pain Points

- The methods currently available have **limitations** for matching images where a person's face is **partially visible** due to **pose** or **illumination**

## Products & Services

- The product is a **software prototype** for matching a facial image to a gallery of facial images with variety of poses and illuminations. The functionalities for the prototype software include:
  1. computing a biometric template (derived by the UH software) from an image
  2. ability to ingest a set of images to create a gallery
  3. matching biometric templates from a probe image to a gallery of templates

## Gains Created

- This product aims to enable the US BP dispatchers to accurately match images in existing databases by providing a beyond-state-of-the-art method for identification

## Pains Alleviated

- Enhancement of the overall situational awareness of the Border Patrol units
- USBP officer increased safety
- Effort and time savings
- Anticipation of future actions by modelling routes and habits of repeat offenders

- 2) [Placeholder for Work plan]
- 3) [Placeholder for Work plan]
- 4) [Placeholder for Work plan]
- 5) [Placeholder for Work plan]

**BTI Education Projects**

**3.A.I. Border Studies Initiative**

Through the University of Houston, the BTI Institute will host a series of Border Studies Symposia/Workshops that will facilitate the Institute's mission to educate the current and future DHS workforce. The symposia/workshops will be part of a process that is designed to culminate in a “National Security and Border Studies” degree program and/or certificates at the University of Houston. The following outline summarizes the Border Studies Workshop plan for FY4.

**Education and Workforce Development Roundtable**

This roundtable (done as a teleconference/webinar) will bring together education and training program managers from DHS key components (CBP, ICE, USCIS, USCG, and FBI) with representatives from the BTI Institute to discuss the proposed framework and solicit specific educational needs, problem sets, and best practices. These needs will be shopped with other BTI Institute stakeholders to refine curriculum and presentations to build the Symposia/Workshops. (Appendix A, Stakeholder List)

**Border Studies Symposia/Workshops/Brown Bags**

Two (2) day workshops based around generic themes will be held during FY19. Continuing Education Units will be provided to DHS personnel in attendance. Invitees will vary based on workshop theme and will include local representatives from major Houston offices including the CBP Houston Laboratory SW Regional Science Center, CBP Port Manager at George Bush Intercontinental Airport, US Immigration and Customs Enforcement. An External Advisory Board member and a BTI Institute researcher/research committee member will be tagged for each event to support and add expertise.

**3.A.I.a Milestones**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
M.1	Complete two Border Studies workshops	Nov 2018; May 2019
M.2	Complete three Brown Bag Sessions	Nov 2018; Mar 2019; May 2019

**Outputs (TBD)**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
D.1	Border Studies Workshop Report with evaluations	Jun 2019

D.2	Brown Bag sessions report with evaluations	Nov 2018; Mar 2019; May 2019
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**Performance Metrics (TBD)**

ID	Description	Effort Period
P.1	Border Studies Workshops census 50 participants; >90% highly satisfied on logistic rating metrics	Jun 2019
P.2	Brown Bag Sessions 15 enrolled per offering; three offerings from student population, three offerings from DHS workforce	Dec 2018 Mar 2019 Jun 2019

In concurrence with the workshop development, the education component of the BTI Institute's mission can grow from workshop sessions (CEUs) to a certificate granting process. This would depend on the organizations that support such a certificate and the time and procedures required to bring this to reality. The same can be said about a degree path (minor, major, and graduate). Investigation to determine if other institutions of higher education have a similar degree program is underway. If so, we can augment by offering transferable hours.

**3.A.II. Summer Research Team for Minority Serving Institutions**

The BTI Institute will host a summer research team focused on issues relating to securing the nation's borders, facilitating legitimate trade and travel, and ensuring the integrity of our immigration system. This Summer Research Team Program for Minority Serving Institutions is offered through the Department of Homeland Security Science and Technology Directorate Office of University Programs and is overseen by the Oak Ridge Institute for Science and Technology. Early career faculty and two students from Minority Serving Institutions (MSIs) will be selected to conduct research at the twelve Centers of Excellence for ten weeks during summer 2019. This program is designed to provide research opportunities and enhance scientific leadership at MSIs in areas that support the mission and goals of DHS. The goals of the program include identifying meaningful and innovative ways to integrate Minority Serving Institutions into DHS science and technology research areas; identifying collaborative follow-on research projects between Minority Serving Institutions and the DHS Centers of Excellence; and providing a knowledge-sharing opportunity between Minority Serving Institutions and the DHS Centers of Excellence.

**3.A.II.a. Milestones (TBD)**

ID	Description	Effort Period
M.1	Confirm with ORISE BTI interest in hosting MSI SR Team	Sep 2018
M.2	Submit list of potential collaborator applicants to ORISE	Jan 2019
M.3	Identify UH Mentor	Feb 2019
M.4	Select team	Mar 2019



M.5	Host Summer Research Team	May-Jul 2019
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**3.A.II.b. Outputs (TBD)**

ID	Description	Effort Period
D.1	Summer Research Team report with evaluations	Aug 2019
D.2	UH Mentor Evaluation	Aug 2019

**3.A.II.c. Performance Metrics (TBD)**

ID	Description	Effort Period
P.1	UH Mentor Evaluation is above average to exemplary	Aug 2019
P.2	Research team report/presentation evaluation by Research Committee	Aug 2019

**3.A.III. Homeland Security Summer Internship Program**

The BTI Institute will host up to six interns from the U.S. Service Academies and/or traditional four-year public/private universities for approximately 30-day internships to work on agreed upon research topics addressing issues in border security, legitimate trade and travel and immigration. Interns will conduct research relevant to CBP's mission and present the results of their research to BTI Institute faculty and staff at the conclusion of their internship. Each intern will be assigned a sponsor from the BTI Institute staff and/or faculty to oversee their research efforts during their stay in the Houston area.

**3.A. Milestones**

ID	Description	Effort Period
M.1	Contact Institutions to express interest in hosting Summer Interns	Sep 2018
M.2	Identify BTI project activities for suitable for summer interns	Jan 2019
M.3	Institutions notify BTI of students selected to participate	Feb 2019
M.4	Students arrive at BTI Institute	Jun 2019
M.5	Students give presentations	Jul 2019

**3.A.I.a. Outputs (TBD)**

ID	Description	Effort Period
D.1	Student presentations and summary report and evaluations to OUP	Aug 2019

**3.A.I.b. Performance Metrics (TBD)**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
P.1	BTI receives feedback from students on overall experience Target: 100% response on evaluations; 100% evaluations rated as excellent	Aug 2019

**3.A.IV Scholarships**

The BTI Institute will solicit applications from graduate students at the University of Houston to compete for three scholarships in FY4. Scholarships will be awarded in the amount of \$1,500 and one scholarship will be awarded in each of the following three thematic areas: 1) Border Security; 2) Legitimate Trade and Travel; 3) Immigration. Students will be asked to submit an original essay (maximum 1500 words). Students eligible to apply for these BTI scholarships will meet the following minimum criteria:

- 1) U.S. citizen
- 2) Current full time graduate student having completed a minimum of 60 semester credit hours with cumulative grade point average of no less than 3.30, or;
- 3) DHS (CBP, USCIS or ICE) personnel actively pursuing advanced degree as part-time student and in good academic standing.
- 4) Interested in a career path leading to a position in one of the following DHS agencies; U.S. Customs & Border Protection, U.S. Citizenship & Immigration Services, and U.S. Immigration & Customs Enforcement.

Essays will be judged on the following criteria: 1) originality of subject matter; 2) relevance to thematic area; 4) student’s awareness of Department of Homeland security mission and relevance of particular topic to agency-specific strategic plan. The award will be in the form of an unrestricted education grant that the student can apply toward any education-related or research-related expense.

**Milestones (TBD)**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
M.1	Announce the Scholarship Opportunity	Oct 2018
M.2	BTI Review of Applications	Dec 2018
M.3	BTI Selection of Scholarships Recipients	Jan 2019

**Outputs (TBD)**

<b>ID</b>	<b>Description</b>	<b>Effort Period</b>
D.1	Report on Scholarship Competition including recipient essays to OUP	Feb 2019

**Performance Metrics (TBD)**

ID	Description	Effort Period
P.1	BTI Successfully Competes and Awards three Scholarships	Oct 2018-Feb 2019

**3.A.V. Cross-Border Fellowships**

The BTI Institute will develop a Fellowship program to facilitate graduate student research in Border Studies. This Fellowship will be created in conjunction with the Monterrey Institute of Technology and Higher Education in Monterrey, Mexico and the Cross Border Institute at the University of Windsor in Windsor, Ontario, Canada.

**4. APPENDIX I. List of acronyms**

AAEI	American Association of Exporters and Importers
AEER	Apex Air Entry/Exit Re-engineering
BMD	Borders and Maritime Security Division
BTI	Borders, Trade, and Immigration
CBP	Customs and Border Protection
CBSA	Canadian Border Services Agency
CBTIR	Center for Borders, Trade, and Immigration Research
COE	Center of Excellence
ConOps	Concept of Operations
COTS	Commercial off-the-shelf
C-TPAT	Customs-Trade Partnership against Terrorism
DHS	Department of Homeland Security
DOJ	Department of Justice
EAB	External Advisory Board
ERP	Energy Research Park
FOA	Funding Opportunity Announcement
HSE	Homeland Security Enterprise
HSI	Homeland Security Investigations
HSTC	Human Smuggling and Trafficking Center
HSUP	Homeland Security University Programs
I/UCRC	NSF Industry/University Cooperative Research Centers Program
IARPA	Intelligence Advanced Research Projects Activity
ICE	Immigration and Customs Enforcement
IEEE	Institute of Electrical and Electronics Engineers
IMAVIS	Image and Vision Computing (Journal)
IPD	Inter-pupillary distance
IT	Information technology
ITAR	International Traffic in Arms Regulations
LBSSr	Log-based single-scale retinex

MSI	Minority Serving Institution
MSR	Monthly Status Report
NFC	Near field communication
NGO	Non-governmental organization
NSF	National Science Foundation
NTI	Nuclear Threat Initiative
OBIM	Office of Biometric Identity Management
OEE	Office of Export Enforcement
OFAC	U.S. Department of Treasury Office of Foreign Assets Control
OFO	Office of Field Operations
OPL	Off-port limits
OUP	Office of University Programs
PACER	Public Access to Court Electronic Records
PI	Principal Investigator
PII	Personally identifying information
PLANS	IEEE/ION Position Location and Navigation Symposium
PM	Program Manager
POA	Participatory Operational Assessment
POE	Port of entry
QHSR	Quadrennial Homeland Security Review
RECONS	Reusable electronic conveyance devices
RFID	Radio-frequency identification
RFP	Request for Proposals
RSD	Resilient Systems Division
RTT	Research and Technology Transition
S&T	Science and Technology Directorate
SCFace	Surveillance Cameras Face
SDK	Software development kit
SOP	Standard Operating Procedure
STEM	Science, Technology, Engineering, and Mathematics
STK	Securities Technology Kitchen
SUS	System Usability Scale
SWOT	Strength, weakness, opportunity, and threats
TAMU	Texas A&M University
TBSSR	Tangent-based single-scale retinex
TEU	Twenty-foot equivalent unit
ToC	Theory of Constraints
TSA	Transportation Security Administration
TSN	Trade Support Network
TT	Tan and Triggs normalization
TTI	The Texas A&M Transportation Institute
TxDOT	Texas Department of Transportation
U.S.	United States
UH	University of Houston
UNCC	University of North Carolina at Charlotte
USCG	United States Coast Guard
USG	United States Government
USML	U.S. Munitions List
UTEP	University of Texas – El Paso

WMD	Weapon of Mass Destruction
WVU	West Virginia University
NSA	National Security Agency
HSSS	Homeland Security Symposium Series
AAR	After-action-review
OTD	Office of Training and Development
NPPD	National Protection and Programs Directorate
NSID	National Security Investigations Division
HSSSAB	Homeland Security Symposium Series Advisory Board
ERO	ICE Enforcement and Removal Operations