

## Modeling Methodology and Simulation of Port-of-Entry Systems

# Project Team Profile

- PI(s) Name(s), University:
  - Benjamin Melamed (PI), Rutgers University
  - Weiwei Chen (Co-PI), Rutgers University
- Project Start Date: January, 2016
- Anticipated End Date: January, 2021
- Project personnel:
  - Mingfei Teng, graduate student

# Problem Statement

- **Background**

- Fast and sustained secure flows of people and freight through a Port-of-Entry (POE) are essential to the U.S. economy
- Excessive POE delays translate into burdens and costs
  - Increased supply chain lead times and attendant disruptive effects
  - Inconvenience to travelers in terms of time and missed connections
  - Elevated transportation carbon footprint

- **Capability Gap**

- CBP-OFO needs decision support tools for POE planning for both optimizing operations and guiding long-term evolution
  - CBP needs to optimize the tradeoff between performance and cost
  - To this end, it needs flexible and high-fidelity simulation models that compute performance metrics, primarily waiting time statistics

# Beneficiary / End User Profile: Jobs

- Who are the beneficiaries / end-users of this research (the “jobs”)?
  - End users
    - Analyst group at U.S. Customs and Border Protection – Office of Field Operations (CBP-OFO)
    - Planners at preparedness and response organizations, such as FEMA
  - Beneficiaries
    - Drivers passing through POEs
    - POE directors and other POE personnel
    - DHS planning personnel, including IT and procurement

# Beneficiary / End User Profile: Desired Gains

- What are the main outcomes and benefits that the end user desires (the “gains”)?
  - A POE modeling platform, serving as an easy-to-use and easy-to-understand in-vitro lab for flexible experimentation with POE scenarios
    - Dynamic editor
    - Animation of traffic flows and statistics
  - A suite of detailed POE simulation models
  - User guide and technical reports documentation for each POE

# Beneficiary / End User Profile: Desired Gains (Cont. 1)

- What are the main outcomes and benefits that the end user desires (the “gains”)?
  - Upstream benefits (analyst end-user group)
    - Ability to evaluate design tradeoffs efficiently and quickly using POESS as a flexible in-vitro laboratory for experimenting and answering “what-if” questions
    - Ability to improve/optimize POE designs
    - Ability to improve/optimize POE resource planning
  - Downstream benefits (POEs)
    - Reduced congestion at POEs leading to
      - Shorter waiting times and savings on gas for drivers
      - Less stress for inspection personnel
      - Lessened exposure to noxious gases for all
    - Better utilization of inspection personnel

# Beneficiary / End User Profile: Pain Points

- What are the main issues the capability / knowledge gap is causing (end user “pains”)?
  - Inability to flexibly gauge the impact of impending congestion by experimenting with mitigations
  - Inability to flexibly gauge the impact of disruptions and experiment with mitigating ensuing congestion
  - Inability to better schedule inspection resources to reduce waiting times

# Products & Services

- What products & services are the outcomes of this research project?
  - Suite of detailed POE simulation models, dubbed ***Port-of-Entry Simulation System (POESS)***
  - Accompanying documentation consisting of user guide and technical reports for each POE modeled

# Gains Created

- What are the gains achieved and how are they measured?
  - Short term (evaluated by end-user satisfaction survey)
    - Ability to flexibly gauge the impact of impending congestion and experiment with mitigations
    - Ability to flexibly gauge the impact of disruptions and experiment with mitigating ensuing congestion
    - Ability to better schedule inspection resources to reduce waiting times
  - Long term (evaluated by field measurements)
    - Shorter average waiting times
    - Increased inspection personnel utilization

# Pains Alleviated

- What are the pains alleviated and how are they measured?
  - Near term (evaluated by end-user satisfaction survey)
    - Inability to flexibly gauge the impact of impending congestion and experiment with mitigations
    - Inability to flexibly gauge the impact of disruptions and experiment with mitigating ensuing congestion
    - Inability to better schedule inspection resources to reduce waiting times
  - Long term (evaluated by field measurements)
    - Long average waiting times
    - Inefficient inspection personnel utilization

# Key accomplishments

- Developed a modeling and simulation methodology was for POESS and documented it (on track)
- Implemented, validated and delivered to our end-user analyst group at CBP-OFO a POESS simulation model and user guide of the Bridge of the Americas (BOTA) POE in El Paso, Texas (on track)
- Conducted a usability survey of end users for the BOTA model, yielding overall end-user satisfaction rate of 83.3%, well over the requisite minimum of 75% (delayed by 6 weeks, but now completed)
- Work is in progress on modeling the Peace Arch POE at Blaine, Washington (on track)

# Key accomplishments: POESS Welcome Screen

**Port-of-Entry Simulation System (POESS)**

Select POE: Bridge of the Americas (BOTA), El Paso, Texas

Select Input File: Browse File... D:\Projects\POESS\El Paso Bridge of the Americas (BOTA)\El-Paso\_BOTA\_input.xlsx

Select Output Directory: Browse Directory... D:\Projects\POESS\El Paso Bridge of the Americas (BOTA)

Type Output File Name: El-Paso\_BOTA\_input\_output.xlsx

Go To Animation Mode Go To Batch Mode

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# Transition Pathways

- How will the work reach the end-user? What is the proposed transition pathway?
  - The end-user group of our project champion and his analyst group at CBP-OFO will receive the POESS software as a distribution folder, with executables and documentation (user guides and technical reports) as well as training
    - **Already done for the Bridge of the Americas POE model**
  - POE directors and other decision makers will receive analysis results from the analyst group aiming to improve POE metrics
    - Vehicle waiting times and inspection personnel utilization
  - We will work with our project champion to identify other potential users at preparedness and response organizations, such as FEMA
    - For example, POESS can be used to gauge evacuation times

# Transition Engagement

- What mechanisms has project staff used for engaging with the potential customer(s)?
  - The design and implementation of POESS has been carried out in close collaboration with our primary champion and his end-user analyst group at CBP-OFO
  - Our primary champion is serving as the POC to all POEs, and provides us with the bulk of the information on POE structure and data on POE operations
  - The POESS software and user guide have been securely distributed via the projects HSUP site, followed by a tutorial of POESS
  - The end-user group then exercised POESS and responded to a usability survey

# Transition Engagement (Cont. 1)

- What mechanisms has project staff used for engaging with the potential customer(s)?
  - The PI and co-PI organized a tripartite transition meeting on 8/25/17 with representatives from Rutgers and UH, as follows:
    - Primary champion and customer/end-user, CBP-OFO
    - BTI personnel, including the director
    - Assistant Director of Information Technology, Rutgers Office of Research Commercialization (ORC)
    - BTI Transition POC
    - Executive Director, BTI Strategic Partnerships
    - Executive Director, UH Office of Intellectual Property

# Transition Engagement (Cont. 2)

- What mechanisms has project staff used for engaging with the potential customer(s)?
  - A Notice of Software Development) has been submitted to the Rutgers Office of Research and Economic Development which administers Intellectual Property at Rutgers University
  - The PI and co-PI have discussed post-project transition plans with the ORC representative, as follows:
    - Searching for a company to take over software support and upgrades of POESS
    - possible commercialization of POESS through the new Rutgers SoCrates program for software licensing

# Transition Challenges (if applicable)

- What does the project team perceive to be the challenges they will face in the near and long term going forward?
  - Near term
    - Good field measurements (empirical data) are needed for model validation, but may not always be available or in “clean” condition, requiring some processing
  - Long term
    - Difficulty finding a company to take over POESS upgrades and maintenance

# Conclusions

- Having developed a modeling and simulation methodology for POEs, the project delivered the first POESS model of the BOTA POE to our end-user group at CBP-OFO
  - The model was tested for its usability and end-user satisfaction
  - All technical problems involved in modeling this complex POE were solved, which would facilitate the modeling of other POEs
- POESS modeling of additional POEs is now on track (on time and within budget)

# Disclaimer

This material is based upon work supported by the U.S. Department of Homeland Security under Grant Award Number 2015-ST-061-BSH001. This grant is awarded to the Borders, Trade, and Immigration (BTI) Institute: A DHS Center of Excellence led by the University of Houston, and includes support for the project “Modeling Methodology and Simulation of Port-of-Entry Systems”, awarded to Rutgers University. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security.