Modeling Methodology and Simulation of Port-of-Entry Systems
Project Team Profile

• PI(s) Name(s), University:
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• 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
Key accomplishments:
POESS BOTA Model Satellite View
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
• 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

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