**Title: Virtual Integrated Real-Time User AnaLytics (VIRTUAL) Tool**

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**Center of Excellence:** Food Protection and Defense Institute (FPDI) (Emeritus)
**COE Lead/Co-Lead Institution:** University of Minnesota

**Project Start Date:** 07/2014

**Project Completion Date:** 06/2016

**Project Status:** Complete

**Research Theme:** Supply Chains

**Participating State(s):** District of Columbia, Minnesota

**Amount Awarded to Date:** $299,024

**Award Number:** 2010-ST-061-FD0001

**Abstract:** The current global food system is increasingly complex where it is incredibly difficult to analyze the macro-level effects of micro-level decisions. Realistically, there isn't a mechanism to scientifically and accurately depict the dynamics of the supply chain distribution of a food product for meaningful analysis and evaluation. The primary goal of this project is to create a simulation tool using virtual models to better understand the dynamics of the global food supply. The model will simulate real life food supply chains which can be used as inputs into other food defense simulation models. This will be accomplished in 6 phases: 1) stakeholder buy-in and engagement; 2) model development; 3) ontology development; 4) model rollout; 5) model enhancements, and 6) model distribution. A key finding from the first year of this effort was that existing food defense models are fragmented in their implementations and built for very specific purposes that limit the ability to reuse them for further research. The implications of this limitation is that significant resources need to be utilized collecting similar datasets multiple times in an effort to understand food supply chain dynamics. A key accomplishment from this project to address this limitation is the development of an initial ontological model that attempts to harmonize the data and its definitions in future food defense models. This tool advances the current state of the art by providing a continuous improvement framework for food defense models and increases the accuracy of the dynamics of modeling real-world supply chains.

**Project Type:** Research

**End User Engagement:**

- Academic Community
- DHS National Protection & Programs Directorate
- Food and Agriculture Industries
- Food and Drug Administration
- Private Sector Other

**Executive Summary (2016):** The current global food system is increasingly complex where it is incredibly difficult to analyze the macro-level effects of micro-level decisions. Realistically, there isnâ€™t a mechanism to scientifically and accurately depict the dynamics of the supply chain distribution of a food product for meaningful analysis and evaluation. A real need exists within the modeling community in collecting and feeding real-world supply chain data within their food defense models in order to provide metrics and analysis that have a real-world impact. Traditionally, each modeling team conducts outreach to the food industry to collect this dataset. However, once this data is collected, it is rarely used again due to confidentiality agreements and the difficulty in mapping datasets between two independent models. The VIRTUAL model attempts to address this need by creating an open source model that can accept existing supply chain data and create new supply chain datasets based off these existing

datasets as well as by proposing an ontological framework to standardized and align the datasets of future food defense models for easier translation between simulations. The primary goal of this project is to create a virtual tool using simulation models to better understand the dynamics of the global food supply. This tool will consist of traceability models capable of real-world and simulated food distribution data which may then be used by other food defense models (such as those that predict the consequences of catastrophic events at any point along the supply chain). It is envisioned that the tool will be used for improving the quality and accuracy of supply chain inputs to existing (and under development) food defense models. The research was conducted in 6 iterative phases: phase 1) stakeholder buy-in and engagement, phase 2) model development including implementation and testing, phase 3) model rollout including the development of an ontological framework, phase 4) education and training, phase 5) model enhancements based on user testing and feedback, and phase 6) positioning, publicizing and promoting the availability of the model to end users as a part of the transitioning plan. The accomplishments of this research include the development of several use cases on how the model may be applied to analyze supply chain dynamics (for example, during outbreak investigations) and to conduct comparative analysis between two (or more) types of supply chains (such as if there was a disruption in the supply chain, how does a business ensure continuity). Another accomplishment is the application of an initial ontological framework to enable mapping of datasets between two independent food defense simulations and models.

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