

WALLACE, RPI
DHS Coastal Resilience Center
Research Project:
Annual Project Performance Report

Covers reporting period January 1, 2016 – June 30, 2016

1. **Project Title:** Community Supply Resiliency (COMSURE)

2. **Principal Investigator / Institution:** William A. Wallace, Yamada Corporation Professor, Industrial & Systems Engineering (ISE), Rensselaer Polytechnic Institute (RPI)

3. **Other Research Participants/Partners:** John Mitchell, Professor, Mathematical Sciences, RPI; Thomas Sharkey, Associate Professor, ISE, RPI; Richard Little, Research Scholar, ISE, RPI

4. **Short Project Description (“elevator speech”):** The resilience of a coastal community to an extreme event depends, to a large extent, on the degree to which critical services can be maintained during the event or restored in its aftermath. In addition to the utilities on which we rely such as power, water, and communications, there are critical commercial services such as banking and food, drug, and fuel distribution that are equally important to community resilience. COMSURE, Community Supply Resiliency, will improve our understanding of how the supply chains for these critical commercial services are impacted by extreme events so that they, and the communities they serve, can be restored quickly following such an event.

5. **Abstract:** The capability of communities to withstand and recover from the disruptions of extreme events will determine, to a large extent, the degree to which the social, economic, and psychological impacts of these events can be reduced. It is well recognized that civil infrastructures (e.g., transportation, power, water supply and sewerage, and communications) are critical to the wellbeing of a community; our past work has focused on these systems. However, it is the social infrastructures (e.g., emergency response, banking, and food, drug, and fuel distribution) that play a crucial role in societal functioning; the availability of these systems following an extreme event is a key element in determining the resilience of a community. Therefore, the objective of the proposed research is to better understand, describe, and portray the supply chains that provide the goods and services needed to respond to and recover from an extreme event, such as a hurricane impacting a coastal community. With this knowledge, models and algorithms will be developed to support emergency management in planning, community development, training and

education, thereby enhancing community supply resiliency.

- 6. End users:** The primary end users for our research will be local emergency managers and DHS analysts who can use the tool to improve policies that affect community resilience to extreme events. The tool will also be made available to private sector service providers interested in improving the resilience of their supply chains. Based on feedback from Federal reviewers following the CRC Annual Meeting in March, we will also reach out to universities offering programs in emergency management to determine how best to incorporate the tool as a training aid into the curriculum. Our research continues to draw heavily upon our association with Warren Lee, Emergency Manager for New Hanover County, NC. We have collected data on the supply chains for the goods and services provided by the social infrastructures in this county, focusing particularly on end-point customer interactions. This information will ultimately be incorporated into CLARC, the artificial coastal community of 500,000 citizens created for our research and analyses. In addition to meetings with DHS's Office of Cyber & Infrastructure Analysis to present our decision support tool MUNICIPAL for their review, we also have had discussions with representatives of the food and drug sector in New Hanover County, and discussed the project at length with Healthcare Ready, a service organization dedicated to improving the resilience of pharmaceutical supply chains.
- 7. Explanation of Changes:** At the request of DHS project management, the MUNICIPAL/COMSURE technology was highlighted at the DHS Technology Showcase on May 20, 2016 and exploratory efforts were undertaken with the Texas Department of Homeland Security and the City of Austin to determine if the MUNICIPAL/COMSURE technology was appropriate to the needs of Austin, TX.
- 8. Unanticipated Problems:** No unanticipated problems have been encountered.
- 9. Project Outcomes:** The primary objective of the research associated with COMSURE is to improve our understanding of how community resilience is affected by interdependent interactions of social and civil infrastructures during extreme events. This is to be accomplished by visualization and mathematical representations of the supply chains for critical commercial services (banking, food, fuel, and drugs). Research to date on infrastructure and resilience has focused primarily on utilities or civil infrastructure (water, power, communications, and transportation). The role of critical commercial services is largely unstudied and what work exists is anecdotal. This is particularly true for the end-of-chain customer interactions that directly affect people. A better understanding of these complex interactions will assist emergency managers, utility service providers, and other key decision makers in determining what assets should be hardened against damage and what should be the priorities for service restoration following an extreme event so that the most critical services are made available in the shortest possible time. A beta-level version of MUNICIPAL has already been assessed within New Hanover County and determined to have great potential as a planning and training tool. COMSURE, when incorporated into the

existing MUNICIPAL architecture, will bring a powerful new capability to the emergency management community. If incorporated into university curricula for emergency management, it also has the potential to make the next generation of EM professionals more comfortable and conversant with computer-aided decision support tools for planning and training purposes.

10. Research Activity and Milestone Progress:

Research Activities and Milestones: Progress to Date

Reporting Period 1/1/2016 – 6/30/2016			
Research Activity	Proposed Completion Date	% Complete	Explanation of why activity / milestone was not reached, and when completion is expected
Data Collection	4/1/16	100%	The data collected were the locations of major groceries, pharmacies, banks, and convenience stores in New Hanover County. Street addresses were obtained from individual corporate websites and converted to GPS coordinates for use in the MUNICIPAL database.
Visualization of Supply Chains	5/1/16	80%	Visualization has not been completed because of technical issues in the software interface between the mapping software (ArcGIS) and the database (Access) formats. Anticipated completion date is 7/31/16.
Assessment	6/1/16	100%	The data collection effort was followed up by discussions with representatives of the food, pharmaceutical, fuel, and banking industries to review the research team’s understanding of the individual supply chains, their dependence on civil infrastructures, and industry practice for preparedness, response, and recovery from extreme events. Based on the feedback to the proposed approach received in these discussions, normative rules for populating the artificial community CLARC with commercial services were developed and will be applied during testing of the updated software.

Research Milestone			
Report on results of data collection and visualization	6/30/16	60%	Data collection is completed but final report cannot be completed until visualizations are finalized. Anticipated completion date is 8/15/16.

11. Transition Activity and Milestone Progress:

No transition activities were proposed at this stage of the project. However, at the request of DHS project management, two activities were added; the DHS Technology Showcase in Washington, DC and exploratory efforts with the Texas Department of Homeland Security and the City of Austin to determine if the MUNICIPAL/COMSURE technology was appropriate to the needs of Austin, TX.

Transition Activities and Milestones: Progress to Date

Reporting Period 1/1/2016 – 6/30/2016			
Transition Activity	Proposed Completion Date	% Complete	Explanation of why activity / milestone was not reached, and when completion is expected
May 20 DHS Showcase in Washington, DC	5/20/16	100%	
Exploratory efforts with the Texas Department of Homeland Security and the City of Austin to determine if the MUNICIPAL/COMSURE technology was appropriate to the needs of Austin, TX.	4/30/16	100%	
Transition Milestone			
Participation in the DHS Technology Showcase	5/20/16	100%	
Phone conference with Texas DHS and the City of Austin	4/12/16	100%	Discussions were initiated with the Texas DHS and the City of Austin in late 2015 to determine if MUNICIPAL was a suitable tool for the Agency and City to use in a vulnerability and response and recovery exercise. Although it was agreed that MUNICIPAL was potentially useful in this capacity, modifications to incorporate the HSIP Gold dataset were necessary and no funding source to do this was identified. Negotiations

			concluded with the understanding that if the necessary modifications to MUNICIPAL were eventually completed, the potential for a working relationship would be revisited.
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12. Interactions with education projects: There has been no involvement to date with the CRC's MSI education partners. However, based on feedback from Federal reviewers following the CRC Annual Meeting in March, we plan to reach out to the MSI education partners offering programs in emergency management to determine how COMSURE might best be incorporated into the curriculum as a training aid.

13. Publications: No publications were anticipated at this stage of the project and none are currently underway.

14. CRC Performance Metrics:

CRC Performance Metrics			
Metric	Research	Education	Center
Courses/certificates developed, taught, and/or modified		See Table	
Enrollments in Center-supported courses/certificates			
HS-related internships (number)	--		
Undergraduates provided tuition/fee support (number)	--		
Undergraduate students provided stipends (number)	--		
Graduate students provided tuition/fee support (number)	--		
Graduate students provided stipends (number)	1		
Undergraduates who received HS-related degrees	--		
Graduate students who received HS-related degrees	--		
Certificates awarded (number)			
Graduates who obtained HS-related employment	--		
SUMREX program students hosted (number)	--		
Lectures/presentations/seminars at Center partners	1		
DHS MSI Summer Research Teams hosted (number)	--		
Journal articles submitted (number)	--		
Journal articles published (number)	--		
Conference presentations made (number)	--		
Other presentations, interviews, etc. (number)	2		
Patent applications filed (number)	--		
Patents awarded (number)	--		
Trademarks/copyrights filed (number)	--		
Requests for assistance/advice from DHS agencies	1		
Requests for assistance/advice from other Federal	1		
Total milestones for reporting period (number)	3		
Accomplished fully (number)	2		
Accomplished partially (number)	1		
Not accomplished (number)	0		
Product/s delivered to end-user/s (description and	See Table		
External funding received	See Table		
Leveraged support			
Articles on Center-related work published on website			
Coverage in media, blogs (number)			
Social media followers (number)			
Posts to social media accounts (number)			
Events hosted (number)			
Website hits (number)			

Table for Documenting CRC Research Project Product Delivery

Product Name	Product Type	Approx. Delivery	Recipient or Anticipated End
N/A			

Table for Documenting External Funding and Leveraged Support

External Funding			
Title	PI	Total Amount	Source
N/A			
Leveraged Support			
Description			Estimated Annual
Office Space			\$8,000
6-week stipend for Graduate Student			\$10,380
Visiting Research Scholar			\$21,600