

**DAVIDSON, UDEL**  
**DHS Coastal Resilience Center**  
**Research Project:**  
**Annual Project Performance Report**  
Covers reporting period July 1, 2016 – June 30, 2017

**1. Project Title:**

An Interdisciplinary Approach to Household Strengthening and Insurance Decisions

**2. Principal Investigator / Institution:**

Rachel Davidson, Professor, Civil Engineering, University of Delaware

**3. Other Research Participants/Partners:**

- Jamie Kruse, Professor, Economics, East Carolina University
- Linda Nozick, Professor, Civil Engineering, Cornell University
- Joseph Trainor, Assistant Professor, Public Policy, University of Delaware

**4. Short Project Description:**

This interdisciplinary project will improve a developing policy analysis tool to help agencies explore the potential effects of policies related to household hurricane risk reduction. The project specifically focuses on better understanding the factors that influence homeowner insurance purchase and retrofit decision-making.

**5. Abstract:**

Two primary mechanisms to manage natural disaster risk— insurance and retrofit—are presently underutilized, suggesting a need to better understand how homeowners make retrofit and insurance purchase decisions. Future programs and policies intended to reduce coastal natural disaster risk will be more effective if designed to align with how homeowners actually make these choices.

This project is advancing understanding of (1) homeowner insurance purchase and retrofit decision-making and (2) the role it plays within the larger insurer-government-homeowner system of managing natural disaster risk. We are leveraging two products from a NIST-funded research project we undertook recently—phone survey data and a holistic framework comprised of interacting mathematical models of hurricane risk, and homeowner and insurer decision-making that can help policy makers consider how specific policy alternatives might affect different stakeholder groups.

In addition to advancing the scientific models and the broader mathematical framework and policy tool, we expect four main near-term outcomes: (1) discrete choice models that

describe homeowner insurance and retrofit decisions; (2) a “system win-win” white paper that fully describes the larger mathematical framework this project contributes to, including description of the interacting models, the insights they produce when combined, the value that the system will provide to practitioners, and the technical requirements for transitioning from the framework to a fully implemented policy tool; (3) a series of short policy briefs on the impact of low cost loans, grants, and insurance premium reductions on homeowner retrofit decisions; insurance adoption decisions; and the impact of hurricane experience on insurance purchases; and (4) analysis of the role of prior hurricane experience and risk perception on protective action decisions.

## 6. End users:

Five primary end users are involved in this project, representing both the mitigation and preparedness directorates of FEMA, state floodplain managers, and the NIST Community Resilience group (Table 1). Acting Division Director of the Risk Analysis Division, one of the three main divisions of the FEMA Mitigation Directorate focuses on identifying hazards, assessing vulnerabilities, and developing strategies to manage the risks associated with natural hazards in communities. In the FEMA Individual and Community Preparedness Division, a stakeholder works to promote preparedness and mitigation activities as adjustments to risk. Chad Berginnis represents the 17,000 members of the ASFPM, an organization dedicated to reducing flood losses nationwide. As a member of the Applied Economics Office and the NIST Community Resilience Group, a stakeholder works on economic analysis of individual and community resilience. Another stakeholder is lead for Disaster Resilience at NIST. We have had multiple conversations with these partners before and during the project through a combination of in-person meetings, conference calls, and email exchanges. Through these interactions we have gained a good understanding of the challenges they face and how we can support their efforts to meet those challenges. In our previous NIST-funded research project, we worked with a reinsurance industry representative to gain input from that perspective.

Table 1. Primary end users involved in project

Name	Title	Organization	Role in project
	Acting Division Director	FEMA Federal Insurance and Mitigation Administration, Risk Analysis Division	Advisory Panel
	Senior Policy Advisor	FEMA Individual and Community Preparedness Division, National Preparedness Directorate	Advisory Panel
Chad Berginnis	Executive Director	Association of State Floodplain Managers (ASFPM)	Advisory Panel
	Research Economist	NIST Applied Economics Office/Community Resilience Group	Advisory Panel
	Lead for Disaster Resilience	Materials and Structural Systems Division	Advisory Panel

## 7. Unanticipated Problems:

None.

## 8. Project Impact:

The longer-term aim of the project is to develop a fully operational policy analysis tool based on our current modeling framework. Risk management officials will be able to use the tool to identify and evaluate alternative public policies and private sector interventions aimed at effective, sustainable, win-win solutions to better manage natural disaster risk associated with existing buildings. A key, novel aspect of the tool is that by examining the system as a whole, solutions can be found that both reduce the societal risk and leave every stakeholder—homeowners, insurers, government agencies—better off. The policy analysis software tool will help officials both evaluate pre-defined policies under consideration, and recommend new policies based on government objectives. It will provide the sound scientific basis for natural disaster risk management policies. The system win-win paper that is a main outcome supports this real-world impact.

In the shorter term, the statistical analyses and policy briefs will inform risk managers about how homeowners make insurance purchase and retrofit decisions and the likely effects of different possible incentives on those decisions. As our end user partners and others continue to work to motivate risk management actions among homeowners and other stakeholders, this information will support their efforts.

## 9. Research Activity and Milestone Progress:

### Research Activities and Milestones: Progress to Date

Reporting Period 7/1/2016 – 6/30/2017			
<b>Research Activity</b>	<b>Proposed Completion Date</b>	<b>% Complete</b>	<b>Explanation of why activity / milestone was not reached, and when completion is expected</b>
Fit discrete choice models for decisions about insurance purchase.	8/16	100	
Write journal paper about homeowner hurricane-related insurance decision-making	11/16	100	
Write journal paper that explains the role of past hurricane experience on homeowner insurance purchase.	6/17	100	
Fit discrete choice models for decisions about homeowner hurricane-related retrofit	5/17	100	

decision-making, including consideration of incentives.			
Write journal paper about homeowner hurricane-related retrofit decision-making, including consideration of incentives	8/17	100	This was due 8/17, but we expect to complete it by the end of 6/17.
<b>Research Milestone</b>			
Submit manuscript to a peer-reviewed journal about homeowner hurricane-related insurance decision-making for protection against both wind and flood damage	11/16	100	
Submit manuscript to a peer-reviewed journal about the role of past hurricane experience on homeowner insurance purchase.	6/17	100	
Submit manuscript to peer-reviewed journal about homeowner hurricane-related retrofit decision-making for protection against both wind and flood damage, including consideration of incentives	8/17	100	This was due 8/17, but we expect to complete it by the end of 6/17.

## 10. Transition Activity and Milestone Progress:

### Transition Activities and Milestones: Progress to Date

Reporting Period 7/1/2016 – 6/30/2017			
<b>Transition Activity</b>	<b>Proposed Completion Date</b>	<b>% Complete</b>	<b>Explanation of why activity / milestone was not reached, and when completion is expected</b>
Group conference call with research team and all end user partners to present progress and get input	7/16	100	
Begin System win-win white paper	3/17	100	
Begin Insurance decisions policy brief	11/16	50	With the completion of the research paper that forms the basis for this policy brief, this task will be much faster to complete now.
Begin Hurricane experience and risk perception policy brief.	12/16	50	With the completion of the research paper that forms the basis for this policy brief, this task will be much faster to complete now.

Group conference call with research team and all end user partners to present progress and get input	1/17	100	
Phone calls with additional end users to get feedback on the system win-win concept and what a useful policy analysis tool based on it would look like.	6/17	50	Due to scheduling issues, we plan to achieve this in the second half of the summer.
<b>Transition Milestone</b>			
Clear set of technical requirements for policy analysis tool	6/17	50	

### 11. Interactions with education projects:

In the Summer of 2016, we hosted two 8-week summer interns from our CRC partner, Tougaloo College, at the Disaster Research Center at the University of Delaware. The students are Irenia Ball and Taralyn Rowell, both African American Female Seniors. While at UD they contributed to this project by reviewing extant insurance literature and developing an inventory of mitigation programs currently being offered by states. These students also visited the Delaware Legislature and with a group of non-profit leaders in Wilmington. They also interacted more generally with UD social science and engineering students and faculty interested in disaster studies. We were able to bring the second student by identifying supplemental funds from the University of Delaware to support her.

### 12. Publications:

- Wang, D., Davidson, R. A., Trainor, J. E., Nozick, L. K., & Kruse, J. 2017. Homeowner purchase of insurance for hurricane-induced wind and flood damage. *Natural Hazards*, 1-25. [published] (Wang, D. is a Ph.D. student)
- Xu, K., Nozick, L., Kruse, J., Davidson, R., and Trainor, J. Affordability of Natural Catastrophe Insurance: game theoretic analysis and geospatially explicit case study, Chapter 15 in *GEOValue: the socioeconomic Value of Geospatial Information*, ed. J. Kruse, J. Crompvoets, and F. Pearlman, Taylor & Francis Group, LLC Baton Rouge, FL. [in press] (Xu, K. is a Ph.D. student)
- Yahyazadeh, Z., Davidson, R., Trainor, J., Kruse, J., and Nozick, L. Homeowner decisions to retrofit to reduce hurricane-induced wind and flood damage. *Journal of Infrastructure Systems*, in review. [submitted]
- Journal paper that explains the role of past hurricane experience on homeowner insurance purchase is in final stage of editing and will be submitted by the end of June. Authorship and title still need to be finalized.

### 13. Tables:

**Table 1: Documenting CRC Research Project Product Delivery**

Product Name	Product Type	Approx. Delivery Date	Recipient or Anticipated End Users
Insurance purchase paper	Journal paper	November 2016	Academic and professional community
Retrofit decision paper	Journal paper	June 2017	Academic and professional community
Experience, emotion, and insurance purchase paper	Journal paper	June 2017	Academic and professional community

**Table 2: Documenting External Funding and Leveraged Support**

External Funding			
Title	PI	Total Amount	Source
Collaborative Research: An Interdisciplinary Approach to Modeling Multiple Stakeholder Decision-making to Reduce Regional Natural Disaster Risk, National Science Foundation	Davidson	\$306,555	NSF
Modeling natural disaster risk management: A stakeholder perspective	Davidson	\$797,000	NIST
Leveraged Support			
Description			Estimated Annual Value
DRC support of interns			\$1,000
UDEL School of Public Policy and Administration support of interns			\$1,000
UDEL Vice Provost of Diversity support of interns			\$3,000

#### 14. Metrics:

<b>Metric</b>	<b>Year 1 (1/1/16 – 6/30/16)</b>	<b>Year 2 (7/1/16 – 6/30/17)</b>
HS-related internships (number)	0	0
Undergraduates provided tuition/fee support (number)	0	0
Undergraduate students provided stipends (number)	0	0
Graduate students provided tuition/fee support (number)	2	2
Graduate students provided stipends (number)	2	2
Undergraduates who received HS-related degrees (number)	0	0
Graduate students who received HS-related degrees (number)	0	1
Graduates who obtained HS-related employment (number)	0	1
SUMREX program students hosted (number)	2	0
Lectures/presentations/seminars at Center partners (number)	0	0
DHS MSI Summer Research Teams hosted (number)	0	0
Journal articles submitted (number)	1	1
Journal articles published (number)	0	1
Conference presentations made (number)	0	0
Other presentations, interviews, etc. (number)	0	0
Patent applications filed (number)	0	0
Patents awarded (number)	0	0
Trademarks/copyrights filed (number)	0	0
Requests for assistance/advice from DHS agencies (number)	0	0
Requests for assistance/advice from other agencies or governments (number)	0	0
Total milestones for reporting period (number)	1	3
Accomplished fully (number)	1	2
Accomplished partially (number)	0	1
Not accomplished (number)	0	0