DHS Coastal Resilience Center
Research Project Work Plan
1/1/2016 – 12/31/2017

1. **Project Title**

   An Interdisciplinary Approach to Household Strengthening and Insurance Decisions

2. **Principal Investigator**

   Rachel Davidson, Professor, Civil Engineering, University of Delaware

3. **Other Research Participants/Partners**

   o   Jamie Kruse, Professor, Economics, East Carolina University

   o   Linda Nozick, Professor, Civil Engineering, Cornell University

   o   Joseph Trainor, Assistant Professor, Public Policy, University of Delaware

4. **Short Project Description**

This interdisciplinary project will advance understanding of homeowner insurance purchase and retrofit decision-making and the role it plays in system-wide efforts to manage coastal natural disaster risk associated with the existing building stock. We will use a rich survey dataset we recently collected to develop predictive statistical models of homeowner decision-making, and analyze related questions developed based on hypotheses associated with the well-known Protective Action Decision Model (PADM) and other issues of importance to our end user partners. We will also introduce the new homeowner decision models into an integrated math modeling framework to examine how the homeowner decisions interact with insurer, reinsurer, and government decisions and thus influence regional coastal risk.

5. **Abstract**

Regional natural disaster risk cannot be fully managed without addressing the vulnerability of the existing building stock. Nevertheless, two primary mechanisms to manage this risk—insurance and retrofit[1]—are presently underutilized. Some suggest only half of single-family homes in Special Flood Hazard Areas and 1% outside of them have flood insurance. Analysis of Florida's windstorm mitigation credit program similarly shows only 4% of homes are expected to retrofit voluntarily. There is a need, therefore, 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 will advance 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. To accomplish these objectives we will leverage two products from a NIST-funded research project we undertook recently—phone survey data and a framework comprised of interacting mathematical models (see Section 6). The phone survey data

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[1]   A retrofit is a physical change to a building designed to reduce its vulnerability to damage, such as, installing hurricane shutters to reduce wind damage, or elevating a building to reduce flood damage.

includes information about self-reported past and future hurricane retrofit and insurance decisions from 358 homeowners in Eastern North Carolina (23% response rate). The mathematical framework includes models of homeowner and primary insurer decisions, together with a model that estimates hurricane losses and inputs representing reinsurer and government roles.

With this dataset and framework, we will undertake three main tasks. First, we will fit discrete choice statistical models that relate a choice (buy insurance or not, retrofit or not) to variables that describe the homeowner, home, and alternatives being considered. Second, we will replace the current expected utility homeowner decision model in the NIST modeling framework with the new empirically-based discrete choice models, and explore the effects of the change. Third, we will formulate analyses and test hypotheses based on the needs of our end user partners and on the testable implications of the Protective Action Decision Model (PADM), one of the most comprehensive social science conceptual models addressing homeowner retrofit and insurance decisions. For example, hazard intrusiveness (i.e., frequency of thought about the hazard) and perception of protection responsibility are expected to increase adoption. While these concepts may be subsumed in risk aversion level in other models of behavior, the PADM separates and explicitly represents their influence on hazards mitigation choices. As an example of an end user driven analysis, we will explore the impact of different incentives on retrofit decisions, a concern end users have explicitly expressed a need for in conversations.

We will achieve three outcomes. First, we will answer several important questions about homeowner preferences, such as: What factors have the greatest influence on insurance and retrofit decisions? Do homeowners' retrofit and insurance decisions interact, and if so, how? What would be the likely effect of different incentives for retrofit (e.g., grant, low interest loan, insurance premium reduction)? How do retrofit and insurance for flood-related damage compare to the same for wind-related damage? How does predicted behavior based on the discrete choice models compare to that based on the widely-used expected utility models? Second, the efforts will result in models that can be used to predict the percentage of homeowners in a region that will buy insurance and/or retrofit under different circumstances and hypothesized government policy interventions. Third, the project will advance our understanding of protective action decision-making by testing hypotheses explicitly drawn from the PADM. All of these outcomes will directly help improve programs and policies intended to reduce coastal natural disaster risk associated with existing homes.