NWIRP Study of Hurricane Maria Impacts and Recovery in Puerto Rico:

Preliminary Project Plan for Characterizing the Impacts to and Recovery of Small- and Medium-sized Businesses and Supply Chains

Jennifer Helgeson, Ph.D.
Research Economist, Applied Economics Office
National Institute of Standards and Technology

Objective

- To identify the underlying characteristics and conditions associated with recovery of supply chains from disturbance from Hurricane Maria in Puerto Rico.

- Examine the recovery trajectories of sampled small- and medium-sized businesses, including manufacturing, retail, and service sectors in Puerto Rico, to provide greater understanding of business continuity resilience planning and supply chain continuity and how these may differ between industries/affected regions.

- This project will also include investigation of the interdependencies with business functions and the broader community (e.g., households, critical health facilities, and schools).

Background (1/2)

Under the National Windstorm Impact Reduction Act Reauthorization of 2015 (Public Law 114-52), NIST is conducting a scientific study of Hurricane Maria's impacts on Puerto Rico and subsequent recovery processes to characterize:

1) *The impacts to and recovery of small and medium-sized manufacturers (SMMs), as well as businesses in retail and service industries;*

2) *The impacts to and recovery of education and healthcare services;*

3) *The impacts to and recovery of infrastructure systems in Puerto Rico, with a focus on infrastructure that supports the functioning of critical buildings (i.e., hospitals and schools) and emergency communications.*

Goals 1 and 2 align to NWIRP Strategic Plan Goal B: *Improve the Understanding of Windstorm Impacts on Communities*

- Objective 7: Improve understanding of <u>economic</u> and social factors influencing windstorm risk reduction measures
- Objective 8: Develop tools to improve post-storm impact data collection, analysis, and archival

Background (2/2)

- Manufacturing and retail business services are an important part of understanding the impacts of Hurricane Maria, as well as the long term recovery of Puerto Rico and its supply chains.

- Manufacturing activity in the Commonwealth accounts for about 45 % of Puerto Rico's Gross Domestic Product (GDP) and over 20 % of its employment (PR BLS 2017).

- According to FEMA (2015), [1] 40 % of small businesses never reopen after a disaster and another 25 %, that do reopen, fail within a year. Evidence suggests that businesses located in communities that are facing economic downturn ahead of a natural disaster event typically do not fare well in recovery (e.g., Corey and Deitch 2013). [2]

- Efforts are needed to: 1. identify and understand mechanisms limiting economy-wide resilience and recovery; 2. develop metrics to identify areas of supply chain vulnerability due to the loss of functionality of the built environment resulting from Hurricane Maria.

1. Corey, C. M. and E. A. Deitch (2011). "Factors affecting business recovery immediately after Hurricane Katrina." Journal of Contingencies and Crisis Management 19(3): 169-181.
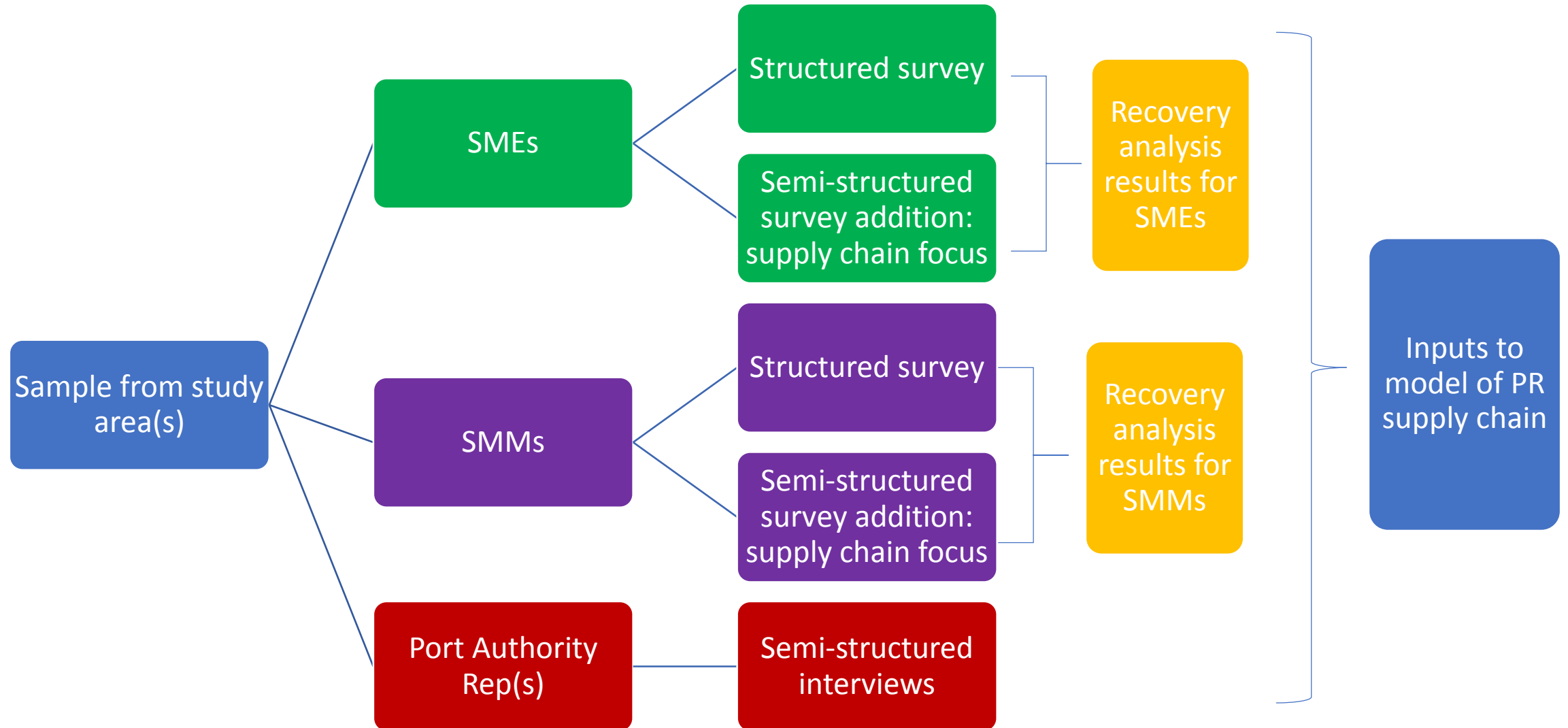2. Federal Emergency Management Agency (FEMA). (2015). "Make Your Business Resilient."
   https://www.fema.gov/media-library-data/1441212988001-1aa7fa978c5f999ed088dcaa815cb8cd/3a_BusinessInfographic-1.pdf

Preliminary Project Plan (1/3)

- Survey data collection:
  - Sampling unit: Organization
    - Small- and medium-size manufacturers (SMMs) and
    - Small- and medium-sized enterprises (SMEs) in the retail and services sectors (e.g., grocery, clothing, and restaurants)
  - Sample in order to assess differences in recovery related to:
    - Geography
    - Population characteristics (e.g., business specialization, business size, public/private ownership)
    - Variation in degree of hazard exposure/impacts

- Project methods include:
1. Structured surveys of owners/managers of SMMs and SMEs
2. Semi-structured surveys of SMMs and SMEs focused on supply chain disruption and recovery
3. Semi-structured interviews with port authorities (e.g., San Juan and Ponce) related to supply chain vulnerability
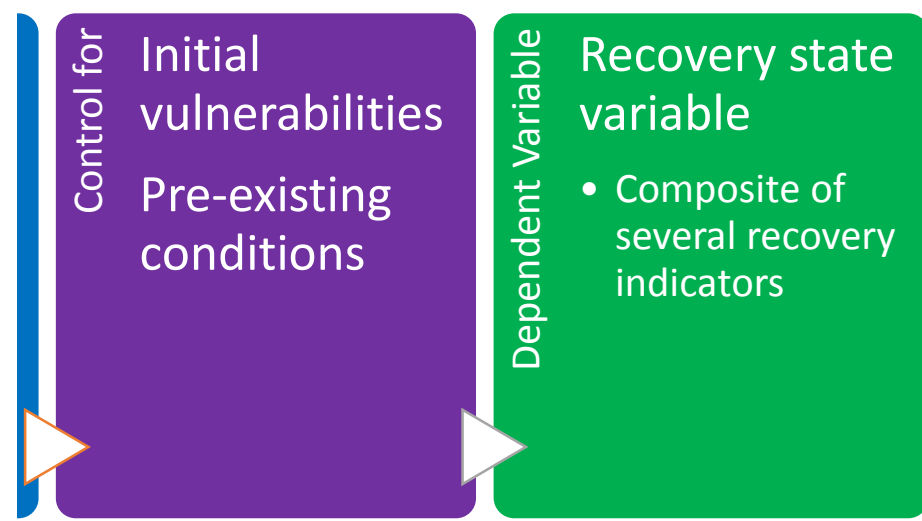
Preliminary Project Plan (3/3)

Modeling to consider the following variables:

- Pre-existing state
    - Resilience characteristics – e.g., flexible decision making structures, economic security of the business
    - Initial vulnerability

- Impacts (direct and indirect)
    - Physical damage – e.g., building, infrastructure, contents, inventory, machinery, functionality
    - Non-physical – e.g., impact on employees, service/supply providers (up- and down-stream), management
    - Interdependencies (infrastructure, households, critical functions)

- Response
    - Decision-making and delays
    - Resources (recovery assistance)
    - Plans in place
    - Policies

- Recovery
    - Physical repair/restoration status
    - Recovery of services (e.g., electricity, water)
    - Delays and decision-making in relation to delays
    - Infrastructure interdependencies
    - Employee-related recovery
    - Recovery finance (e.g., applications and funds received)

Recovery of Social Functions

Independent Variables

Control for Initial vulnerabilities

Pre-existing conditions

Dependent Variable Recovery state variable
- Composite of several recovery indicators

FY18 Progress Updates

- Developing a better understanding of the potential study area:
  - Population characteristics
  - Distribution of businesses and industrial parks, relative to critical functions (e.g., hospitals)
  - Hazard impacts (building damage, deaths)
- Writing and submitting contract for survey and interview research services to NIST's Acquisitions Management Division
- Identifying linkages between projects (e.g., overlapping samples, methods, models, and analyses)
- Collecting background data for SMEs
  - Lists of SMMs
  - Understanding regionally important manufacturing sectors
  - Preliminary impact assessments, damage, and closure data from PRiMEX (Puerto Rico Manufacturing Extension Partnership)
  - Damage assessments
  - Collection of data on institutional characteristics by business type and region

Next Steps

- Award contract for survey and interview data collection
- Coordinate with other NWIRP Hurricane Maria projects
- Develop draft sampling strategy for survey research
- Develop draft structured survey, semi-structured survey, and interview instruments
- Prepare packages for data collection instrument approvals
  - NIST's Institutional Review Board
  - Office of Management and Budget's Paperwork Reduction Act

Recovery of Social Functions