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Stakeholder Perceptions of Climate Adaptation Leadership Port of Providence Case Study

Eric N. Kretsch
University of Rhode Island, EKretsch@LighthouseCG.com

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STAKEHOLDER PRECEPTIONS OF CLIMATE ADAPTATION LEADERSHIP:
PORT OF PROVIDENCE CASE STUDY

BY

ERIC N. KRETSCH

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE

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OF

ERIC N. KRETSCH

APPROVED:

Thesis Committee:

Major Professor

Austin Becker

Robert Thompson

James Opaluch

Nasser H. Zawia
DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND
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ABSTRACT

Climate change presents a wicked problem for coastal planners and policy makers (Lazarus, 2008) that transcends political boundaries and involves complex social and infrastructure networks (R. Biesbroek, Termeer, Kabat, & Klostermann, 2009). Traditional ways of thinking, problem solving, and policy making must be transformed (R. Biesbroek et al., 2009). Leadership is acknowledged as critical to solving complex problems (G. R. Biesbroek, Klostermann, Termeer, & Kabat, 2013; Eisenack et al., 2014; Meijerink & Stiller, 2013; Stiller & Meijerink, 2015). Complex infrastructure and social systems will need to undergo “transformational adaptation” in response to rising seas and stronger storms (Kates, Travis, & Wilbanks, 2012). Many stakeholders across various jurisdictional boundaries and at all levels of government will need to play a role (Kates et al., 2012). This research explores the port of Providence community’s perceptions around the responsibility to lead in resilience planning and systemic transformational change, specifically evaluating gaps between stakeholders and those expected to lead the change. We found that stakeholder perceptions of adaptation leadership contribute to an institutional void, in which it is unclear who is responsible and who pays for resilience investment. This research emphasizes the need for pre-planning dialogue in the face of wicked problems in order to develop consensus for resilience investment strategies. Pre-planning allows clarification of stakeholder roles and politically, economically, and socially feasible resilience options can be identified.

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1. Introduction

1.1 Problem Statement

Climate change presents a wicked problem for coastal planners and policy makers (Lazarus, 2008) that transcends political boundaries and involves complex social and infrastructure networks (Biesbroek, Termeer, Kabat, & Klostermann, 2009). Traditional ways of thinking, problem solving, and policy making must be transformed (Biesbroek et al., 2009). Leadership is acknowledged as critical to solving complex problems (Biesbroek, Klostermann, Termeer, & Kabat, 2013; Eisenack et al., 2014; Meijerink & Stiller, 2013; Stiller & Meijerink, 2015). Complex infrastructure and social systems will need to undergo “transformational adaptation” in response to rising seas and stronger storms (Kates et al., 2012). Many stakeholders across various jurisdictional boundaries and at all levels of government will need to play a role (Kates et al., 2012). This research explores one seaport community’s perceptions around the responsibility to lead in resilience planning and systemic transformational change, specifically evaluating gaps between stakeholders and those expected to lead the change.

2. Literature Review and Background

2.1 Background

Seaports comprise complex coastally located systems inherently vulnerable to climate impacts (Becker et al., 2013; Bender et al., 2010; Emanuel, 2013; Tebaldi, Strauss, & Zervas, 2012). Sea level rise and surge flooding associated with climate change intensified tropical storms present a complex problem to seaports. Though resilience planning has become more prevalent globally, few resilience measures have been implemented in the U.S. (Moser & Ekstrom, 2010, 2011), or in the world's ports (Becker, Inoue, Fischer, & Schwegler, 2012).

The planning process can be hindered by a wide variety of barriers defined as “obstacles that can be overcome with concerted effort, creative management change of thinking, prioritization, and related shifts in resources, land uses, institutions, etc.” (Moser & Ekstrom, 2010, p. 22027). Effective leadership can help break down some of these barriers (Moser & Ekstrom, 2010). Planners and policy makers need better information on how barriers are formed including causes (Biesbroek et al., 2013) and entry points (Eisenack et al., 2014), including research directed at understanding how insufficient leadership influences barriers.

Using the business and regulatory stakeholder group at the Port of Providence in Providence, R.I., we asked port stakeholders who they felt had a responsibility to lead in resilience planning and implementation. Then using an evaluative framework, we asked the leaders to react to stakeholder perceptions as well as evaluate their leadership role. The purpose of this study was to examine whether or not gaps exist between business

stakeholder and regulatory stakeholder perceptions of leadership responsibility and how such gaps might contribute to resilience barriers.

Climate change, resulting sea level rise and increased tropical storm activity pose a significant threat to seaports. By 2100, scientists project a doubling in the frequency of category four and five hurricanes (Bender et al., 2010), as well as increases in wind and surge produced by these storms (Emanuel, 2013; Tebaldi et al., 2012). Ports by their nature are located at the interface between land and sea, leaving them inherently vulnerable to sea level rise and storm impacts (Becker, Matson, Fischer, & Mastrandrea, 2014). This presents a “wicked problem” that transcends traditional problem solving and policy processes because they involve multiple stakeholders across multiple jurisdictions at all governmental levels (Biesbroek et al., 2009). The cost of problem solving is felt early, but benefits are often not seen until far in the future. Wicked problems require changes in thinking and changes in problem solving processes (Lazarus, 2008).

Future major storm events, on the scale of Hurricane Katrina and Superstorm Sandy, are likely to impair port operations and have a major impact on U.S. economies at all scales, local to global (Becker et al., 2014; Neumann et al., 2014; Nicholls & Cazenave, 2010). Extreme weather events such as hurricanes result in multiple direct, indirect, and intangible consequences (Becker et al., 2014). These include damages to port facilities, equipment, and buildings; loss of business for port tenants; cost of cleanup and emergency response; loss of jobs; environmental damages; and impacts to quality of life (A. Becker et al., 2014). The Port of Providence has a history of close calls as well as two near direct landfalls (Appendix 1, Rhode Island Emergency Management Agency, 2014).

Hurricane impacts reach beyond the port area to regional economies through supply chain disruptions (A. Becker et al., 2012, 2014; Hallegatte, 2008; Koetse & Rietveld, 2009). Economic impacts of port activity reach far beyond the port. In 2011, U.S. ports handled 53% of U.S. imports and 38% of U.S. exports by value via 62,000 vessel calls (Chambers & Liu, 2013). In 2014, the U.S. port system supported over 23 million jobs (direct, indirect, and induced); approximately \$4.6 trillion in total economic value, and approximately \$3.2 billion in tax revenue (American Association of Port Authorities, 2015). Port closures, shipment delays, and other impacts as a consequence of hurricane damage have the potential to displace and reduce ports economic benefit (Hallegatte, 2008).

As part of resilient intermodal transportation systems, resilient ports provide economic benefit to regions and nations (Southworth, Hayes, McLeod, & Strauss-Wieder, 2014). They also provide researchers a defined space to study gaps in stakeholder perception of leadership in the face of wicked problems, because port systems include multiple stakeholders across various levels of government and jurisdiction (Becker et al., 2014; Mitchell, Agle, & Wood, 1997; Notteboom & Winklemans, 2002; Stewart, 2014; Winklemans & Notteboom, 2007). Previous work used stakeholder-based methods to identify possible resilience strategies within seaport systems. Becker and Caldwell (2015) focused specifically on identifying possible resilience strategies within the port communities of Gulfport, Miss. and Providence, R.I. Understanding a suite of options is important to improving resilience, but it is a long path from understanding options to implementation of resilience strategies.

The Rockefeller Foundation 100 Resilient Cities Program defines resilience as “the capacity of individuals, communities, institutions, businesses, and systems within a city to survive adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience” (The Rockefeller Foundation, 2015, p. 2). The Foundation also highlights leadership and strategy, in which successful leadership “promotes leadership and effective management, empowers a broad range of stakeholders, and fosters long-term and integrated planning (The Rockefeller Foundation, 2015, p. 2)”.

“Transformational adaptation” such as the construction of flood barriers, the elevation of entire seaports, or the relocation of infrastructure to less vulnerable locations are complex resilience strategies; effective management through strong leadership and strategy is needed to promote long-term and holistic planning efforts.

2.2 Literature Review

2.2.1 Adaptation Leadership

Adaptation leaders are defined here as “those that will implement climate resilience strategies in complex systems such as ports”. From the literature, adaptation leaders are individuals, an organization, or a group of organizations that help complete the resilience implementation process by facilitating functions within a group of stakeholders (Meijerink & Stiller, 2013; Moser & Ekstrom, 2010, 2011; Stiller & Meijerink, 2015). The functions include but are not limited to setting deadlines, sourcing and allocating resources, disseminating information, and connecting stakeholders. Adaptation leaders also display certain behaviors that build trust and encourage stakeholder participation (Podsakoff, MacKenzie, Moorman, & Fetter, 1990). These behaviors include but are not limited to acting as a role model, encouraging out of the

box thinking and intellectual thought, and providing one-on-one support to stakeholders. These actions and behaviors reduce the impact of barriers to adaptation (Moser & Ekstrom, 2010). In this section we better define adaptation leadership.

Rarely does any singular agent have the absolute power to make major transformational change to a complex system like a seaport (Kates et al., 2012). Leadership is more likely to emerge from certain stakeholders that motivate and sustain the participation of other stakeholders (Stiller & Meijerink, 2015). A collective leadership is considered important for navigating around policy barriers, and it can help overcome barriers when a lack of mandates, resources, information, and authorization exist (Biesbroek et al., 2009; Karlsson, Parker, Hjerpe, & Linnér, 2011; Meijerink & Stiller, 2013, 2013; Moser & Ekstrom, 2010; Stiller & Meijerink, 2015). Adaption leadership can also help develop consensus around decisions in which many stakeholders are presented with multiple resilience options (Becker, 2016; Biesbroek et al., 2013; Karlsson et al., 2011; Vogel, Moser, Kaspersen, & Dabelko, 2007).

Stiller and Meijerink (2015) describe five functions of leadership: *political-administrative function*, *an enabling function*, *an adaptive function*, *a dissemination function* and *a connective function*. In this study, we use these functions as a guide to help stakeholder-identified leaders assess and report on their own leadership responsibility (Section 3.3). Since adaptation leaders are expected to bring about transformational change we can expect that they might have transformational leadership qualities. Transformational leaders often display the ability to articulate a vision, provide a model of behavior, promote cooperation among members of a group, expect high performance of community members, and provide individual support and intellectual stimulation.

These behaviors enhance trust between leaders and stakeholders, increasing participation and leading to more favorable change (Podsakoff et al., 1990). For more information on adaptation leadership see Appendix 3.

Past studies have examined which organizations are responsible for leading adaption for large systems such as ports. Becker and Caldwell (2015) suggest that state and local authorities are largely responsible for planning and implementing adaptation strategies and that *Long-range planning* (like transformational adaptation) is best fit under state purview (Becker & Caldwell, 2015). Our study investigates who at the Port of Providence is perceived as responsible to lead such long-range resilience and adaptation planning activities.

2.2.2 Barriers relation to leadership

Researchers have identified many barriers to resilience planning created by leadership including intuitional void, fragmentation, and insufficient leadership (Biesbroek et al. (2009), Moser & Ekstrom (2010), Stiller & Meijerink (2015)). An institutional void is when “there is no clear division of who decides” or “who is responsible” (Biesbroek et al., 2009, 7). Institutional void does not just mean there is no decision maker, it can be seen when there is a lack of decision making structure or when the mechanisms and processes of decision making do not exist (Biesbroek et al., 2009). Such a void can happen when decision makers are presented with new, un-before-seen challenges, such as the results of climate change.

Fragmentation, a barrier similar to institutional void, occurs when there are multiple stakeholders able to act to make change to a system, but no one party takes the lead or there are multiple disjointed efforts (Biesbroek et al., 2009; Moser & Ekstrom,

2010). For example, the Port of Providence is made up of multiple business owners and each owner has some flexibility to alter their existing property. They also have the choice to support and participate, or oppose and obstruct other actions or planning processes. Fragmentation occurs when it is not clear who should be making decision and who should be acting to make change.

Leadership can be a cross-cutting issue, meaning it has the potential to both break down and to create barriers throughout the policy process (Moser & Ekstrom, 2010). Barriers caused by insufficient leadership and the lack of a decision-making structure benefit from increased dialogue (Douglas et al., 2011). Dialogue throughout various stages of the resilience process motivate leadership by instilling ownership, expectation, and accountability (Moser & Ekstrom, 2011). Dialogue through early engagement increases trust and motivates participation in the planning process (Douglas et al., 2011) by elevating the stature of the resilience process and those involved (Moser & Ekstrom, 2011). An example of this dialogue is pre-planning. Pre-planning is a process the engages stakeholders in problem solving before any management decisions are made (Becker, In press). These process are often facilitated by boundary-spanning organizations (Preston, Rickards, Dessai, & Meyer, 2013; Tribbia & Moser, 2008).

Boundary-spanning organizations or individuals co-exist with decision-making organizations, but do not have any formal decision-making authority (Tribbia & Moser, 2008). Universities and research institutes are examples. These organizations transcend jurisdictions and act as translators between different stakeholder groups (Tribbia & Moser, 2008; Vogel et al., 2007). Pre-planning brings together different stakeholder groups, translates information between stakeholder groups, facilitate collaboration, and

provide mediation services (Tribbia & Moser, 2008). Pre-planning processes allow for dialogue around un-before-discussed risks, the political, economic, and social feasibility of resilience options, and roles of stakeholders within the community, without laying blame or calling out any specific organization (Becker, In Press). We propose that pre-planning phases of climate resilience decision-making motivate leaders and allow for a clarification of leadership roles, which by doing so reduces the impact of barriers in the resilience process (Moser & Ekstrom, 2011) Pre-planning dialogue can also motivate the participation of those responsible to lead (Douglas et al., 2011; Moser & Ekstrom, 2011).

Barriers are likely to be seen in port stakeholder networks in the face of complex and never-before-seen challenges. This study examines how stakeholders perceive leadership responsibility. It then proposes strategies to break down barriers to effective planning for resilience. It does so by addressing three research questions through interviews and surveys of stakeholders of the Port of Providence, Rhode Island.

2.3 Research Questions

1. Are there differences in who public and private stakeholders see as responsible for leading resilience implementation at the Port of Providence?
2. Are there differences in how stakeholders and who stakeholders perceive as responsible to lead resilience implementation see the responsibility to lead resilience implementation at the Port of Providence?
3. What barriers do leaders see as inhibiting their leadership role for climate resilience in the Port of Providence?

3. Methods

In order to compare perceptions of leadership responsibility, we undertook a two-part study. We first engaged Port of Providence business and government stakeholders in a survey that asked respondents to identify the organizations they saw as responsible for the planning and implementation of three long-term transformational strategies. We also asked respondents to assign responsibility to seven forms of leadership (Section 3.1) leadership, as follows: independent businesses, businesses in collaboration with each other, informal public-private collaboration, formal public-private collaboration, local (Providence and East Providence), state (Rhode Island), and federal lead. We used this information to identify organizations perceived to be responsible for resilience implementation.

We then interviewed high-level managers from these respondent-identified leader organizations. We asked the managers to evaluate their organizations responsibility to facilitate leadership functions in implementing resilience strategies at the Port of Providence. We did this by using a framework, which describes the role of leadership in the implementation process. This framework is described in in Section 3.3.

Throughout this paper “stakeholders” refers to the port of Providence stakeholder community, “participant” refers to those that participated in the Port of Providence workshop, “respondent” refers to those that responded to the Part 1 survey, and “interviewee” or “manager” refers to those interviewed in Part 2 and represent organizations perceived as responsible to lead.

Study Area

The Port of Providence is located south of downtown Providence at the mouth of Providence River and head of Narragansett Bay (Figure 1). The study area encompasses waterfront industrial business on both the Providence and East Providence side of the river.

Figure – The study area represented by the red boundary, includes Interstate-195, business along Allen's Avenue and Shipyard Road. Save the Bay and two water terminals in East Providence.

The port is critical to RI economy and the Rhode Island, Connecticut, and Massachusetts region (Providence Working Waterfront Association, 2008; ProvPort, 2015; U.S. Energy Information Administration, n.d.) and is located in an exposed location to climate impacts including sea level rise and storm surge from hurricanes (Rubinoff, 2007). The governance structure of the port is complex, notably there is no operating port authority (Becker et al., 2014). Overlapping local and state zoning laws and regulations govern the port and approximately 30 independent businesses operate within the study area.

Stakeholders from the Port of Providence participated in previous planning and research efforts, of which this project forms a part. In August of 2015, 30 port stakeholders participated in a hurricane resilience workshop (from this point referred to as “the workshop”) that used tools and visualizations to introduce stakeholders to hurricane vulnerability and possible resilience strategies. The workshop initiated a dialogue within the port community. Using storm visualizations, stakeholders assessed impacts to the port in the weeks, months, and years following the storm scenario. We presented participants with three potential resilience concepts called Protect, Relocate, and Accommodate, which are explained in detail in Appendix 2B.

Workshop results concluded that participants were aware of the climate change risks their business face, however, there was no consensus on who is responsible for implementation of resilience strategies and who would pay for them in what time frame. Participants did evaluate resilience strategies and found that protecting the port (with some sort of barrier) best met their goals. There was also resistance to relocating port

infrastructure to less vulnerable locations, indicating that strategy is less feasible. For additional information on the study area see Appendix 2.

3.1 Part I – Survey of Port Stakeholders

In order to understand which organizations port stakeholders perceive as responsible for adaptation leadership, we engaged 31 port stakeholders representing both the business and regulatory community around the Port of Providence. Twenty-six stakeholders responded to our survey and 25 completed the survey in full, 13 represented a business or non-government organization and 12 represented government. Of those who responded, nine reported operating facilities within the study area and 14 were interested in port operations for economic, regulatory, emergency response, or planning reasons. We asked the respondents a series of questions on the three long-term resilience strategies presented to them in the workshop, which are Protect, Relocate, and Accommodate (Appendix 4A). These represent three broad archetypal strategies that could be implemented at the port, as follows:

Protect – This concept “protects” the port using large-scale infrastructure like a storm barrier located seaward of the port. This concept requires the construction of a barrier that would protect from some community-identified surge height. This concept, unless including a lock system, does not accommodate for impacts from sea level rise as this rise is passive, and the barrier will remain open to allow for navigation of commerce.

Relocate – This concept moves some infrastructure out of locations deemed vulnerable by the community during the planning. Examples of infrastructure that could

be moved are chemical storage facilities (e.g., oil tanks), office space, and equipment storage facilities. This would require the purchase of off-port locations.

Accommodate – This concept invests in improvements to port infrastructure in order to better withstand storm surge related impacts. Examples include elevating properties, elevating utilities and structures, utilizing floodable spaces and break through walls, and waterproofing structures. This strategy has the potential to accommodate for sea level rise, though this was not discussed in detail during the workshop. For additional information on the resilience concepts see Appendix 2B.

Table 1 – We used the *Forms of Leadership* to evaluate which type of organization is responsible for the implementation of resilience at the Port of Providence.

<i>Form of leadership</i>	<i>Description</i>
Businesses independently	Private businesses independently have sole responsibility for the implementation of resilience.
Business in collaboration	Private businesses collaborate to improve resilience collectively with no/little government support.
Public-private informal collaboration	Business and government working cooperatively to improve resilience. An example of this is a Special Area Management Plan process.
Public-private formal collaboration	Public and private organizations work cooperatively in a Rhode Island legislature authorized/mandated body. An example of this is the Governor’s Commission of Dredging, formed by governor Lincoln Almond in 1996 (ESNR, 2008)
Local lead (City of Providence and East Providence)	City governments take a lead role in facilitating implementation of resilience in the study area.
State lead (Rhode Island)	The state of Rhode Island takes a lead role in facilitating implementation of resilience in the study area.
Federal lead (United States)	The U.S. federal government takes a lead role in facilitating implementation of resilience in the study area.

To investigate which organizations stakeholders perceive as responsible for implementing resilience strategies within the study area, we presented respondents with seven possible “leadership forms,” as follows, *port business independently; port business in collaboration; public-private informal collaboration; public-private formal collaboration (i.e. special committee on port resilience); and local; state; and federal*

lead. We developed these using the definition of leadership provided in Stiller and Meijerink (2015) and personal communications with policy experts (Fugate, 2016; Robadue, 2016).

We asked respondents to assign the responsibility of these leadership forms to implement each of the resilience concepts (Protect, Relocate, and Accommodate). Stakeholders answered on a 1 – 5 scale: (1) *not responsible at all*, (2) *less responsible than others*, (3) *just as responsible as others*, (4) *more responsible than others*, and (5) *entirely responsible*. These scores were averaged to indicate how the group as a whole perceived the responsibility of each leadership form.

For each resilience strategy, we asked respondents which entities (person, organization, agency, business, etc.) they see as responsible for implementing resilience and tabulated the number of mentions each entity received as well as created word clouds using the online application Wordle.

3.2 Part II – Interview of stakeholder perceived leaders

In Part 1 of the study, respondents identified nine entities as leaders in our open-ended questions, as follows: the city governments of Providence and East Providence, the Rhode Island Department of Transportation, the Department of Environmental Management, the Coastal Resources Council, Statewide Planning (part of the RI Department of Administration), CommerceRI, the U.S. Army Corps of Engineers, and an organization that represents the Port of Providence business community. In part 2 of the study, we interviewed seven of the nine high-level managers of the entities identified in part 1, while two declined to be interviewed (Appendix 4C).

These managers are referred to as “interviewees” in the next sections; it is important to note, that respondents identified the organizations, while we identified a high-level manager that represents each organization. We asked organization managers to react to the word clouds created during Part 1 of the study (Figure 5). In the interviews, respondents discussed whether or not they perceived their organization to be in a leadership role for storm resilience. After recording initial reactions, we asked the interview subjects to evaluate their organizations responsibility to using the framework provided in Section 3.3. To follow up, we asked respondents what barriers they see that prevents their organization from moving forward in resilience implementation. In order to analyze interview transcripts we adapted a conceptual framework that describes the roles of leadership throughout the resilience policy process. For more information on interview analysis see Appendix 4D.

3.3 Conceptual Framework

In order to structure interview analysis, we adapted a framework (Stiller & Meijerink, 2015), through which we could evaluate each organization’s responsibility throughout the resilience planning and implementation process. To do this we combined a simple model of the policy process made up of three major steps, *understanding*, *planning*, and *managing* and the conceptual leadership functions framework in Stiller and Meijerink (2015) (Figure 2).

Figure 1 – Leadership functions throughout the Policy Process - The Political Administrative Function, Enabling Function Adaptive Function, Dissemination Function, and Connective Function are facilitated by leadership throughout the policy process (understanding, planning, and managing).

As described by Moser and Ekstrom (Moser & Ekstrom, 2010), *understanding* includes identifying problems and measuring their potential impact on a system. *Planning* involves identifying potential resilience options, assessing the feasibility, costs, and benefits, and selecting the optimal option. And *managing* entails installing, monitoring, and evaluating the selected resilience option. In this paper, we discuss “implementation” as a combination of the three phases of the policy process.

Throughout the resilience planning process, leaders provide five functions that help facilitate the policy process and deliver the process from one stage to the next (Stiller & Meijerink, 2015), as follows:

1. *Political-administrative function* – consists of “every day” actions taken to facilitate the management of the policy process such as making decisions on strategy options and designating funding sources for selected strategies.

2. *Enabling function* – motivates progress by instilling a sense of urgency, though initiating discussions and setting deadlines.
3. *Adaptive function* – creates new ideas and process, as well as solutions to exposed barriers. This function allows the organization to change structurally to meet external changes and forces.
4. *Dissemination function* – provides information on new ideas, problems, and solutions to resilience partners and collects information from partners and incorporates them into decision-making.
5. *Connective Function* – incorporates stakeholders into a collective group. It provides connections between stakeholders by initiating meetings and work sessions and by engaging new stakeholders.

We used this framework to evaluate how high-level managers perceived their organization's leadership role both temporally (or throughout the resilience planning process) and functionally (in the facilitation of leadership functions). For additional information on adaptation leadership see Appendix 3, for more information on methods see appendix 4..

4. Results

4.1 Survey respondents see a collaborative effort as necessary for implementing resilience strategies

Results from Part 1 of the study address Research Question 1. Survey respondents identified their initial opinions about what form of leadership is responsible for the implementation of resilience. Results indicated that they perceive a *public-private informal collaboration* as the optimal choice to lead resilience implementation, though they also supported a state lead effort (Figure 3). In this part, we averaged the 1-5 scaling described in our methods. A score of 1, the lowest possible score, indicated that the stakeholder group did not see that organization as responsible. A score of 5, the highest possible score, indicates complete responsibility. Three, being the mid-point, indicated that scales were neutral on the leadership structures responsibility to lead.

Respondents felt that a *public-private informal collaboration* is most responsible to implement resilience with the average of responses evaluating it as *more responsible to entirely responsible* (this is represented as a score of greater than four, Figure 3). *State led* leadership also scored highly and is the second choice for leadership by the stakeholders (Figure 3). On the other hand, respondents do not see *private business independently* or *private businesses in collaboration* as responsible to implement resilience strategies. Average scores lower than three, shown in Figure 3, indicate this.

Figure 2 – Public-private informal collaboration received an average score of greater than four; the only other form of leadership above four is state lead. A score of one indicates “not responsible at all”, two indicates “less responsible”, three indicates “just as responsible as others”, four indicates “more responsible than others”, and five indicates “entirely responsible”..

4.2 Stakeholders from different sectors (public vs. private) have different ideas about which organization should be responsible for leading resilience actions

Though stakeholders collectively see a collaborative effort as responsible there were disagreements between public and private stakeholders when presented with different resilience strategy options. For example, private sector respondents hold different opinions than public sector respondents when it comes to identifying responsibility for the *accommodate* strategy (Figure 4). Business respondents tend to see government-centric leadership structures as more responsible than business-centric leaderships structures. This is indicated by scores greater than three (meaning tending to be more responsible) for *local*, *state*, and *federal lead*.

On the other hand, respondents representing public organizations tend to see business-centric leadership structures as more responsible, as indicated by scores greater than three for *private businesses independently* and *private business in collaboration*. This is an example in which private respondents see public leadership structures as responsible for resilience implementation, whereas government respondents see private leadership structures as responsible. It is important to note; however, that the highest average score is for both *public-private informal collaboration* and *state lead*.

These findings align with the work of Karlsson et al. (2011), who observed that geographic location; stakeholder's roles and characteristics; and the options in question presented to stakeholders, influenced how stakeholders perceived responsibility of climate negotiation (Karlsson et al., 2011). In the case of the Port of Providence, we see that respondents perceive the responsibility of leading resilience action differently, this is likely based on various factors, including whether or not their organization is located within the study area, who they represent (public or private organization), and which resilience strategy they are presented with.

Next, we explored how respondents perceive responsibility for implementing each of the three resilience concepts individually. We were interested in seeing whether or not resilience strategy would affect who respondents see as responsible to implement resilience.

Figure 3 – Public stakeholders tend to see private-centric leadership structures as responsible, while private stakeholders tend to see public-centric stakeholders as responsible. A score of one indicates “not responsible at all”, two indicates “less responsible”, three indicates “just as responsible as others”, four indicates “more responsible than others”, and five indicates “entirely responsible”.

Open-ended questions asking stakeholders who is responsible for leading the implementation of *accommodate*, *relocate*, and *protect*, showed that stakeholders perceive 36 different organizations as responsible (Figure 5).

Overall stakeholders listed numerous organizations as having responsibility for the various strategy options (Figure 5). When comparing implementation responsibility for *accommodate*, *relocate*, and *protect* we see that respondents felt that “Businesses”, along with the Rhode Island Department of Environmental Management, should be responsible for implementing *accommodate* strategies. They felt that the City Governments and CommerceRI should be responsible for implementing *relocate* strategies. Finally, they felt that the U.S. Army Corps of Engineers and the State of Rhode Island responsible for implementing *protect* strategies.

Figure 4 – Different organizations were identified as responsible for each resilience strategy:

a.) # of Unique organizations mentioned by respondents - 21; Total Mentions - 46; RI Government (8), Federal Government (6), USACE (6), RICRMC (4), RIDEM (4), City Government (3), Public (2), RI Statewide Planning (1), Collaboration (1), URI (1), CommerceRI (1), ProvPort (1), City Planning (1), Save the Bay (1), FEMA (1), Private (1), Mass Government (1), RIDOT (1), Business (1), URICRC (1); $n = 25$.

b.) # of unique organizations mentioned by respondents - 21; Total mentions - 49; City Government (8), CommerceRI (5), Business (4), RICRMC (4), None (no organization) (4), Rhode Island Statewide Planning (3), Federal Government (3), RIDEM (3), RIDOT (2), ProvPort (2), RI Government (2), Collaboration (1), Courts (1), Public (1), URI (1), Save the Bay (1), City Planning (1), Government (1), Port of Providence (1), Public-Private Formal Committee * (1), USACE (1); $n = 25$.

c.) # of unique orgs - 24; Total Votes - 45; Business (5), RIDEM (5), Collaboration* (4), RICRMC (4), City Government (3), RI Statewide Planning (2), EPA (2), USACE (2), FEMA (2), Providence Working Waterfront (1), URI (1), URICRC (1), RIDOT (1), Federal Government (1), None (1), NOAA (1), Governor's Office (1), USCG (1), Public (1), Port of Providence (1), Petroleum Industry (1), Special Committee* (1), Public-Private Committee* (1); $n = 25$.

It is difficult to define where leadership for resilience implementation rests, because there are so many stakeholders of the Port of Providence and so many options for building resilience to climate change. Our results show that 36 different organizations, spanning public and private; local, state, and federal, are seen by respondents as having responsibility to lead in resilience implementation. Though some organizations received more mentions than others, our study provides empirical evidence that there is a lack of

consensus amongst port stakeholders when it comes to determining which entity should take a leadership role. This leaves an institutional void when it comes to resilience implementation. This has led to a situation in which no entity has taken action because no entity is mandated to take on the problem. For a list of acronyms used in survey analysis please see Appendix 5.

4.3 Perceived leaders felt they were leaders, but not entirely

Results from interviews in Part 2 of the study addressed Research Question 2. They show that representatives of six of the seven managers interviewed stated that their organization is, in fact, a leader in resilience implementation. These representatives characterized their leadership in two ways: One group perceived their organization as a leader, but with limits to its ability to implement change at the Port of Providence. The second group felt that their entity could participate in leadership activities, but not be a sole “leader.” For example one respondent after stating their leadership role said, *“We do have a direct role. I see us as a direct participant.”*

When we asked interviewees to evaluate their role in the resilience implementation process, we found that no representative felt that their organization fulfilled all of the five functions of leadership throughout the policy process (understanding, planning, and managing; Section 3.3). For example two interviewees felt that their organizations held responsibility for fulfilling *the dissemination, adaptation,* and *connective* functions during the *planning* phase for climate resilience; however, they felt that they had no role in the *managing* phase and that the responsibility for leading implementation would thus need to be passed to someone else.

Similarly, another manager felt that, for the *protect* strategy in particular, their organization is responsible for the managing phase but not for the planning phase of that project. This suggests that the resilience strategy we presented interviewees with also impacted their perception of the organizations responsibility. Another representative stated that their organization focused on the dissemination of information to help port businesses understand their risk, this suggests the organization sees themselves as fulfilling the *dissemination* function during the *understanding phase* of the policy process, but not any other functions and they felt no responsibility in the *planning* or *managing phase*.

Only one representative indicated that their organization held responsibility to complete all of the leadership functions; however, this organization only indicated it could complete these functions during the *planning phase* and was less sure about its role in the *managing phase*. The least discussed by managers and least fulfilled functions were the *enabling function* and the *political and administrative function*. These functions allocate funds as well as motivate and set deadlines for other stakeholders participating in the process, suggesting that this may inhibit action toward resilience implementation at the Port of Providence.

These results indicate that no one leader fulfills all the leadership functions throughout the policy process from understanding to managing. However, it is shown that each organization plays a role in resilience implementation. This is an example of fragmentation, a barrier described in Section 2.2.2, because multiple organizations can influence the process and take the lead. However, who should take the lead is unclear, because so many organizations are involved. This lack of continual and clear leadership

results in the fragmentation of responsibility. It is not clear who should be acting at what phase, or who is responsible for what part of resilience implementation.

4.4 Leaders face barriers that affect their perception of leadership responsibility

To answer Research Question 3 about barriers to leadership, we asked interviewees what barriers they felt were inhibiting their actions on resilience implementation. We identified four barriers that inhibited leadership organizations from taking a leadership role at the Port of Providence; they are 1) expertise, 2) jurisdiction, 3) lack of resources, and 4) lack of mandates/authorization. These barriers impacted some of the leaders' perception of their organizations role in leading the resilience process making them see their organization as less responsible, because they faced one or more of these barriers.

4.4.1 Expertise

We found that interviewees did not feel that their organizations had the skills or expertise to fulfill one or more of the leadership functions necessary to plan and implement resilience. We asked specifically how they felt their organization could fulfill each of the five leadership functions for climate resilience described in Section 3.3. For example, one interviewee felt that their organization could not complete the *connective* function because, their organization had no history of bring groups of collaborators together and did not know who should be involved, stating that, "*A limitation is our [lack of] understanding of all of the players*". The time horizons involved in implementing climate resilience also factored into interviewee's perceptions of their organizations mandate or expertise. Only one organization stated that they could plan or operate within the 50-100 year into the future time period, in which many of the major impacts of

climate change are likely to be felt. One leader stated, “*Resiliency is not something that is going to be addressed by one organization*” meaning that for this leader, it was going to take a collaborative effort, with multiple organizations with multiple skill sets, access to resources, and of different jurisdictions to improve the resilience of the port.

4.4.2 Jurisdiction/scope

Interviewees reported that they felt their organizations were limited by their jurisdiction and/or their scope, when it came to planning for climate resilience for the Port of Providence. Some organizations were limited to working within in a unit smaller than the study area. For example, one leader stated, “*Yes we take a lead role within the City limits, [but not beyond].*” This representative said that within their city they had the ability to take the lead; however, they would need to be part of a larger collaborative effort if the entire Port of Providence (which includes both the City of Providence and East Providence) were included in a major planning effort.

Other interviewees felt that planning at the port scale was too small of a unit to work, stating, “*We have taken [a leadership role] ... for the entire coastline, including in Providence Harbor, [but we do not focus specifically on any one location].*” Another organization explained that their long-term resilience planning work was spread throughout the state, “*Yes, [we have] taken a high-level leadership role in Providence Harbor as well as other locations.*” They stated that if port business stakeholders reached out to them they would be able to input information into the planning process, but they would not take the initiative to begin a planning process without being approached by an entity more directly linked to the study area. This interviewee followed up to saying that

at a lack of resources also limited their participation in planning for climate resilience at the Port of Providence.

4.4.3 Lack of resources

In fact, a lack of resources turned out to be a recurring theme. Every interviewee stated that the lack of resources limited their organization's ability to lead in the resilience planning and implantation process at the port of Providence. Below are three examples of interviewee statements about this issue.

"Funding is always an issue, if we don't have the resources to complete the job correctly then that is a barrier."

"Funding, authority, and appropriation barriers, we can't just go out and do anything we want"

"Resources are always an issue, [we] are always spread everywhere thin, personnel and financial."

The lack of personnel and financial resources heavily impacted how leaders perceived their organization's role at the port. All managers of perceived leader organizations expressed the need for more money and more personnel if their organization was going to take a lead role in climate adaptation for the Port of Providence. One manager expressed the importance of a resilience grant process as a way to provide resources, suggesting that grants incentivize the participation of businesses, government, and non-governmental organizations (including universities).

4.4.4 Lack of mandates/authorization

Interviewees discussed how they often rely on the actions of others before acting themselves and that the resilience planning process needs a catalyst to begin. Two

interviewees, one state (Rhode Island) and one federal, stated that though their involvement was within their jurisdiction a lack of authorization from legislative organizations inhibited their leadership at the Port of Providence. An interviewee stated, “...*If we are going to impose change... it would take specific authority to require that.*” Other interviewees stated that though not totally in their jurisdiction but if mandated by law, their organization would be motivated to take a lead role in resilience implementation at the port, particularly if grant funding was provided to conduct the work. Another interviewee stated, “*Funding, authority, and appropriation barriers, we can’t just go out and do anything we want.*”

4.5 Managers see opportunities to collaborate as motivation and chance to clarify roles

Interviewees explicitly stated the need for dialogue to help motivate their organization into a leadership role. Along with access to funding, leaders stated, “*opportunities to cooperate*”, “*a group that was constantly driving discussion*”, and “*it is helpful to have things like the workshop to help remind [us of potential risks] and give ideas.*” One interviewee mentioned the Port of Providence workshop conducted prior to this research as a valuable motivating force. This aligns with other findings in other work in which dialogue between stakeholders instilled ownership in the process as well as increased trust and motivated participation (Douglas et al., 2011). Pre-planning opportunities, like the workshop and the process described in Douglas et al. (2011) motivate participation.

Interviewees also suggested that pre-planning dialogue helps clarify leader roles. One interviewee stated that conversation with other Port of Providence stakeholders allowed them “*to see what other people do*”. This same interviewee previously

mentioned that they did not know “*all the players*”. This suggests that pre-planning would allow for representatives of leadership organizations to see what other organizations do so managers can evaluate what roles their organization plays and when in the process. Pre-planning opportunities provide clarification of the feasible and stakeholder community supported resilience options (Becker, In press). One interviewee stated that they did not know how to act because they did not know what resilience strategy was likely to be implemented. Pre-planning can provide the opportunity for managers of perceived leadership organizations to interact with a portfolio of plausible resilience options; this helps clarify their leadership roles and when they need to take action. For additional results see Appendix 6.

5. Conclusion

Though representatives of all of the perceived leader organization described playing a leadership role for the implementation of resilience strategies, no interviewee felt that their organization was solely responsible for the entire implementation process. In this case study, we found that port stakeholders represented in a survey identified seven possible organizations as “responsible for climate resilience implementation.” However, when managers of the seven organizations were interviewed, none was willing to assume such a leadership role alone. Interviewees identified multiple barriers that inhibited their leadership, including misaligned jurisdiction, unclear mandates, a lack of resources, and a lack of expertise.

We also found that when comparing public and private stakeholders, each group perceived different members of the community as responsible for resilience implementation. When we compared perceptions around three different resilience strategy alternatives, we found that respondents felt that different leaders were responsible for the implementation of different types of resilience strategies. For “protecting” the port with the construction of a storm barrier, respondents felt that the state government should lead. If the port were to implement a “relocate” strategy to try to move uses out of the floodplain area, then respondents thought that a public - private collaboration should be formed to implement. Finally, “accommodating” existing uses should fall on the private sector for investment and implementation.

The sheer number of stakeholders involved in planning for the port, further contributes to an institutional void and fragmentation of leadership responsibility. Survey respondents representing port stakeholders mentioned 36 unique organizations with

responsibility to lead resilience implementation. This contributes to institutional void because it is unclear who should be leading or who should be deciding. There is also no formal decision making process. Results showed that though all organizations interviewed play a role it is unclear who plays what role and when. This contributes to fragmentation of leadership responsibility.

Our results provide evidence of the importance of informal pre-planning dialogue in order to motivate and clarify leadership roles. Interviewees specifically discussed the Port of Providence workshop (a pre-planning exercise) as a motivating factor to their participation, stating that future collaborative opportunities would motivate their participation. Pre-planning dialogue allows for ownership to be taken (Moser & Ekstrom, 2011), cultivates trust and participation (Douglas et al., 2011), and as our results suggest allow for those perceived responsible to lead to “*see what other people do*”. This helps clarify the many roles (or functions) that perceived leader organizations must take. Pre-planning processes allow for discussion of politically, economically, and socially feasible resilience options (Becker, In press), this discussion allows for further clarification of leadership roles.

Dialogue held during pre-planning processes can reduce the impact of and help navigate around barriers (Douglas et al., 2011), because it allows for the transaction of information from one organization to another (Tribbia & Moser, 2008). Even though this type of exercise requires funding and prioritization by multiple stakeholders in the community, future dialogue, however, is critical so that roles may be clarified, alternatives agreed upon, and responsibility for action may be taken.

Appendix 1: Appendix Introduction

The appendixes below describe in greater detail aspects of this thesis. They provide greater detail on the Port of Providence and the Port of Providence Stakeholder Workshop, the storm scenario and resilience strategies used during the workshop, a literature review on the definition of adaptation leadership, additional methods, and additional results that were obtained. We also provide a copy of the survey and copy of the interview script.

Appendix 2: Port of Providence

This appendix provides more information on the Port of Providence as well as the Port of Providence stakeholder workshop that took place in August of 2015. A team of URI researchers that include Austin Becker, Richard Burroughs, Duncan McIntosh, and Eric Kretsch conducted this workshop. This project was a Rhode Island Department of Transportation, URI Transportation Center, and Federal Highway Administration funded grant.. Appendix 2A provides more background on the Port of Providence and it's importance to the regional economy. Appendix 2B provides more detail on the Port of Providence stakeholder workshop. It also provides more information on the storm scenario and resilience strategies presented to workshop discussed in this thesis.

Appendix 2A: Port of Providence Background

(Authors: Eric Kretsch, Austin Becker, Richard Burroughs, and Duncan McIntosh)

The study area for this project includes ProvPort, the main port terminal, and 23 other waterfront businesses and industries, which together, take up nearly 573 acres of waterfront in Providence and East Providence (Becker et al., 2010). ProvPort itself sits on

nearly 105 acres of land that are owned by the City of Providence and operated by a five board member nonprofit organization, which contracts the services of Waterson Terminals LLC to operate and maintain the Port. ProvPort generated more than \$200 million in economic benefits for the region and over 2,400 jobs were attributed to port activities in 2009 (Providence Working Waterfront Association, 2010).

The Port is located at the northern end of Narragansett Bay, an ecologically sensitive estuary that provides breeding grounds for marine life in the region. The length and orientation of Rhode Island's Narragansett Bay, and its proximity to the Atlantic hurricane zone, make it susceptible to extreme storm surges from the southerly winds that are generated when a hurricane passes to the west of the Bay. As such, the Federal Emergency Management Agency (FEMA) considers Providence to be the "Achilles heel of the Northeast" (Rubinoff, 2007). The most recent major storm, Hurricane Carol in 1954, produced 14.5 feet of storm surge in Providence. Most of the port lands in the study area are 3-10 feet above mean high water. A 25 foot hurricane barrier north of the port protects the downtown Providence area, but could result in higher storm-surge levels just south of the barrier at the port, as surge waters would accumulate in Providence Harbor instead of spreading throughout the low-lying region now protected inland of the barrier.

Appendix 2B: Port of Providence Workshop (Hurricane Scenario and Resilience Concepts)

(Authors: Eric Kretsch, Austin Becker, Richard Burroughs, and Duncan McIntosh)

In August of 2015, the Port of Providence business and government stakeholder group participated in a half-day workshop to discuss port vulnerabilities and also discuss

potential long-term transformation resilience concepts that could be employed within the port. Since 1851, 37 hurricanes have passed within 50 miles of Rhode Island (Rhode Island Emergency Management Agency, 2014), which corresponds to a 22.8 % chance of a hurricane approaching Rhode Island in a given year. In the past 100 years, Providence suffered two near-direct hit, from the unnamed Hurricane of 1938 and Hurricane Carol in 1954.

During the Port of Providence stakeholder workshop, researchers from the University Of Rhode Island Department Of Marine Affairs presented workshop participants with a storm scenario and visualizations to enhance dialogue between participants. We developed a scenario using input from a project steering committee. We identified a worst-case category three hurricane, using Sea, Lake, Overland Surges from Hurricane modeling (SLOSH) to identify potential surge heights. In this scenario the storm hit at high tide and caused a 21ft surge, just below the design height of the Fox Point Hurricane Barrier located north of the Port of Providence (Figure 13). We presented storm scenario images and images of the resilience strategies to promote dialogue between workshop participants

Figure 5 - Image of hurricane storm scenario; this image depicts ProvPort proper (Image: Duncan McIntosh).

Figure 6 - Image of hurricane storm scenario; this image depicts Motiva Enterprise's tank farm, west of Allen's Ave (Image: Duncan McIntosh)

Figure 7 - Surge generated by hurricane storm scenario. Based on RIGIS, 2013 DEM derived from a 1-meter resolution digital elevation model originally produced as a part of the Northeast LIDAR Project in 2011 (Image: Duncan McIntosh)

During the workshop, we also presented port stakeholders with concepts that represent three different long-term transformation resilience concepts to increase port resilience. These are hypothetical concepts; a mixture these strategies would likely be necessary to build resilience at the port of Providence.

Figure 8 - Examples of Accommodate; Top Left: raised utilities (Courtesy of PNYNJ); Top Right: port terminal elevation (Courtesy Port of Gulfport Elevation Plan); Bottom Left: Flood proof utility box (Pt. Judith, RI), Bottom Right; Breakaway walls (RIEMA)

Accommodate

The “Accommodate” (Figure 8) concept proposed a suite of strategies that allow businesses to remain in place, but enhance resilience through upgrading, hardening, elevating and flood-proofing infrastructure and buildings (see e.g., (MassPort, 2014) .

Properties would be retrofitted to withstand significant flooding, while retaining existing

uses that could be operational upon receding of the flood. Through smart planning and improved practices, debris impacts could also be limited, decreasing physical and environmental damage. The “Accommodate” concept proposed a major investment on a property-by-property basis. Options that were discussed included:

- Elevating buildings
- Constructing breakaway walls
- Flood-proofing utilities
- Creating floodable first floors
- Elevating land under structures
- Elevating critical utilities (e.g., power, water, sewer)
- Raising backup generators, air conditioning units and oil or gas tanks above the base flood elevation or onto roof of building
- Flood-proofing building foundations
- Using flood/salt water tolerant construction materials
- Sealing around utility entry points
- Installing waterproof bulkheads
- Installing pumps with backup generators to pump out access water
- Reinforcing windows and doors
- Covering piles of material with debris tarps and strapping
- Constructing storm water retention ponds

Protect

Figure 9 - Example of Protect; a hypothetical Field's Point Hurricane barrier south of the Port of Providence (Image: URI Landscape Architecture 444 Fall 2014).

The “Protect” concept (Figure 9) reduces storm risk by decreasing the probability of occurrence of impacts (Tol et al., 2008). To do so, it proposes relocating the existing Hurricane Barrier to a new location, south of Fields Point, which would protect the Port of Providence area. The United States Army Corps of Engineers (USACE) constructed the existing barrier in the 1966 to protect the downtown Providence area (USACE, 2007). However, the barrier leaves exposed all the maritime infrastructure in the study area, as it is located seaward of the barrier. The “Protect” concept envisions the construction of a new barrier and berm system, with a similar design to the Maeslatkering Barrier in the

Port of Rotterdam, at Fields Point along the southern edge of the study area. The Protect design concept would span the mouth of Providence Harbor, tying into the existing elevation in Providence and East Providence. The floodgate could be closed in the event of a storm, effectively protecting Providence Harbor from forcing associated with hurricane level storm surge and wave action. When open, the gates would rest on dry docks on the east and west sides of the harbor entrance. To close the gates the arms would be floated so that they may swing closed to meet in the center of the channel. A multipurpose levee located along the shoreline incorporates an earth berm and green wall along the landside, and a living shoreline along the waterside. A pedestrian/bike path might run along the top of the levee, and bleachers could be located on a portion of the landward side for viewing the adjacent sports fields.

Relocate

Relocate (Figure 11), also called “retreat” in climate change literature, reduces the impact of a storm event by limiting the potential negative effects through moving structures away from the flood plain (Tol et al., 2008). Historically, relocation has occurred after an event, when structures are damaged, abandoned, and rebuilt in an area further from shore or more protected . Relocation may be more appropriate for non-water dependent uses such as residential housing, as opposed to water dependent coastal infrastructure. However, in some cases infrastructure such as lighthouses (e.g., Cape Hatteras Light in North Carolina) have been moved back away from an eroding bluff. The “Relocate” concept proposed moving some or all of the current industrial uses in Providence Harbor out of harm’s way. It suggested that other locations around Narragansett Bay could provide a less exposed area from which to do business, while still

providing the infrastructure requirements such as access to highway, rail, navigation channels, pipelines, to operate. The current Exxon Mobil petroleum facility in East Providence provided an example of such a location, where the berthing facility is located along the water's edge but the petroleum product is piped upland and stored in a tank farm located well away from the floodplain at an elevation of 50 feet

Figure 10 - Example Relocate; Exxon Mobil Berth and Terminal East Providence (Image: Eric Kretsch).

Appendix 3: Literature related to the definition of adaptation leadership

In this appendix, we will discuss leadership in regards to adaptation and introduce the concept of “adaptation leadership.” Leadership takes many forms and can be defined in many ways (Meijerink & Stiller, 2013; Moser & Ekstrom, 2010, 2011; Stiller & Meijerink, 2015). However adaptation leaders, defined here as “those that will implement climate resilience strategies in complex systems such as ports” can be thought to possess certain behaviors like articulating a vision and stimulating intellectual thought and also thought to complete specific functions like setting deadlines and locating and allocating resources (Podsakoff et al., 1990; Stiller & Meijerink, 2015).

Defining leadership

Adaptation leadership can play a key role in navigating adaptation barriers such as a lack of mandates, resources, information, and authorization to act (Moser & Ekstrom, 2010). Further, a lack of leadership can exacerbate such barriers to action. Adaptation leadership can help to find consensus and make decisions in complex communities with multiple levels of government in which many stakeholders have multiple adaptation options (Becker, 2016; Biesbroek et al., 2013; Karlsson et al., 2011; Vogel et al., 2007)

Functions of Adaptation Leadership

To meet the climate change challenge, strong adaptation leadership is expected to enhance the development and selection of resilience options (Stiller & Meijerink, 2015). So-called “transformational adaptation”, which are large scale changes that transform places, like storm barriers or relocating vulnerable infrastructure, may require even greater input from leadership due to the system-wide issues it presents (Kates et al., 2012). Research suggests stakeholders at all levels, local to national and including

business, knowledge institutions, and government officials must communicate to transform impacted systems (Kates et al., 2012). Leadership can play a major role in these transformations by providing the ability to maneuver around adaptation barriers (Meijerink & Stiller, 2013; Moser & Ekstrom, 2010; Stiller & Meijerink, 2015).

Adaptation leadership does not always conform to the typical hierarchical forms of leadership where “an often charismatic, positional leader (someone with a formal leadership position) succeeds in getting followers for his ideas” (Stiller & Meijerink, 2015, p. 2). Adaptation leadership lies often in organizations or a group of individuals or organizations and is also transferable from one organization to another (Stiller & Meijerink, 2015). Such an organization(s) is responsible for fostering transformational change.

Podaskoff et al. (1990) discusses behaviors of transformational leaders. Since resilience implementation is a transformational process, we can expect that an adaptation leader will display six behaviors (Podsakoff et al., 1990), these are:

1. *Identifying and articulating a vision* – Identifies new opportunities for the future; presenting to followers and inspiring followers to reach new vision.
2. *Providing an appropriate model* – Provides a model of behavior and action that followers can emulate.
3. *Fostering the acceptance of group goals* – Promotes cooperation among members of the group in order to motivate the group to work towards group-established goals.
4. *High performance expectations* – Expects more from group members than what is or has been standard practice.

5. *Providing individualized support* – Shows caring and respect for individual members opinions, struggles, and needs.
6. *Intellectual stimulation* – Provides an environment that stimulates followers to re-evaluate their way of operating and allows for changes in follower behavior.

Leader behaviors enhance follower or actor trust and satisfaction with the process (Podaskoff et al., 1990). Actors must be satisfied with the process in order to be involved. Adaptation leader behaviors are only one aspect of adaption leadership; adaptation leadership facilitates functions that motivate and sustain the policy process. Behaviors and functions of leaders are important to understand in order to analyze how Port of Providence actors and leaders perceive leadership roles in the port community.

Stiller and Meijerink (2015) developed a model of adaptation leadership functions that facilitate the development and implementation of resilience options. Leadership in this model is not confined to a “top-down” authoritarian structure, often strong leadership is presented by organizations that allow for the development of new ideas and practices (Stiller & Meijerink, 2015). Leaders create resilience policy by investing human and financial resources; setting deadlines and establishing an urgency to work; changing the work environment or operation routines, translating new ideas into policy, and organizing actors in a stable working group (Stiller & Meijerink, 2015). Stiller and Meijerink’s model consist of five adaptive leadership functions the political-administrative function, the enabling function, the adaptive function, the dissemination function, and the connective function. Adaptation leaders by facilitating these five functions to reduce the impact of barriers to adaptation (Moser & Ekstrom, 2010). In other research, we see examples of the disseminative and connective functions. In Vogel et al. (2007), Tribbia

and Moser (2008), and Kahan (2010) we see examples of the disseminative and connective functions and a discussing of discuss various aspects related to these functions.

Vogel et al. (2007) and Tribbia and Moser (2008) focus on a decision-maker's abilities to incorporate science into decision-making. This work clarifies how climate adaptation knowledge is developed between scientists and policy-practitioners. Vogel et al. (2007) discusses the "science-practice interface" and the importance of bridging gaps between scientists and practitioners so that informed decision-making can occur. This interface previously seen as linear from scientist to practitioner recently is described as dynamic, where information passes bi-directionally and each group is altered by the interaction (Vogel et al., 2007).

We see that adaptation leaders provide this the link between science and practice via the dissemination and connective functions between decision-maker and scientist (Stiller & Meijerink, 2015; Tribbia & Moser, 2008). Stakeholders can provide localized knowledge that improves the quality of decisions. (Becker, 2016; Burroughs, 1999; Messner, Becker, & Adolf, 2016; Preston, Rickards, Fünfgeld, & Keenan, 2015). It is important to note again that many organizations may be adaptation leaders, because they facilitate various functions (Moser & Ekstrom, 2010; Stiller & Meijerink, 2015).

Adaptation leaders must possess transformational leadership behaviors and facilitate various functions in the policy process. These Adaptation leadership behaviors and functions increase participation, trust, and motivate and sustain resilience implementation. This results in more optimal resilience outcomes ones that are politically, economically, and socially feasible. The leaders identified by Port of

Providence stakeholders may possess the traits of an adaptation leader. This study looks at how leaders facilitate the functions described in this section.

Appendix 4: Additional Methods

This appendix provides more information on survey and interview methods including the analysis of both survey and interview results. We also provide a copy of the survey used in Part 1 (Appendix 4A) of the study and a script of the interview used in Part 2 of the study (Appendix 4D).

Appendix 4A – Copy of Survey

Introduction

Thank you for continuing to support *Hurricane Resilience: Long Range Planning for the Port of Providence*. This survey follows your participation in the initial port survey and/or in the Aug. 3 workshop at Save the Bay. Participants expressed concern that there was no clear leader for improving long-term port hurricane resilience. This survey investigates this issue and also helps us evaluate workshop outcomes and methods.

Note that this survey includes links to the PortofProvidenceResilience.org website, which has additional information about the study. Links will open as separate tabs in your web browser. Please do not close out the Survey Monkey browser window in the middle of the survey, as doing so will require you to retake the survey from the start.

With your help, we will continue to work toward a resilient future for Rhode Island's commercial and industrial ports.

Information collected in this study will be reported in aggregate and not connected to you or your organization by name. All data will be confidential and maintained in accordance with URI procedures. No risks or discomfort to you are anticipated through your participation in this survey. The decision to take part in this study is up to you and you may quit at any time. You may discuss and concerns with Prof. Austin Becker at (401) 874-4192 or by email at abecker@uri.edu. If you have questions about your rights as a research participant, you may contact the office of the Vice President for Research, 70 Lower College Road, Suite 2, University of Rhode Island, Kingston, Rhode Island, telephone: (401) 874-4328.

If you understand your rights as a participant in this research project and are ready to move on please click on "Next".

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Study Area

This survey focuses on the port of Providence (see Figure 1), defined as the waterfront properties bounded by the Fox Point Hurricane Barrier, I-95, Field's Point and the Save the Bay Facility and including the waterfront businesses on the East Providence side of the harbor. Many of these areas would be heavily affected by a major hurricane. Click [HERE](#) for an example scenario.

Figure 1: Study area is outlined in Red. (Image: Austin Becker)

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Introduction

At the August 3rd workshop, participants and researchers discussed three long-term resilience planning concepts. As a reminder, these are "long-term planning concepts" that would be implemented over the the next several decades, as opposed to hurricane response planning of the type already well-established in the port area. More information can be found by clicking on the links below.

Accommodate the storm surge through incremental improvements.

Relocate some business to less exposed areas (as appropriate).

Protect the entire study area through the construction of a new barrier.

The next sections will ask questions referring to the above resilience concepts.

In the following sections, questions will refer to "implementation". For this survey, "implementation" refers to:

- Initiating planning process.
- Coordinating stakeholders.
- Developing, assessing, and selecting resilience options (with stakeholder input).
- Identifying and allocating resources.
- Managing the successful change to improve resilience.

If you understand this information please click "Next". Remember, you can always return to PortofProvidenceResilience.org if you need more information.

Introduction

Please provide the information requested below. Note that your responses to this survey will remain confidential and all results will be presented in aggregated form.

1. Name

* 2. Job Title

* 3. Organization associated with

* 4. Did you attend the August 3rd Port of Providence Resilience Workshop?

☐ Yes

☐ No

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Part 1: Collaboration in Resilience Implementation

For this section "resilience implementation" refers to the implementation (as appropriate) of aspects from all three long-term resilience concepts discussed in the previous section.

How strongly do you agree or disagree with each of the below statements?

- * 5. Private businesses have the sole responsibility for implementation of long-term resilience strategies within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Level of Agreement	☐	☐	☐	☐	☐

- * 6. A collaboration of private businesses should be responsible for implementation of long-term resilience strategies within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Level of Agreement	☐	☐	☐	☐	☐

- * 7. A public-private collaboration should be responsible for implementation of long-term resilience strategies within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Level of Agreement	☐	☐	☐	☐	☐

- * 8. A formal private-public collaboration (special committee) should be formed to implement long-term resilience strategies within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Level of Agreement	☐	☐	☐	☐	☐

- * 9. Government (at the levels indicated) should take a lead role in facilitating implementation of long-term resilience strategies within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Local Government (City of Providence)	☐	☐	☐	☐	☐
State Government (Rhode Island)	☐	☐	☐	☐	☐
Federal Government	☐	☐	☐	☐	☐

* 10. Which specific organizations (consider public, private, non-profit, etc.) should play a lead role in resilience implementation within the study area?

11. Port of Providence businesses should initiate longterm resilience planning:

- ☐ now.
- ☐ within the next 2 years.
- ☐ in 2-5 years.
- ☐ in 5-10 years.
- ☐ in 10+ years.

* 12. Implementing long-term resilience strategies will likely require large amounts of funding. Please assess the responsibility of funding long-scale resilience amongst the below parties from *not responsible at all* to *entirely responsible*.

	Not responsible at all	Less responsible than other parties	Just as responsible as other parties	More responsible than other parties	Entirely responsible
Private Businesses	☐	☐	☐	☐	☐
Local Government (Cities of Providence and East Providence)	☐	☐	☐	☐	☐
State Government (State of Rhode Island)	☐	☐	☐	☐	☐
Federal Government	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Other (please specify)

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13. Comments (optional):

Part 2: Accommodation

These questions refer to the "Accommodate" concept. If you need to refresh your memory, please click on the highlighted link.

- * 14. I would support an effort to implement aspects of the "Accommodate" concept within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Level of Agreement	☐	☐	☐	☐	☐

- * 15. Please assess the responsibility for the implementation of the "Accommodate" concept:

	Not responsible at all	Less responsible than other parties	Just as responsible as other parties	More responsible than other parties	Entirely responsible
Private Businesses Independently	☐	☐	☐	☐	☐
Private Sector in Collaboration	☐	☐	☐	☐	☐
Private-Public Sectors in Collaboration	☐	☐	☐	☐	☐
Formal Private-Public Collaboration (Special Committee)	☐	☐	☐	☐	☐
Local Government (Cities of Providence and East Providence)	☐	☐	☐	☐	☐
State Government (State of Rhode Island)	☐	☐	☐	☐	☐
Federal Government	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Other (please specify)

- * 16. Which specific organizations (consider public, private, non-profit, etc.) should play a lead role in implementing aspects of "Accommodate" within the study area? Please name them if possible.

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Part 3: Relocate

These questions refer to the "Relocate" concept. If you need to refresh your memory, please click on the highlighted link.

- * 18. I would support an effort to implement aspects of the "Relocate" concept within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Level of Agreement	☐	☐	☐	☐	☐

- * 19. Please assess the responsibility amongst the below parties for the implementation of the "Relocate" concept.

	Not responsible at all	Less responsible than other parties	Just as responsible as other parties	More responsible than other parties	Entirely responsible
Private Businesses Independently	☐	☐	☐	☐	☐
Private Sector in Collaboration	☐	☐	☐	☐	☐
Private-Public Sectors in Collaboration	☐	☐	☐	☐	☐
Formal Private-Public Collaboration (Special Committee)	☐	☐	☐	☐	☐
Local Government (Cities of Providence and East Providence)	☐	☐	☐	☐	☐
State Government (State of Rhode Island)	☐	☐	☐	☐	☐
Federal Government	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Other (please specify)

- * 20. Which specific organizations (consider public, private, non-profit, etc.) should play a lead role in implementing aspects of "Relocate" within the study area? Please name them if possible.

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Part 4: Protect

These questions are on the concept "**Protect**". If you need to refresh your memory, please click on the highlighted link.

* 22. I would support an effort to implement aspects of the "Protect" concept within the study area.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Level of Agreement	☐	☐	☐	☐	☐

* 23. Please assess the responsibility among the below parties for the implementation of the "Protect" concept.

	Not responsible at all	Less responsible than other parties	Just as responsible as other parties	More responsible than other parties	Entirely responsible
Private Businesses Independently	☐	☐	☐	☐	☐
Private Sector in Collaboration	☐	☐	☐	☐	☐
Private-Public Sectors in Collaboration	☐	☐	☐	☐	☐
Formal Private-Public Collaboration (Special Committee)	☐	☐	☐	☐	☐
Local Government (Cities of Providence and East Providence)	☐	☐	☐	☐	☐
State Government (State of Rhode Island)	☐	☐	☐	☐	☐
Federal Government	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Other (please specify)

* 24. Which specific organizations (consider public, private, non-profit, etc.) should play a lead role in implementing aspects of "Protect" within the study area?

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Appendix 4B - Stakeholder Surveys Analysis

In the survey, respondents were asked to assign responsibility resilience strategy implementation of the three major concepts to the seven leadership forms. Stakeholders

answered on a 1 – 5 scale, this included (1) *not responsible at all*, (2) *less responsible than others*, (3) *just as responsible as others*, (4) *more responsible than others*, and (5) *entirely responsible*. We averaged responses in order to evaluate how the group as a whole sees the responsibility of each form of leadership.

The lowest average score possible is one; this means that all stakeholders see that form of leadership as “*not responsible at all*” for the implementation of the strategy. A score of three is the mid-point indicating stakeholders see that form of leadership just as responsible as everyone else. A score less than three indicates stakeholders see that organization less responsible, with lesser responsibility, as you get closer to one. A score of greater than 3 indicates that that form of leadership is more responsible than other, with greater responsibility as you get closer to five. Five is the max score, meaning that all stakeholders perceive that form of leadership as entirely responsible for the implementation of the given resilience strategy.

We analyzed open-ended questions by tabulating the number of mentions. We then used Wordle to develop word clouds. These word clouds are visual representations of the number of mentions each organization received. The larger the font the greater the number of mentions. Actual counts are located in the captions of each word cloud image. We used these word clouds in interviews to show high-level managers efficiently how stakeholders perceived their organization as well as other organizations.

Appendix 4C – Copy of Interview Script

Interview Script

Leadership, responsibility, and incentive for long-term resilience planning

Documents needed:

- Study Area Map
- Brief description of Resilience Concepts
- Definition of Implementation and long-term resilience planning
- Word Clouds

Interview Process:

1. Briefly describe study area; explain project to those interviewees that have not participated in Port Resilience work before, as well as, to those that have been participating, explain where this interview fits into larger project.
 - 1.1. IMPORTANT: Study area, port focus, explanation of interview purpose.
2. Discussion about long-term resilience planning (what it means), as well as, the long-term resilience concepts for the Providence Harbor (Relocate, Accommodate, Protect); define implementation (use same definition from survey).
 - 2.1. Use of concept descriptions
 - 2.2. IMPORTANT: Long-term resilience planning; concepts; “implementation”
3. Introduction of findings from perceptions survey (word clouds)
 - 3.1. Explain what they are, pass to interviewee to examine and ask questions.
 - 3.2. Explain that these are stakeholder perceptions and do not indicate who actually should be doing long-term planning.
4. Explanation of anonymity of responses.
5. Begin questions:
 - 5.1. Has your organization taken a lead role in long-term resilience planning at the Providence Harbor?
 - 5.1.1. What has your organization done?
 - 5.1.2. What role do you see your organization taking at this point?
 - 5.2. “Now that we have gone over these word clouds, you’ll notice that stakeholders have mentioned X as an organization possibly responsible for taking a leadership role at the Providence Harbor; *do you see your*

organization as having responsibility to take on a leadership role in long-term planning at the Providence Harbor?

5.3. If **yes**;

5.3.1. Why has the organization not stepped into this role?

5.3.1.1. Incentives

5.3.2. What would motivate your organization to take on this role?

5.3.2.1. Incentives

5.3.3. Do you perceive any barriers that keep your organization from taking a leadership role?

5.4. If **no**;

5.4.1. Why does your organization not perceive itself as responsible for a leadership position?

5.4.1.1. Barriers

5.4.2. Do you perceive any barriers that keep your organization from taking a leadership role?

Thank you for meeting with me and have a fantastic day!

Appendix 4D – Leader Interview Analysis

Interviews with representatives of the seven leader organizations ranged from 10 minutes long to 30 minutes long. We recorded these interviews and transcribed them using Microsoft Word. We printed these transcripts and analyzed the text using colored pencils in order to identify common themes. During analysis we identified:

- Perceptions of their organizational responsibility for implementing resilience at the Port of Providence
- Perceptions of their organizations role in leading other port stakeholders in planning and implementing resilience measures
- Barriers and incentives.

To ensure accuracy of analysis, we selected a random selection of transcription and had two other researchers from our group analyze the transcripts and identify themes. We

compared, conversed, and where need adjusted the analysis process and outputs to ensure consistency.

Appendix 5: Acronyms used in Word Cloud figures

This appendix shows the acronyms used in the analysis of open-ended questions asking stakeholder to state specific organizations responsible for resilience implementation.

Table 2 – Acronyms used in Word Cloud figures

CityGov	City Governments (City of Providence; City of East Providence)
COTP	Captain of the Port
FedGov	Federal Government
FEMA	Federal Emergency Management Agency
NOAA	National Oceanic and Atmospheric Administration
PEMA	Providence Emergency Management Agency
RICRMC	Rhode Island Coastal Resources Council
RIDEM	Rhode Island Department of Environmental Management
RIDOT	Rhode Island Department of Transportation
RIEMA	Rhode Island Emergency Management Agency
RIGov	Rhode Island Government
URI	University of Rhode Island
URICRC	University of Rhode Island Coastal Resources Center
USACE	United States Army Corps of Engineers
USCBP	United States Customs and Border Patrol
USCG	United States Coast Guard
USDHS	United States Department of Homeland Security
USEPA	United States Environmental Protection Agency

Appendix 6: Additional Results

In this appendix, we show additional results collected during the survey. Results augment the findings outlined in the results section of the main text.

Figures 12, 13, 14, 15 show how survey respondents perceive the responsibility to lead of the 7 forms of leadership described in Section 3.1 in relation to what resilience strategy (i.e. resilience in general, protect, relocate, and accommodate) they are considering.

Figures 16, 17, and 18 show results of the open-ended questions asking survey respondents to state specific entities responsible for resilience implementation at the port. The larger font organizations received more mentions.

Appendix 6A – Responsibility to implement Resilience

Figure 11 - Public-private informal collaboration received an average score of greater than four, the only other above four is state lead. A score of one indicates “not responsible at all”, two indicates “less responsible”, three indicates “just as responsible as others”, four indicates “more responsible than others”, and five indicates “entirely responsible”.

Appendix 6B – Responsibility to implement Protect

Figure 12 – State lead received the highest average score. A score of one indicates “not responsible at all”, two indicates “less responsible”, three indicates “just as responsible as others”, four indicates “more responsible than others”, and five indicates “entirely responsible”.

Appendix 6C – Responsibility to implement Relocate

Figure 13 – Overall, all stakeholders only see a State Led form of leadership as responsible to implement Relocate. However, there is great disagreement between public and private stakeholders. A score of one indicates “not responsible at all”, two indicates “less responsible”, three indicates “just as responsible as others”, four indicates “more responsible than others”, and five indicates “entirely responsible”.

Appendix 6D – Responsibility to implement Accommodate

Figure 14 - - Public stakeholders tend to see private-centric leadership structures as responsible; while private stakeholders tend to see public-centric stakeholders as responsible. A score of one indicates “not responsible at all”, two indicates “less responsible”, three indicates “just as responsible as others”, four indicates “more responsible than others”, and five indicates “entirely responsible”.

Appendix 6E – Specific Organizations responsible for Resilience

Figure 15 - # of unique organizations mentioned by respondents - 36; Total Mentions - 83; RICRMC (8), City Government (7), RIDEM (5), Business (5), RIDOT (5), USACE (4), ProvPort (4), Save the Bay (3), Terminal Operators (3), RIEMA (3), RI Statewide Planning (3), FEMA (2), USCG (2), Public (2), PEMA (2), USEPA (2), CommerceRI (2), URICRC (2), RI Governor's Office (1), USDHS (1), USCBP (1), USDOT (1), University (1), City Planning (1), COTP (1), Pilots (1), Tugs (1), Providence Working Waterfront (1), QDC (1), Exxon Mobil (1), Sprague (1), Motiva (1), Public - Private Partnership* (2), Harbor Commission* (1), Port Authority* (1), Non-Profit Collaborative Committee* (1); n = 25.

Appendix 6F – Specific organizations responsible for Protect

Figure 16 - # of Unique organizations mentioned by respondents - 21; Total Mentions - 46; RI Government (8), Federal Government (6), USACE (6), RICRMC (4), RIDEM (4), City Government (3), Public (2), RI Statewide Planning (1), Collaboration (1), URI (1), CommerceRI (1), ProvPort (1), City Planning (1), Save the Bay (1), FEMA (1), Private (1), Mass Government (1), RIDOT (1), Business (1), URICRC (1); n = 25.

Appendix 6G – Specific organizations responsible for Relocate

Figure 17 - # of unique organizations mentioned by respondents - 21; Total mentions - 49; City Government (8), CommerceRI (5), Business (4), RICRMC (4), None (no organization) (4), Rhode Island Statewide Planning (3), Federal Government (3), RIDEM (3), RIDOT (2), ProvPort (2), RI Government (2), Collaboration (1), Courts (1), Public (1), URI (1), Save the Bay (1), City Planning (1), Government (1), Port of Providence (1), Public-Private Formal Committee * (1), USACE (1); n = 25.

Appendix 6I – Specific organizations responsible for Accommodate

Figure 18 - # of unique orgs - 24; Total Votes - 45; Business (5), RIDE (5), Collaboration* (4), RICRMC (4), City Government (3), RI Statewide Planning (2), EPA (2), USACE (2), FEMA (2), Providence Working Waterfront (1), URI (1), URICRC (1), RIDOT (1), Federal Government (1), None (1), NOAA (1), Governor's Office (1), USCG (1), Public (1), Port of Providence (1), Petroleum Industry (1), Special Committee* (1), Public-Private Committee* (1); n = 25.

Bibliography:

American Association of Port Authorities. (2015, March). The 2014 National Economic Impact of the U.S. Port System. Prepared for American Association of Port Authorities.

Becker, A. (2016a). 17 The state of climate adaptation for ports and the way forward. In *Climate Change and Adaptation Planning for Ports* (pp. 265–273). New York: Rutledge.

Becker, A. (2016b). Using boundary objects to stimulate intellectual thinking: Hazard Resilience for the Port of Providence. *Sustainability Science*.

Becker, A., & Caldwell, M. R. (2015). Stakeholder Perceptions of Seaport Resilience Strategies: A Case Study of Gulfport (Mississippi) and Providence (Rhode Island). *Coastal Management*, 43(1), 1–34.
<https://doi.org/10.1080/08920753.2014.983422>

Becker, A. H., Acciaro, M., Asariotis, R., Cabrera, E., Cretegny, L., Crist, P., ... Velegrakis, A. F. (2013). A note on climate change adaptation for seaports: a challenge for global ports, a challenge for global society. *Climatic Change*, 120(4), 683–695. <https://doi.org/10.1007/s10584-013-0843-z>

Becker, A., Inoue, S., Fischer, M., & Schwegler, B. (2012). Climate change impacts on international seaports: knowledge, perceptions, and planning efforts among port administrators. *Climatic Change*, 110(1-2), 5–29. <https://doi.org/10.1007/s10584-011-0043-7>

Becker, A., Matson, P., Fischer, M., & Mastrandrea, M. (2014). Towards seaport resilience for climate change adaptation: Stakeholder perceptions of hurricane

- impacts in Gulfport (MS) and Providence (RI). *Progress in Planning*.
<https://doi.org/10.1016/j.progress.2013.11.002>
- Bender, M. A., Knutson, T. R., Tuleya, R. E., Sirutis, J. J., Vecchi, G. A., Garner, S. T., & Held, I. M. (2010). Modeled Impact of Anthropogenic Warming on the Frequency of Intense Atlantic Hurricanes. *Science*, 327(5964), 454–458.
<https://doi.org/10.1126/science.1180568>
- Biesbroek, G. R., Klostermann, J. E. M., Termeer, C. J. A. M., & Kabat, P. (2013). On the nature of barriers to climate change adaptation. *Regional Environmental Change*, 13(5), 1119–1129. <https://doi.org/10.1007/s10113-013-0421-y>
- Biesbroek, R., Termeer, K., Kabat, P., & Klostermann, J. (2009). Institutional governance barriers for the development and implementation of climate adaptation strategies. Earth System governance, peoples places, and the planet.
- Chambers, M., & Liu, M. (2013). Maritime Trade and Transportation by the Numbers [Government]. Retrieved January 24, 2015, from
http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/by_the_numbers/maritime_trade_and_transportation/index.html
- Douglas, E. M., Kirshen, P. H., Paolisso, M., Watson, C., Wiggin, J., Enrici, A., & Ruth, M. (2011). Coastal flooding, climate change and environmental justice: identifying obstacles and incentives for adaptation in two metropolitan Boston Massachusetts communities. *Mitigation and Adaptation Strategies for Global Change*, 17(5), 537–562. <https://doi.org/10.1007/s11027-011-9340-8>
- Eisenack, K., Moser, S. C., Hoffmann, E., Klein, R. J. T., Oberlack, C., Pechan, A., ... Termeer, C. J. A. M. (2014). Explaining and overcoming barriers to climate

- change adaptation. *Nature Climate Change*, 4(10), 867–872.
<https://doi.org/10.1038/nclimate2350>
- Emanuel, K. (2013). Downscaling CMIP5 Climate models shows Increased tropical cyclone activity over the 21st century. *PNAS*.
- Hallegatte, S. (2008). An Adaptive Regional Input-Output Model and its Application to the Assessment of the Economic Cost of Katrina. *Risk Analysis*, 28(3), 779–799.
<https://doi.org/10.1111/j.1539-6924.2008.01046.x>
- Karlsson, C., Parker, C., Hjerpe, M., & Linnér, B.-O. (2011). Looking for Leaders: Perceptions of Climate Change Leadership among Climate Change Negotiation Participants. *Global Environmental Politics*, 11(1), 89–107.
https://doi.org/10.1162/GLEP_a_00044
- Kates, R. W., Travis, W. R., & Wilbanks, T. J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences*, 109(19), 7156–7161.
<https://doi.org/10.1073/pnas.1115521109>
- Koetse, M. J., & Rietveld, P. (2009). The impact of climate change and weather on transport: An overview of empirical findings. *Transportation Research Part D: Transport and Environment*, 14(3), 205–221.
<https://doi.org/10.1016/j.trd.2008.12.004>
- Lazarus, R. J. (2008). Super wicked problems and climate change: Restraining the present to liberate the future. *Cornell Law Review*, 94, 1153.
- Meijerink, S., & Stiller, S. (2013). What Kind of Leadership Do We Need for Climate Adaptation? A Framework for Analyzing Leadership Objectives, Functions, and

- Tasks in Climate Change Adaptation. *Environment and Planning C: Government and Policy*, 31(2), 240–256. <https://doi.org/10.1068/c11129>
- Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of who and What Really Counts. *Academy of Management Review*, 22(4), 853–886. <https://doi.org/10.5465/AMR.1997.9711022105>
- Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences*, 107(51), 22026–22031. <https://doi.org/10.1073/pnas.1007887107>
- Moser, S. C., & Ekstrom, J. A. (2011). Taking ownership of climate change: participatory adaptation planning in two local case studies from California. *Journal of Environmental Studies and Sciences*, 1(1), 63–74. <https://doi.org/10.1007/s13412-011-0012-5>
- Neumann, J. E., Price, J., Chinowsky, P., Wright, L., Ludwig, L., Streeter, R., ... Martinich, J. (2014). Climate change risks to US infrastructure: impacts on roads, bridges, coastal development, and urban drainage. *Climatic Change*, 1–13. <https://doi.org/10.1007/s10584-013-1037-4>
- Nicholls, R. J., & Cazenave, A. (2010). Sea-Level Rise and Its Impact on Coastal Zones. *Science*, 328(5985), 1517–1520. <https://doi.org/10.1126/science.1185782>
- Notteboom, T., & Winklemans, W. (2002). Stakeholder relations management in ports: Dealing with the interplay of forces among stakeholder in a changing competitive environment. *IAME 2002, International Association of Maritime Economists Annual Conference*.

Podsakoff, P. M., MacKenzie, S. B., Moorman, R. H., & Fetter, R. (1990).

Transformational leader behaviors and their effects on followers' trust in leader, satisfaction, and organizational citizenship behaviors. *The Leadership Quarterly*, 1(2), 107–142. [https://doi.org/10.1016/1048-9843\(90\)90009-7](https://doi.org/10.1016/1048-9843(90)90009-7)

Preston, B. L., Rickards, L., Dessai, S., & Meyer, R. (2013). Water, seas, and wine: science for successful adaptation. In *Successful adaptation to climate change*.

Providence Working Waterfront Association. (2008, April). Economic Effects of Allens Avenue Businesses. Providence Working Waterfront Alliance.

Providence Working Waterfront Association. (2010). Economic Impact - Providence Working Waterfront Association. Retrieved from <http://providenceworkingwaterfront.org/index.php/providences-working-waterfront/economic-impact/>

ProvPort. (2015, January 5). The Economic Impact of ProvPort's Terminal Services. ProvPort.

Rhode Island Emergency Management Agency. (2014). Rhode Island 2014 Hazard Mitigation Plan Update. Retrieved from http://www.riema.ri.gov/resources/emergencymanager/mitigation/documents/RI%20HMP_2014_FINAL.pdf

Rubinoff, P. (2007). Increasing resilience along Rhode Island's Coast. Coastal Resources Center. Narragansett, RI.

Southworth, F., Hayes, J., McLeod, S., & Strauss-Wieder, A. (2014). *Making U.S. ports resilient as part of extended intermodal supply chains* (No. NCFRP Report 30). Washington, DC: Transportation Research Board.

- Stewart, R. (2014). Port Management. In *The Business of Transportation* (Vol. 1). Santa Barbara, CA: Praeger.
- Stiller, S., & Meijerink, S. (2015). Leadership within regional climate change adaptation networks: the case of climate adaptation officers in Northern Hesse, Germany. *Regional Environmental Change*, 1–13. <https://doi.org/10.1007/s10113-015-0886-y>
- Tebaldi, C., Strauss, B. H., & Zervas, C. E. (2012). Modeling sea level rise impacts on storm surges along US coasts. *Environmental Research Letters*, 7(1), 014032. <https://doi.org/10.1088/1748-9326/7/1/014032>
- The Rockefeller Foundation. (2015, November). City Resilience Framework: 100 Resilient Cities. The Rockefeller Foundation. Retrieved from http://www.100resilientcities.org/page/-/100rc/Blue%20City%20Resilience%20Framework%20Full%20Context%20v1_5.pdf
- Tol, R. S. ., Klein, R. J. T., & Nicholls, R. J. (2008). Towards successful adaptation to sea-level rise along Europe's coasts. *Journal of Coastal Research*, 24(1), 3–11.
- Tribbia, J., & Moser, S. C. (2008). More than information: what coastal managers need to plan for climate change. *Environmental Science and Policy*, 11, 315–328.
- (USACE) United States Army Corps of Engineers. (2007). Hurricane Barriers in New England and New Jersey - History and Status after four decades.
- U.S. Energy Information Administration. (n.d.). Rhode Island: State Profile and Energy Estimates [Government]. Retrieved March 20, 2015, from <http://www.eia.gov/state/?sid=RI>

- Vogel, C., Moser, S. C., Kasperson, R. E., & Dabelko, G. D. (2007). Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships. *Global Environmental Change*, 17(3–4), 349–364.
<https://doi.org/10.1016/j.gloenvcha.2007.05.002>
- Winklemans, W., & Notteboom, T. (2007). Port master planning: Balancing stakeholders' interests. *The Reality of Dilemmas of Globalisation*, 395–408.