"We need very fluid leadership - people who can share power": Climate change adaptation leadership lessons from the Atlantic Region of Canada

by

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ABSTRACT

Evidence-based insights on leadership practice are needed to support climate change adaptation. Climate change adaptation leadership is systematically investigated in Canada using a regional case study approach involving seven nested case examples. Informant interviews, documentary analysis, participant observation, and site visits in the Atlantic Region of Canada are used to examine specific leadership interventions across a continuum of styles and approaches. These leadership interventions are examined through the lens of complexity leadership theory (CLT), transdisciplinary collaborative leadership and innovation typing, and in view of their implications for climate change adaptation practice.

Research findings show that climate change adaptation leadership is a fluid process, operating over a continuum of leadership styles and functions, which embraces context complexity. Four particular leadership styles are identified. These include shared, distributed (*instigators)*, distributed/supportive (*mobilizers*), and supportive (*extension agents*).   Key features of successful adaptation leadership and practice include: the development and use of contextual intelligence, the creation of dual or co-leadership alliances, an expanded understanding of the role of champions, and the more explicit structuring of collaborative innovation networks. In addition, leadership challenges can be addressed through focusing early on in identifying and addressing barriers to adaptation. Findings from the Atlantic Region of Canada are used to develop an initial inventory of technical and behavioural leadership competencies. These competencies include collaboration. power sharing, bridging science for results, and project management. Finally, the thesis develops an archetype climate change adaptation leader as one who acts individually, or as part of broader work teams, organizations or

innovation networks to effect change. As a leader, they obtain varied multi-level governance experience, understand that to enhance collaboration it is important to understand the interrelationship of leadership, followership and context, and that their role might shift over time in dealing with adaptation challenges. An archetype leader understands the process of innovation and can apply various types of innovation to craft integrated adaptation solutions. In addition, an archetype climate change adaptation leader views professional development as an apprenticeship, and embrace the roles of both mentor and protégé.

A number of questions for further study include: how can the literature on the role of women and leadership be used to inform climate change adaptation; what factors influence the complexity of interactions between bureaucratic levels within organizations to either enhance or reduce bureaucratic fault lines; how intergenerational tension in different climate change adaptation leadership contexts can be understood and addressed; do situations involving the destruction of climate change adaptation leadership create structural limits for adaptation; how can the concept of contextual intelligence be more fully articulated as a climate change adaptation leadership competency; and can specific cases of climate change adaptation leadership in collaborative innovation networks be examined to further develop best practices? Two additional questions for further study relate to professional development within climate change adaptation leadership: how can succession planning and mentoring be best integrated into practice to create the archetype as developed in this thesis; and what is the potential role for a climate change adaptation leadership apprenticeship model?

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DEDICATION

1978 - 1982

To Josephine for her perseverance, companionship and love
during one of the most hectic years of our lives.

1982 - 1984

I would be remiss if I did not mention
the unfaltering faith and support of my wife, Josephine, throughout.
In addition to my moral well-being, she contributed to the cartographic work herein.

2010 - 2017

Once again, Josephine has shown her love, support and patience
in watching this process unfold. I could not have done it without her.

I dedicate this amazing journey to you.

Ich liebe dich

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CHAPTER 1 – INTRODUCTION

"… key actors, advocates and champions are decisive for initiating, mainstreaming and sustaining momentum for climate adaptation planning and implementation…"
(Mimura et al., 2014: 19)

1.1 Problem Context

Societies and cultures have been responding to short- and long-term variability in the climate system for millennia (Torry, 1983; Barnes et al., 2013). However, observed and modelled changes in temperature, precipitation, and extreme weather events over the past few decades have been novel and unexpected, leading to increased uncertainty over the predictability of these changes (Milly et al., 2008). These novel shifts in climate present society, including key actors, advocates and champions who are faced with responding to these changes, with both technical and adaptive challenges (O'Brien and Selboe, 2015a).

One of these adaptive challenges is how to mainstream climate change adaptation implementation and planning into broader social transformation. Mainstreaming, as used in this dissertation, is conceptualized as "*the integration of policies and measures that address climate change into development planning and ongoing sectoral decision-making, so as to ensure the long term sustainability of investments as well as to reduce the sensitivity of development activities to both today's and tomorrow's climate*" (Klein et al., 2007, 2). How then do actors approach the need for climate change adaptation as part of broader social transformation and what specific entry points are used in crafting effective responses? This thesis takes the perspective that this is in large part a governance challenge, involving questions of who is governed, how governance tasks are distributed amongst relevant authorities, and what form governance mechanisms should take (Lövbrand et al., 2009)?

Mainstreaming is implicit in considerations of climate governance. Climate governance is defined as *"... all the purposeful mechanisms and measures aimed at steering social systems toward preventing, mitigating or adapting to the risks posed by climate change"* (Jagers and Stripple, 2003, 388). Unlike climate governance mechanisms for the reduction of greenhouse gas emissions (mitigation), climate adaptation governance is an emerging field (Keskitalo, 2010). There is an inherent complexity in managing climate adaptation governance - from problem identification to option selection and implementation, and this complexity poses a number of barriers (Moser and Ekstrom, 2010). Some of the key barriers that have been identified relate to leaders and leadership. Leadership, as used in this thesis is "*...a social influence process, operating with constraints*" (Pfeffer, 2000, 211), whose overall aim is to create meaning and value (Podolny et al., 2010). As such, the identification of what constitutes effective leadership for climate change adaptation is one aspect of climate governance. The research described in this thesis suggests that investigating the complexity and fluidity of leadership and leadership contexts over time may be an effective approach in determining what constitutes an effective response to climate change adaptation.

What is meant by a climate change adaptation practice and what role does leadership play in climate adaptation governance? The international perspective views climate change adaptation as: "*The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects*" (IPCC, 2014: 118). Climate change adaptation, therefore, has a very practical element (Eyzaguirre and Warren, 2014). Adaptation practices are "*...actual adjustments, or changes, in decision environments, which might ultimately enhance resilience or reduce vulnerability to*

observed or expected changes in climate" (Adger et al., 2007: 720). The latest Assessment

Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) presents the view that

champions for adaptation planning, including key practitioners and local social influencers

within networks, are an important enabling factor in the process of adaptation (Mimura et al.,

2014). These practitioners must, of necessity, operate within formal and informal multi-level

governance networks. Multi-level governance, as used here, is *" ... the dispersion of authority*

away from central government—upwards to the supranational level, downwards to subnational

jurisdictions, and sideways to public/private networks" (Hooghe and Marks, 2001).

In a Canadian context, climate change adaptation champions or leaders are recognized as a

mechanism for making the transition from awareness of climate change issues to action (Burch,

2008; Vasseur, 2010, Warren and Lemmen, 2014; Burch et al., 2014; May, 2015). These leaders

must navigate multi-level climate governance regimes, that are themselves evolving (Henstra,

2015). A survey of Canadian municipalities and other case studies highlight the perception of a

lack of leadership in climate change adaptation practice (Hanna et al., 2013; May, 2015). More

broadly, leadership that is visionary, entrepreneurial and collaborative, and that supports

learning, is viewed as key to enhancing institutional adaptive capacity (Gupta et al., 2010).

This dissertation systematically explores climate change adaptation leadership in a Canadian

context. However, the leadership landscape for climate change adaptation is complicated.

Navigating this landscape requires actor/agents in climate adaptation policy and decision making

environments to operate within multi-level contexts. For instance, whether or not actor/agents

have an understanding of global climate models and emission scenarios impacts the development

of local climate risk management strategies. This weaving of various scales of process and

levels of interest poses a leadership challenge. This suggests that leadership must cross scales

and levels during the exercise of adaptation practices (Wilbanks, 2007; Adger et al., 2009; Galaz et al., 2011; Thompson et al., 2012). Adaptation practices, to be effective, must often access and unlock information held by multiple governance levels. In addition, since adaptation is a process (Smit et al., 2000), there is a temporal aspect to the exercise of leadership which has a direct impact on the ability of all levels of governance to develop sound, complementary adaptation practices. The multi-level complexity of leaders' interaction and this temporal aspect has yet to be examined in detail.

Meijerink and Stiller (2013) consider what kind of leadership is needed for climate change adaptation. Their work builds on the scholarship of complexity leadership theory (Uhl-Bien et al., 2007; Marion, 2013) and concludes, "*we expect the interaction between various leadership types and institutional factors to explain why some adaptation efforts are more successful than others*" (Meijerink and Stiller, 2013: 254). The research presented here builds upon their conceptual approach in a specific Canadian setting (Atlantic Canada). This is in keeping with the idea that multi-level climate adaptation governance is complex and requires multi-layered, multi-level, collaborative leadership approaches.

1.2 Project Goal, Objectives and Research Questions

Leadership, as a discipline, is a lens through which climate change adaptation can be examined. This is especially relevant as climate change adaptation emerges as a distinct area of practice, requiring a variety of competencies, skills, tools, and varied intervention styles developed through both training and experience.

The goal of the research project is to explore the role of leadership at the interface of climate change adaptation, knowledge generation and action in multi-level governance settings. Following the approach of previous research studies (Keskitalo, 2010; Meijerink and Stiller,

2013; Stiller and Meijerink, 2016), specific, embedded case studies from the Atlantic Region of Canada are used to make analytic generalizations (Yin, 2012) that examine leadership in a variety of contexts and settings. The intent is to ultimately inform policy-relevant climate change adaptation practice (Moss et al., 2013) that can be used to enhance overall climate governance (Jagers and Stripple, 2003).

Two objectives, along with their relevant research questions, frame the analysis of leadership in climate change adaptation governance:

1. **To understand climate change adaptation by analyzing the role of leadership during the process of adaptation planning and implementation** (*adaptation leadership processes*)

    Question 1.1: What adaptation entry points are being used to initiate opportunities for the development and exercise of climate change adaptation leadership?

    Question 1.2: What competencies are being used by climate change adaptation leaders to address adaptation challenges?

    Question 1.3: What are the barriers to climate change adaptation leadership and how are they overcome?

    Question 1.4: How are formal and informal power dynamics (authority and influence) navigated in multi-level climate change adaptation leadership contexts?

2. **To examine different climate change adaptation leadership contexts to develop recommendations for strengthening practice-relevant climate adaptation** (*adaptation practice effectiveness*)

    Question 2.1: What areas of leadership theory are most useful for enhancing climate change adaptation?

Question 2.2: How can these leadership theories inform the development of climate change adaptation over time?

With respect to objective 1, one of the most important ways to respond to both the technical and adaptive challenge of climate change is through skillful engagement (O'Brien and Selboe, 2015a). Adaptation planning often involves multi-disciplinary and collaborative approaches to gather scientific and other relevant information, assess vulnerability and risk, and consult with relevant stakeholders. Only then can sound adaptation decisions be taken. Actors and networks of actors convene to solve problems. Policy development, in general, involves both puzzling, i.e. the solving of problems, and powering, the navigation of differences in power resources amongst stakeholders (Hoppe, 2011).

In the current context of climate change adaptation leadership, skillful engagement in planning and policy development entails identifying and removing existing barriers to adaptation (Moser and Ekstrom, 2010), resolving the various power dynamics which exist during deliberations (May, 2013), developing trust, and working across governance levels (Cash and Moser, 2000). The effective exercise of leadership, therefore, is dependent on this skillful engagement. The greater the level of knowledge and awareness of these challenges by actor/leaders, the greater the chance for success.

With respect to objective 2, there is a richness and variety in the leadership literature that can benefit the development of sound adaptation practice. The image of a singular, heroic leader taking charge and forging ahead is perhaps best well-known. However, leadership theory has also focused on team-based approaches (Kouzes and Posner, 2007), collaboration (Gray, 2008), dual leadership (Heenan and Bennis, 1999), innovation (Drucker, 1985), followership (Collinson, 2006), adaptation and adaptive capacity (Heifetz et al., 2009), and complexity (Uhl-

Bien et al., 2007). Any one of these aspects of leadership theory can act as a touchstone to enhance knowledge of how climate change adaptation is conceived and practiced.

In addition, just as there is no one method for mainstreaming adaptation in all contexts, so too, is there no one ideal leadership model (Meijerink and Stiller, 2013). Taking a broad approach that considers a wide range of leadership literature is a useful first step in examining specific adaptation initiatives. A number of scholars have developed integrative ways of constructing frameworks to assess leadership. Adaptive leadership theory (Heifetz et al., 2009), collaborative leadership theory (Gray, 2008), and complexity leadership theory (Uhl-Bien et al., 2007) are three such examples. The work of Mintzberg (2013), who argues that there is a potentially misleading distinction between leadership and management is another example. These theories and their contribution to this research will be discussed in more detail in section 2.5.

1.3 Research Setting/Empirical Context

My research on leadership and climate change adaptation governance is situated in the Atlantic Region of Canada, which includes the Provinces of Newfoundland and Labrador, New Brunswick, Nova Scotia, and Prince Edward Island (Figure 1). These four provinces have developed novel, collaborative ways of working together to address climate change (Government of Canada, 2014). At the same time, the provinces are also working in a web of federal-provincial, provincial-provincial, provincial-municipal, and provincial-international multi-level governance networks for climate change adaptation (NRCan 2016). These governance networks also include First Nations, academic institutions, businesses, non-government organizations, and individuals, as part of this web of climate change adaptation actors.

As a region, some of the common climate change adaptation risks include sea level rise, storm surge and other extreme weather events, threats to infrastructure, saltwater intrusion into groundwater and impacts on watersheds and the natural environment (Vasseur and Catto, 2008). Specific adaptation challenges that the region face are discussed in more detail in Section 3.3. In one example, saltwater intrusion as a threat to freshwater supply has been identified in Prince Edward Island, as well as parts of Nova Scotia and New Brunswick (ACASA, 2011). Another is the impact that storm surges from more frequent extreme weather events pose to cultural heritage infrastructure in Cape Breton, Nova Scotia (PCA, 2016).

Each province has specific adaptation challenges, requiring development of novel strategies (Hallegatte, 2009). For instance, to standardize consideration of climate change by local municipalities, Nova Scotia has mainstreamed requirements for community adaptation planning within Integrated Community Sustainability Plans (ICSPs) (Nova Scotia, 2011). In another example, Prince Edward Island is considering climate change as part of a broader review of provincial land use policy statements of provincial interest (PEI, 2009). Concurrently, the provinces are also engaged with other governance levels in both formal and informal collaborative settings (ACASA, 2016). This has occurred as a way to leverage resources for action and share best practices. Provinces are also reliant on financial resources, in particular seed funding from the federal government and tax revenues, for infrastructure development and climate change adaptation, as leverage for pursuing their own activities. In addition, as a collective, the provinces have been active internationally, as signatories to the New England Governors/Eastern Canadian Premiers Climate Change Action Plan (Government of Canada, 2014). They have also developed and endorsed the Atlantic Energy Framework for

Figure 1 – Regional Case Study – Atlantic Region of Canada
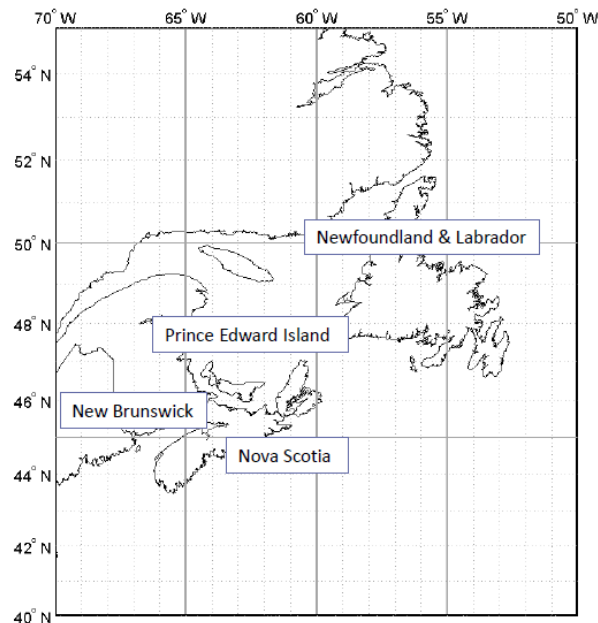
Collaboration (Government of Canada, 2014). More detailed information on the research setting and its empirical context is contained in section 3.3.

The implications of this research setting and empirical context for the dissertation are that, from a leadership perspective, the situations described pose both technical and adaptive challenges for climate change adaptation practitioners. Technical challenges include such measures as developing guidelines for land use planning (UPEI 2016a) or ensuring that infrastructure is designed to account for changes in climatic design criteria (UPEI 2016b). Adaptive challenges require behavioural change and overcoming social barriers to action, such as solidifying buy-in for community wind energy projects (Vass, 2013) or raising awareness of the need to integrate climate change into emergency management (St. Louis and Killorn, 2014). Practitioners, as leaders in climate change adaptation, require competencies, both technical and behavioural, which can be applied within a complex web of governance networks. Capturing the

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experience of leaders in the Atlantic Region of Canada is relevant for climate change adaptation practice when leadership is viewed as a process of social influence, acting within an environment of complexity and uncertainty to produce tangible adaptation outcomes.

1.4 Structure

This dissertation examines the concept of climate change adaptation leadership from a number of different perspectives. In the chapters that follow, the literature on climate change adaptation and adaptation practices, multi-level governance and leadership is surveyed to provide a detailed conceptual framework in support of the objectives and research questions (Chapter 2); the methodology and methods used to collect and analyze data are then presented (Chapter 3). Findings as they relate to the six questions identified in section 1.2 are described in Chapters 4 and 5 (adaptation leadership processes in Chapter 4 and adaptation practice effectiveness in Chapter 5). A discussion of the significance of these findings is then provided (Chapter 6). Finally, research results are summarized and further research questions are developed along with recommendations for future examinations of leadership as a fluid and adaptive process that fosters ongoing, reflective, climate change adaptation practice (Chapter 7).

CHAPTER 2 – LITERATURE REVIEW

*"Leadership is increasingly conceived of as a dispersed phenomenon,
and some theories treat is as an emergent property of interacting agents
rather than the behaviour of any one individual"*
(Meijerink and Stiller, 2013: 253)

2.1 Background

In Chapter 1, two research objectives and six questions of relevance to climate change adaptation leadership were introduced. The two objectives relate to climate change adaptation leadership processes and climate change adaptation practice effectiveness. The theoretical foundations behind these objectives, climate change adaptation, climate governance, and adaptation practices are examined in more detail in this chapter. This approach situates climate change adaptation within overall climate governance, with a focus on mainstreaming as an important mechanism for developing climate change adaptation practices in support of climate adaptation governance. Then, the scholarship on leadership is addressed. Beginning with a discussion on the meaning of leadership, the chapter reviews how leadership theory changed over time. From there, leadership's relevance to climate change adaptation and adaptation practices are discussed. Subsequently, a conceptual framework for climate change adaptation leadership is presented, which serves to address the two research objectives and six questions developed as part of this dissertation. The conceptual framework provides a foundation for the research methodology and methods used (Chapter 3).

2.2 Climate Change Adaptation

Climate change adaptation is increasing in importance as a governance challenge within the broader climate governance community (Mimura et al., 2014). Following the definition cited in section 1.1, there are various types of adaptation that can be distinguished as a way to develop appropriate management responses: anticipatory, autonomous, or planned (IPCC 2007; Ontario, 2009). Adaptation is anticipatory if it occurs proactively in advance of impacts, autonomous if it occurs, spontaneously, but not deliberately, or planned if it occurs as a result of deliberate policy decisions that initiate action (Ontario, 2009). Adaptation is also influenced by factors such as what systems or parts of system are adapting, what climate phenomena or hazards are being adapted to, the timing relative to climate impact, temporal scope and spatial considerations (Smit et al., 2000; Lemmen et al., 2008).

Strategies for adapting to climate change are often multi-faceted and can be either broadly or narrowly defined. For instance, very broadly, countries, such as the Government of Canada (2011), have developed frameworks for adaptation policy, as well as entire key economic areas, such as forestry (Government of Canada, 2008). As the scope narrows, adaptation can become the purview of specific industries (Pickering et al., 2012), communities (Bizikova et al., 2008), businesses (UNFCCC, 2016), or non-governmental organizations (van Aalst et al., 2008). This dissertation takes the view that a broad-based understanding of leadership (through the objectives set out in Chapter 1) is necessary to pursue climate change adaptation through appropriate engagement, collaboration and innovation in moving from vision to action (Burton, 2008).

2.3 Climate Governance

Climate governance is a structured way of responding to the complex challenges of climate change. It encompasses "… *all the purposeful mechanisms and measures aimed at steering social systems toward preventing, mitigating or adapting to the risks posed by climate change*" (Jagers and Stripple, 2003, 388). As a specific sub-discipline of governance theory, it inherits some of governance theory's broader precepts. For instance, there is acknowledgement that both classical-modernist and new political perspectives can be used to frame governance (Hajer, 2003). The classical-modernist perspective refers to traditional arrangements for structured policy making by politicians and bureaucracies (op cit, 176). The new political perspective is characterized by "*the ensemble of mostly unstable practices that emerge in the struggle to address problems that the established institutions are - for a variety of reasons - unable to resolve in a manner that is perceived to be both legitimate and effective*" (op cit, 176). In addition, governance comprises a host of institutions, which are defined here as *"... systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to participants in these practices and guide interactions among the occupants of the relevant roles*" (Schroeder, 2005, 27). These institutions can be either formal (Paddock, 2011) or informal (Ostrom, 2007; Pelling et al., 2008). Vatn (2009) considers institutions as rationality contexts for decision making. Generic principles of governance used by institutions seek to address not only effectiveness, but also efficiency, equity, legitimacy, and sustainability (Nelson et al., 2007). The relevance for climate governance is that there are complex webs of institutions and rationality contexts, both formal and informal, which provide mechanisms and measures to prevent, mitigate or adapt to climate risk. To this point, climate governance specifically addresses issues of complexity, and how it is incorporated into decision making; reflexivity, and

how goals are openly questioned; along with participation, and how it can contribute to effectiveness (Huitema et al., 2011). Climate change federalism has been suggested as an institutional mechanism to foster sub-national innovation and leadership, local experimentation, ownership of solutions developed, and learning from mistakes (Shobe and Burtaw, 2012).

A further concept that climate governance inherits from current governance theory is the role that actors and actor networks play in demonstrating leadership by navigating the various institutions and institutional mechanism discussed above. Leadership is identified as an important ingredient in effective governance (Armitage, 2008; Evans et al., 2015; Imperial et al., 2016). Climate governance also acknowledges that adaptation practices (Adger et al., 2007) are those skills and techniques used in the exercise of climate leadership.

2.4 Adaptation Practices

Climate adaptation governance is, of necessity, solution-oriented, with a practical focus (Eyzaguirre and Warren, 2014; Hinkel and Bisaro, 2016). The practices that support climate adaptation governance engage collaborative networks of scientists, policy-makers, and stakeholders (Wheaton and MacIver, 1999). This governance involves the interplay of both top-down vs. bottom-up policy approaches (Dessai and Hulme, 2003), often involving relatively small, regional scales (Wilbanks, 2003). Examples include community development of heat health alert systems (Health Canada, 2011) or storm surge mapping for land use planning (Bizikova et al., 2008).

A number of conceptual lenses are used as rationality contexts (Vatn, 2009) for climate adaptation governance. This leads to a variety of approaches for framing climate change adaptation, including the intersection of adaptive capacity, adaptation and vulnerability (Smit and Wandel, 2006); vulnerability in an of itself (Adger, 2006); and the interplay of vulnerability,

adaptation, and resilience (Vogel et al., 2007; Deppitsch and Hasibovic, 2011). Risk management is also viewed as a governance imperative (Carter et al., 2007; Lemmen et al., 2008; May and Plummer, 2011). The specific distinction between and amongst concepts is often not clear (see Cutter et al. (2008) for a discussion of adaptive capacity, vulnerability and resilience; O'Brien et al. (2004) for vulnerability; and Klein et al. (2003) and Welsh (2013) for resilience). All of this suggests that concept framing in the early stages of climate adaptation governance is especially important. Adaptation approaches or entry points can be based on specific hazards, vulnerabilities, adaptive capacity issues, or policy matters (Ebi et al., 2005). This is explored in more detail as part of the dissertation's conceptual framework (section 2.7).

Adaptation practices, therefore, are a way to influence the selection of defined adaptation entry points for climate adaptation governance. These practices aim to conceive and operationalize *"...actual adjustments, or changes, in decision environments, which might ultimately enhance resilience or reduce vulnerability to observed or expected changes in climate*" (Adger et al., 2007: 720). Adaptation practices are differentiated along several dimensions, including sector, actor, or geographic area (Adger et al., 2007). The fourth IPCC assessment recommends a diverse portfolio approach, where actions incorporate multiple levels, multiple relationships, and create synergies between adaptation and mitigation (Klein et al., 2007). In addition, clear linkages to sustainability and disaster risk management are made (Yohe et al., 2007). The fifth IPCC assessment introduces a number of new concepts that add breadth to what constitutes adaptation practices. It explicitly examines approaches related to formal adaptation planning and implementation (Mimura et al., 2014), enumerating the economic aspects of adaptation (Chambwera et al., 2014), and creating climate resilient-pathways (Denton

et al., 2014). This dissertation takes the position that adaptation practices are an essential ingredient for exercising climate change adaptation leadership.

Climate adaptation governance, within broader climate governance, is purposeful, planned and preventative, and aimed at implementing specific mechanisms and measures. Purposeful climate adaptation governance, under this framing, is not only the purview of states and state authorities, but can also involve any number of other non-state actors. It is inclusive, and often a multi-level, multi-stakeholder process. It allows for flexibility in the assessment, selection and use of various adaptation processes, both regulatory and non-regulatory. In addition, climate adaptation governance is not explicitly subsumed by any implied, ongoing formal processes, for example, the United Nations Framework Convention on Climate Change (UNFCCC) deliberations or specific national plans or strategies. Climate adaptation governance can also be emergent, depending on specific contexts (Meijerink and Stiller, 2013) and can be incorporated into existing activities and policy approaches (Klein et al., 2007). Using a portfolio approach to climate adaptation governance, any number of diverse climate adaptation entry points can be conceived and developed. Decision-making for climate change adaptation involves multi-level approaches and consideration of the inter-relatedness of those decisions. Opportunities for synergy between different adaptation practices can increase climate adaptation success.

In summary, climate change adaptation is increasingly relevant within the climate change discourse. As defined, adaptation within climate governance has a number of characteristics that pose challenges for developing effective adaptation responses. These responses can involve a number of potential adaptation entry points depending on the circumstances (Ebi et al., 2005). For instance, this dissertation examines entry points which include: adaptation planning, adaptive

capacity, resilience, vulnerability, maladaptation avoidance, sustainability, and disaster risk reduction (see Table 4). It is important to note that these entry points are not necessarily mutually exclusive. A thorough understanding of leadership is one means to navigate complexity in climate change adaptation governance. The sections that follow discuss leadership in general and propose a framing for climate change adaptation leadership. This conceptual framework is presented as a means to investigate the role of leadership in facing both the technical as well as the adaptive challenges of climate change (O'Brien and Selboe, 2015).

2.5 Leadership

In advance of discussing adaptation leadership processes (objective 1) and adaptation practice effectiveness (objective 2), as presented in Chapter 1, it is necessary to situate the concepts within existing leadership scholarship. This section begins with a review of current leadership theory and then highlights research within one subset of available approaches (post-charismatic/post-transformational). This includes the consideration of leadership as a continuum (Mintzberg, 2013), requiring a structured consideration of complexity – CLT (Uhl-Bien et al., 2007). From there, a review of climate change adaptation leadership, as it has been interpreted as part of CLT (Meijerink and Stiller, 2013) serves as background to the conceptual framing of this dissertation (see section 2.7).

Scholars refer to leadership as an elusive science with ever-increasing challenges related to definition, context, research design, and complexity (Rumsey, 2013b: 456). As in any other area of research it is a product of its own historical development. Leadership theory has a place in both the private sector and public administration (Parry and Bryman, 2006; Pfeffer and Sutton, 2006; Bourgon, 2011; Murphy et al., 2017). Both of these institutions have changed radically over time and so too has leadership scholarship. Generally, there are five research approaches

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for exploring leadership that can be identified: the trait approach, style approach, contingency approach, transformational/new leadership approach, and post-charismatic/post-transformational approach (House and Aditya, 1997; Parry and Bryman, 2006; Glynn and De Jordy, 2010; van Wart, 2010). A summary of these approaches and key attributes of each is presented in Table 1. Scholarship within the last approach, post-charismatic/post-transformational, is presented in more detail. In particular, research on the relationship between leadership and management (Mintzberg, 2013), leadership as necessary for navigating complexity (Uhl-Bien et al., 2007), and collaboration (Gray, 2008) will be presented in more detail.

Table 1 – Summary of Leadership Theory Approaches

Area of Scholarship	Key Defining Focus	Key References
Trait	Characteristics of charismatic individuals define leadership	Parry & Bryman, 2006 MacMillan, 2015
Style	Definite, identifiable competencies can be learned and applied	Glynn & De Jordy, 2010
Contingency	Situational context is essential for applying appropriate leadership intervention	Lortsch, 2010
Transformational	Change, innovation, entrepreneurialism are primary functions	Drucker, 1985 Keeley et al., 2013
Post-Charismatic/ Post-Transformational	Hybrid approach that includes some aspects of all previous areas, plus includes collaboration and complexity	Uhl-Bien et al., 2007 Gray, 2008

First, the trait approach focuses on identifying immutable characteristics of existing charismatic leaders – "*who leaders are*" (Glynn and DeJordy, 2010, 122). Traits as diverse as height, appearance, intelligence, and need for power have all been examined in relation to leadership effectiveness, at one time or another (House and Aditya, 1997). This approach relies heavily on biographical accounts (MacMillan, 2015) to identify the personal characteristics of

great leaders (van Wart, 2010). A leader, under this approach, is a singular individual, with unique talents, who is studied to determine what characteristics have contributed to their success.

Second, the style approach involves the identification of key competencies from which to form the basis of leadership training and development – "*what leaders do*" (Glynn and DeJordy, 2010, 122). Competencies are: "*knowledge, skills, abilities, and other characteristics associated with effective job performance*" (Steen et al., 2009:110). These competencies can be either technically-based – knowledge or skills that are formally taught, or behaviourally-based, skills that are more experiential (Steen et al., 2009). These are usually reflected in formal competency profiles. In the 1950's, Peter Drucker pioneered work that influenced thinking on the key tasks of the manager of tomorrow: managing by objectives; taking more risks for a longer period of time, with risk-taking carried out at lower levels of the organization; making strategic decisions; building an integrated team, with each member able to assess and measure their own performance and develop their skills; communicating information fast and clearly, as well as motivating (using responsible participation of peers and subordinates); transcending one's own function and integrating within the whole business; and relating product to the industry and whole environment (i.e. generate useful business intelligence) (Drucker, 1954). From this perspective, key distinctions between leadership and management are developed (Bennis and Nanus, 1985) which, while contested, continue to be reflected in current leadership approaches (e.g. UKTSO, 2011). Those contesting this dichotomy see it as an unnecessary and potentially misleading separation of key functions within organizations, with an overemphasis of leadership versus management (Stacey, 2012; Mintzberg, 2013). This is discussed in more detail below in the context of CLT.

Third, the contingency approach focuses on situational factors that require a flexing of how a leader reacts – contingent variables such as follower expectations, organizational tasks, and a leader's power or influence (Lortsch, 2010, 411). The term crucible is used to describe the environment in which a leader emerges, operates, and develops (Bennis and Thomas, 2002). This is echoed in another important discussion of tempering a leader's formal and informal power with contextual intelligence, smart power, or enlightened power (Brass and Burkhardt, 1993; Coughlin et al., 2005; Nye, 2010; Savoie, 2010). Collinson (2006) reappraises the role of followers in defining and ultimately accepting who leaders are. Followership is an important component in the characterization of a leader's contextual intelligence (Kellerman, 2012). Senge (1990) pioneers work on leadership, team learning, and systems thinking. These concepts become a key part of CLT discussed in section 2.5.2. Heifetz (1998) and Heifetz et al. (2009) distinguish between technical and adaptive challenges, which both require different leadership approaches. This work also provides a cornerstone for CLT. Christensen (1985) examines the different roles that planners play in a variety of decision-making environments, with differing uncertainties, and concludes that these professionals are often be asked to assume diverse roles – from administrator/regulator, to facilitator/mediator, to experimenter/innovator, or charismatic leader, as the situation requires. This again, places a focus on the importance of contextual intelligence for leadership.

Fourth, the transformational or new leadership approach emerged in the 1980s with the *"conception of the leader as someone who defines organizational reality through the articulation of a vision, which is a reflection of how he or she defines the organizational mission, and the values that will support it"* (Parry and Bryman, 2006, 450). Kouzes and Posner (2006) develop five practices for exemplary leadership. Westley and Mintzberg (1989) fuse visionary leadership

and strategic management. The transformational aspects of this approach relate to the ideas of championing change (Kotter, 1995; Gebelein et al., 2010) and innovating for continued success. Much of this thinking is rooted in Joseph Schumpeter's work on creative destruction (Schumpeter, 1942) and the need for continual organizational renewal. Entrepreneurialism is related to this leadership style and is about searching for change, responding to it, and exploiting opportunities (Drucker, 1985). The transformational approach posits that there is a need in all organizations for ingenuity in its broadest form (Homer-Dixon, 2000) and also social innovation through the spread of invention within society (Westley et al., 2007; Westley et al., 2011; OECD, 2015). Transformation, in this view, is the ability to evolve, adapt, and improve in order for organizations to survive and thrive (Vlok, 2012; Keeley et al., 2013). Innovators, inventors, and entrepreneurs drive change through active adaptation – seizing opportunities that arise (Sachs and Meditz, 1979). Keeley et al. (2013) develop ten types of innovation that can be harnessed in order to build what they term breakthroughs. These types are presented in Table 2. This research posits that innovation falls into three general categories: configuration - the way that a product's value is created; offering – the actual product that is provided; and experience – the way in which a customer-facing focus is managed Within each of the three categories of innovation they identify, sub-categories are developed to provide more granularity on the innovation process. For instance, under configuration they consider network innovation – what connections are fostered with other organizations to create value? Under offering innovation, what are the unique features an functionality of products developed? In the experience category, how is customer engagement innovation organized to foster meaningful interactions? In this view, the ability to harness a number of innovation types concurrently in any particular situation, increases the potential for transformative change.

Fifth, the post-charismatic/post- transformational leadership approach encompasses a number of different perspectives on leadership. Distributed leadership describes a situation where multiple individuals or work teams can exercise leadership functions in multiple contexts at the same time (Shuffler et al., 2013). Leadership is distributed within all parts of an organization. Post-charismatic approaches reflect a tendency toward theory hybridization. For instance, there is a strand that deals with collaborative leadership (e.g. Ryan, 2001; Gray, 2008; Weber and Khademian, 2008). Collaborative leadership is about "*managing tensions in balancing acts, consensus building, integrations, interaction, common boundary objects, shared decision making,* [and] *coaching the process*" (Klein, 2008, S122). Shared leadership is a team-

Table 2 – Ten Types of Leadership Innovation (Keeley et al., 2013)

Category	Sub-Category	Definition
Configuration Focused on the innermost workings of the system	**Value Model**	The way in which value is created
	Network	Connections with others to create value
	Structure	Alignment of talent and assets
	Process	Signature methods for work performance
Offering Focused on the core product or service delivered	**Product Performance**	Determining features and functionality
	Product System	Provision of complementary products and services
Experience Focused on customer-facing elements	**Service**	Support and enhancement provided to offerings
	Channel	Delivery of offerings to users
	Brand	Representation of offerings to others
	Customer Engagement	Fostering distinctive interactions

based (Shuffler et al., 2013) co-leadership situation where *"two or more individuals within a collective contribute to the accomplishment of leadership performance requirements"* (Zaccaro et. al, 2013: 31). The focus shifts from those key actors at the head of organizations to more collective decision-making contexts. Patricia Pitcher (1995) uses the terms artists, craftsmen (or artisans), and technocrats to identify different important roles within organizations. Heenan and Bennis (1999) coin the term co-leadership to highlight the potential benefit of partnerships between two key individuals - *"two at the top"* (Crutchfield and McLeod Grant, 2010: 132).

2.5.1 Mintzberg's Continuum

To capture the complexity of this fifth approach to studying leadership, Mintzberg (2013) provides a useful continuum to explain the various types of leadership and their interconnectedness. While he does use the term management, he makes the argument that there is little to be gained by distinguishing between management and leadership, and that the concept of management has not been given the focus it deserves. For him, *"Instead of distinguishing leaders from managers, we should be seeing managers **as** leaders, and leadership as management practiced well"* (Mintzberg, 2013:7). While this is view is somewhat contested in the leadership literature, for this dissertation it is important to indicate that both leadership and management are equally important. The implications of this will be highlighted in section 2.5.2. Figure 2 presents an adaptation of this continuum.

The diagram, Figure 2, presents a general transition from left to right, portraying a movement from maximal individual control (only manager) to minimal individual control (no manager). In between are a number of leadership styles identified in the literature, from participative (Lortsch, 2010), shared (Heenan and Bennis, 1999), distributed (Gronn, 2002), supportive (Shuffler et al., 2013), and minimal (Collinson, 2006; Ernston et al., 2010). By using

a continuum approach, Figure 2 captures the fluidity inherent in management/leadership styles

and the idea that for different complex adaptive challenges (Heifetz, 1998), different leadership

interventions may be required. Fluid leadership relies on expertise rather than position, within a

climate of trust and mutual support (Woods et al., 2004). Fluidity is used here in the sense of the

ability to flow easily and, in particular with "*smooth elegance or grace*" (Oxford, 2016). Since

leading through complexity is at the core of addressing technical and adaptive challenges, CLT,

with a focus on certain core leadership functions (Uhl-Bien et al., 2007) (the *what* of adaptation

leadership), is a useful complement to the question of leadership style (the *how*) presented in this

section.

Figure 2 – The Leadership Continuum
(adapted from Mintzberg, 2013)

THE MANAGEMENT/LEADERSHIP CONTINUUM

Only Manager ⟷ No Manager

Maximal Participative Shared Distributed Supportive Minimal

Maximum
Control &
Individual Exercise
Of Power & Influence

Minimum
Control &
Individual Exercise
Of Power & Influence

LOCUS OF DECISION-MAKING

Individual Dual/Co-Leader Team Follower
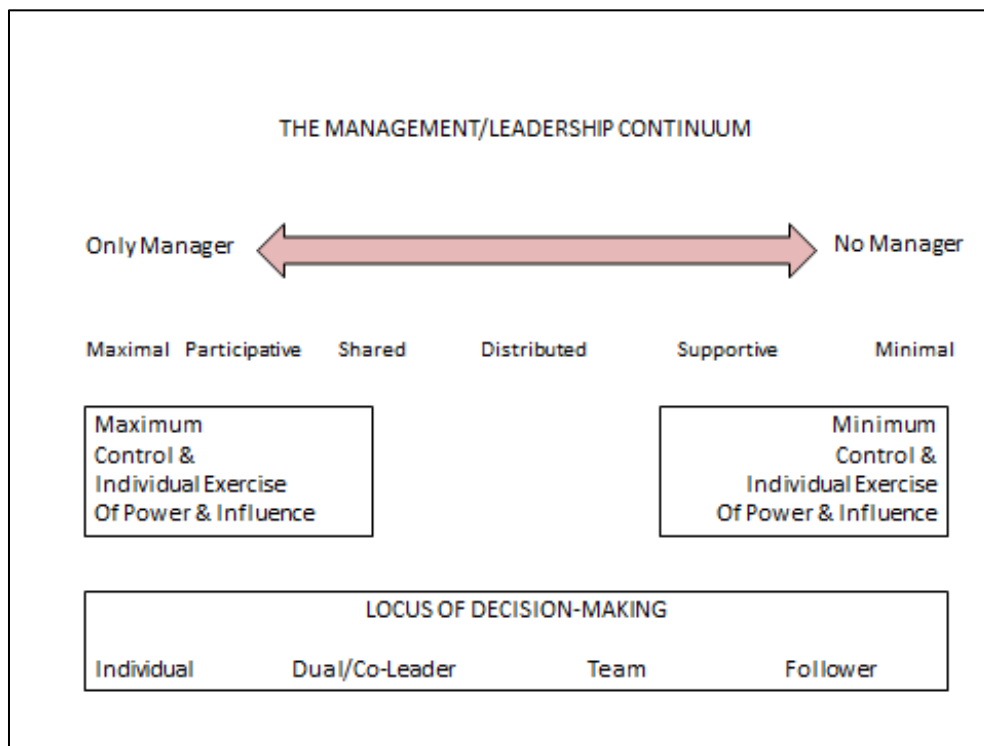
2.5.2 Complexity Leadership Theory (CLT)

Building on Heifetz's (1998) view of the nature of adaptive leadership, CLT is proposed as a way to deal with the perceived elusiveness of existing leadership approaches (Uhl-Bien et al., 2007; Marion, 2013; Rumsey, 2013b; Murphy et al., 2017). "*Much of leadership thinking has failed to recognize that leadership is not merely the influential act of an individual or individuals but rather is embedded in a complex interplay of numerous interacting forces*" (Uhl-Bien et al., 2007, 302). CLT uses a complex adaptive systems perspective to describe administrative, enabling and adaptive leadership, within an emergence dynamic or changing contextual landscape. Table 3 provides a summary of these basic leadership functions. These functions are enhanced by Meijerink and Stiller (2013) and informed by work in transdisciplinary, collaborative leadership (Gray, 2008) which also focuses on the functions necessary for distributed leadership success. More on these last two studies will be presented in section 2.6. Since innovation leadership also forms part of the conceptual framing, and has been discussed previously, it is included in Table 3 for reference.

In addition, there are a number of contextual challenges that are seen to influence leadership under complexity. One is a disequilibrium of system state which disrupts existing political and administrative institutions; a second is the need for coordinated processes to facilitate interaction and agent communication; a third is the interdependence of ultimate decisions made by one individual and another, requiring trust and empathy; another is the diversity of ideas and heterogeneity of personnel that create the need for conflict resolution, mediation and creation of common understanding; a fifth relates to the identification of a catalyst (agents, processes, or symbols that speed formation); a sixth is the creation of tags (persons, processes, or symbols that facilitate a selective interaction common interest) or boundary objects;

Table 3 – Comparison of Complexity, Collaborative, and Innovation Leadership

Complexity Leadership	Transdisciplinary Collaborative Leadership	Innovation
Functions Heifetz et al., 1998 Uhl-Bien et al., 2007 Meijerink & Stiller, 2013	**Tasks** Gray, 2008	**Types** Keeley et al., 2013
Political – Administrative maintaining traditional methods of bureaucratic monitoring and control	**Cognitive** managing meaning through visioning and framing	
Enabling creating organizational conditions for creative problem solving	**Structural** meeting the need for coordination and information exchange via social networks	**Configuration** focusing on the innermost workings of the system
Adaptive responding to immediate need for emergent change		**Offering** focusing on the core product or service delivered
Connective realizing connectivity across different levels, policy sectors, actors	**Processual (Process-oreinted)** ensuring that the interactions among team members are constructive and productive	
Dissemination sharing innovative ideas and approaches developed	**Networking** brokering and boundary spanning between actors	**Experience** focusing on customer-facing elements

and finally, there is the need for creation of a common culture of expectation (a climate that expects agents to interact, that embraces heterogeneity, where agents are expected to work through process-related conflicts, be creative, learn, and be adaptable) (Marion, 2013: 188). These contextual challenges underscore the relevance of a leader's contextual intelligence (Nye, 2010) in sustaining momentum for change. CLT (Uhl-Bien et al, 2007) is a useful theory from the post-charismatic/post-transformational leadership approach that identifies specific functions, that in conjunction with fluid leadership styles (Mintzberg, 2013), can provide a way to examine climate change adaptation leadership processes and practice effectiveness, as defined in this dissertation.

2.6 Climate Change Adaptation Leadership

In a Canadian context, climate change adaptation champions or leaders are recognized as key enablers for making the transition from awareness of climate change issues to specific action (Burch, 2010; Warren and Lemmen, 2014; Burch et al., 2014). This is increasingly being supported by research into removing barriers to adaptation (Eisenack et al., 2014). More broadly, leadership that is visionary, entrepreneurial and collaborative, and that supports learning can enhance institutional adaptive capacity (Gupta et al., 2010).

In Canada, there is a perception that climate change adaptation practice lacks leadership (Environics, 2010; Hanna et al., 2013; May, 2015). To further complicate the leadership landscape, climate change adaptation is required within a multi-level governance context, suggesting leadership requirements must cross jurisdictions and scales (Adger et al., 2009; Galaz et al., 2011; Thompson et al., 2012). These challenges have a direct impact on the ability of decision makers at all levels to develop sound adaptation practices. Navigating the multi-level complexity of leaders' interactions and the layering of leadership is the main focus of this thesis.

The transition in thinking in governance theory from singular, authoritarian leadership to more actor-based, consensus-driven, network-based, distributed leadership functions is observed in environmental governance (Armitage, 2012; Imperial et al., 2016). This is consistent with the material presented in the previous section. To examine this in more detail, there have been calls to explicitly treat leadership in the environmental sciences as an analytical rather than a normative concept (Evans et al., 2015). To this end, various scholars recognize the important role of leaders, entrepreneurs and networks of influence in the governance of social-ecological systems (Galaz et al., 2001; Folke et al., 2003; Olsson et al., 2006; Anderies et al., 2006; Gupta et al., 2010; Gutierrez et al., 2010; Berkes and Ross, 2013) and sustainability (Kates et al., 2001;

Kates, 2011). Other related conceptual framings that describe components of environmental leadership are often used. These framings include cross-scale brokerage (Ernston et al., 2010), super agency (Dengler, 2007), opinion leadership (Crona and Bodin, 2010), and policy innovation (Huitema and Meijerink, 2010). Entrepreneurialism and innovation are also suggested as a way to facilitate transformative adaptation (Burch et al., 2017). There is also research to suggest that leadership style should adapt to the various stages of the adaptation process (Vignola et al., 2017).

In climate governance, there is also research that provides a focus on leadership (Andresen and Agrawal, 2002; Tomkins and Adger, 2004; Lynch et al., 2008; Keskitalo, 2010b; Termeer et al., 2011; Meijerink and Stiller, 2013; O'Brien and Selboe, 2015; Stiller and Meijerink, 2016). Meijerink and Stiller (2013) use the concept of CLT (Uhl-Bien et al., 2007) and conclude that there are important political-administrative, connective, adaptive, enabling, and dissemination leadership functions that impact climate adaptation. This study expands the leadership functions of CLT from three to five (adding connective and dissemination) and adds a political dimension to the political/administrative function, previously presented in section 2.5.2. These two additions to CLT are important in that they emphasize the multi-level character of climate change adaptation. As such, leaders in this sphere of influence must show an aptitude for *"realizing connectivity across different levels of government, policy sectors, and a large variety of actors"* (Meijerink and Stiller, 2013: 252). In this way, there in an emphasis in CLT on proactively connecting actors, and disseminating information, while mainstreaming adaptation outcomes over a political landscape. Further, the dissemination function allows champions to share *"innovative ideas and approaches which are developed through the adaptive function within the network"* (op cit., 252). Also, the inclusion of a political aspect to the administrative

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function acknowledges the governance nature of administrative leadership for climate change adaptation. Table 3 incorporates these enhancements of CLT.

Meijerink and Stiller (2013) suggest that there are four important leadership strands that can make for effective adaptation: policy, connectivity, complexity, and sustainability leadership. Policy leadership involves the development of innovative solutions (Huitema and Meijerink, 2010). Connectivity leadership is one aspect of Gray's (2008) elaboration of collaborative leadership, where three important tasks: cognitive, structural, and process-oriented (processual) are identified for transdisciplinary teams. Cognitive tasks are related to managing meaning through visioning and framing; structural tasks meet the need for coordination and information exchange via social networks; processual (process-oriented) tasks ensure that the interactions among collaborators are constructive; networking tasks provide brokerage outreach to span boundaries between actors (Gray, 2008). Complexity leadership deals with developing adaptive organizations to deal with emergence (Rogers et al., 2013), particularly as it relates to the innovation process (Keeley et al., 2013). Sustainability leadership relates to principles of adaptive management in social-ecological systems (e.g. Olsson et al., 2006).

Before presenting the conceptual framing, it is worth putting the work surveyed in this literature review in an overall perspective. It is often difficult to parse the various influences that comprise modern leadership theory. This is particularly challenging when faced with treating leadership as an analytical rather than a normative concept (Evans et al., 2015). Understanding leadership requires a hybrid approach, taking into account, not only leaders themselves, but also their followers and the changing contexts in which they operate (Collinson, 2006; Rumsey, 2013b).

Care is necessary in using an operational definition of leadership which best reflects the problem being evaluated. This definition was developed previously in section 2.5. A social influence stance takes into account the necessary interaction between leaders and followers, as well a particular actor's contextual intelligence to switch between these roles, as the situation requires. The constraints piece reflects the importance of not only differential power relationships but also identifying barriers to leadership and overcoming them in specific contexts. Successful leadership should be aspirational and result in positive organizational outcomes, either through vision creation or action/execution (Kouzes and Posner, 2007), and create both meaning and value. Adaptation practices are the set of tools that accomplish this creation of meaning and value (Adger et al., 2007). Collaborative, consensus-based, post-transformational leadership approaches are increasingly part of these adaptation practices (Bidwell et al., 2013). CLT (Uhl-Bien et al., 2007; Gray, 2008; Meijerink and Stiller, 2013) is one such post-transformational leadership approach.

2.7 Conceptual Framing

This section describes the conceptual framing to explore climate change adaptation leadership in the Atlantic Region of Canada. The framing is based on an existing scheme developed by Smit et al. (2000). In laying the groundwork for a framing of climate change adaptation leadership, it is useful to return to an understanding of the process of adaptation. Frameworks for assessing adaptation are needed to help understand and facilitate improvements in the adaptation process (Burton et al., 2007; Dickinson, 2007).

Focusing on adaptation and the role leadership plays in it requires a hybrid approach, using existing CLT (Meijerink and Stiller, 2013; Stiller and Meijerink, 2016). In developing a general anatomy of adaptation, Smit et al. (2000) pose four questions for guiding any analysis of

adaptation and adaptation processes. First, what is the focus of the adaptation effort – what are the climate related stimuli or hazards of interest, what temporal and geographic scales are being examined (op cit., 229-235)? Second, who or what adapts – how is the system defined, what are its key characteristics, sensitivities, vulnerabilities, and adaptability (op cit., 235-239)? Third, how does adaptation occur – what processes and outcomes are evident which lead to either reactive or planned results (op cit., 239-242)? Fourth, how effective is adaptation – what principles, evaluation criteria and methods are used to define progress on adaptation (op cit., 243-245)?

The application of the above general anatomy is useful for developing a systematic, comprehensive leadership assessment framing. The four questions developed by Smit et al. (2000) are recast here to focus on the question of leadership as developed thus far. First, to what ends is the leadership effort focused – what are the adaptation entry points and adaptive challenges of interest? Second, who or what leads adaptation – which individuals, organizations, teams or actor networks play a leadership role in defining system characteristics, sensitivities, vulnerability and adaptability? Third, how does adaptation leadership occur – in which contexts does adaptation leadership occur, what leadership functions are required and does it change over time? Fourth, what constitutes effective adaptation leadership – what specific leadership attributes and skills are most effective for sustainable climate change adaptation? The usefulness of these questions has been previously explored (May, 2015). Appendix 1 is a synthesis of the literature in support of the conceptual framing. The next four sections will address each of the four questions in more detail. What will emerge is the perspective that climate change adaptation leadership requires thinking about complexity (Meijerink and Stiller, 2013) within a hybrid leadership approach (Mintzberg, 2013).

2.7.1 To What Ends is Leadership Focused?

There are a number of flexible ways in which adaptation entry points can be developed by climate leaders as part of overall sense making (Kløcker Larsen et al., 2012). One of the key challenges is that leaders must navigate differing views on how others, such as followers, perceive climate change and current vulnerability, which in turn, influences how best to determine which adaptation entry point are appropriate (O'Brien and Selboe, 2015a). For illustrative purposes,Table 4 lists some examples taken from both the peer-reviewed and unpublished literature. It is acknowledged that there may be other potential leadership avenues, such as equity and justice (Vancura and Leichenko, 2015).

Table 4 lists seven general adaptation entry points that can be seen in a review of climate change adaptation practice, along with their use in multi-level governance contexts. It is important to note that the overall objectives noted in the table are not necessarily mutually exclusive. As different organizations attempt to make sense of how to approach the process of adaptation, each finds their own voice in defining the problem. First, adaptation can be the key focus of planning efforts, as in the development of stand-alone adaptation plans or strategies (Smit et al., 2001). Second, developing overall adaptive capacity can be used to set climate priorities (Gupta et al., 2010). Third, leaders are increasingly using the concept of resilience to frame decision-making, in both a physical and social sense (Vogel et al., 2007; Deppitsch and Hasibovic, 2011). Fourth, the notion of vulnerability reduction is still an essential adaptation entry point when assessing planned options (Smit and Wandel, 2006; Ribot, 2011). Fifth, as the challenges become more complex, leaders are becoming more conscious of avoiding maladaptation in their assessment of longer term projects (Barnett and O'Neill, 2010). Sixth, one of the more common ways in which to approach adaptation is through mainstreaming, and

integration of climate considerations within both mitigation and sustainability frameworks (Bizikova et al., 2008). Seventh, with increased concern over changing extreme weather and related climatic events, adaptation is being incorporated as part of comprehensive climate risk management and disaster risk reduction, a special type of mainstreaming (Carter et al., 2007; Lemmen et al., 2008; May and Plummer, 2011). Notwithstanding the adaptation entry point selected, the careful selection of particular adaptation entry points serves to focus the vision and meaning making phase of climate change adaptation leadership via the enabling function of CLT (Uhl-Bien et al., 2007; Stiller and Meijerink, 2013).

2.7.2 Who or What Leads Adaptation?

The premise of this question is grounded in the concept of actors and agency (Giddens, 2011; Schultz et al., 2011). Agency is the flow of individual action in everyday life that has both intended and unintended consequences (Giddens, 1984). Section 2.6 presented some ways in which sense making and selection of relevant climate change adaptation entry points have been used in various multi-level governance contexts. Agency is the connector between sense making and the exercise of leadership, as presented in section 2.5. Leadership, therefore, places this individual action and agency into not only in a leader/follower context (Collinson, 2006), but into the broader continuum as presented in Section 2.5.1 and Figure 2 (Mintzberg, 2013). This framing emphasizes an expanded view of social influence as including collaboration between actors as well as the complex network dynamic characteristic of teams, organizations and innovation networks (Day et al., 2006; Dhasanai and Parkhe, 2006; Kouzes and Posner, 2007).

Table 4 – Adaptation Leadership Entry Points

Objectives	Focus	Multi-Level Governance Contexts	Example
Adaptation	Explicitly using the concept of adaptation to influence decision environments	**International** Policy	World Bank (Burton et al., 2006)
		National Science Assessments	Canadian Forestry Sector (Lemprière, et al., 2008)
		Sectoral/Regional Adaptation Design	Province of Ontario grape and wine industry (Pickering et al., 2012)
		Community Adaptation Planning	City of Windsor, Ontario (2012)
Adaptive Capacity	Building the capacity to adapt to future changes in decision environments	**Regional** Collaborative Arrangements	Atlantic Climate Adaptation Solutions (ACASA, 2016) www.atlanticadaptation.ca
		Community Networks	Sudbury, Ontario (Vasseur, 2011)
Resilience	Using the concept of resilience (either physical or social) to identify needed changes in decision environments	**Corporate** Resilience Strategy	Various (NTREE, 2012)
		Landscape Ecosystem Based Adaptation	IUCN (Andrade et al., 2010)
Vulnerability Reduction	Identifying vulnerable systems to move forward with changes in decision environments	**National** Climate-proofing	Public Infrastructure (PIEVC, 2008)
		Community Heat-Health Alert Response	Toronto, Ontario (cited in Health Canada, 2008)
Maladaptation Avoidance	Avoiding changes in decision environments that will lead to maladaptation in future	**Community** Climigration	West Coast, Alaska (Bronen & Chapin III, 2013)
		Community GHG emission increases	Melbourne , Australia (Barnett and O'Neil, 2010)
Adaptation, Mitigation and Sustainability (AMSD) and Mainstreaming	Integrating climate change considerations into current sustainable development instruments	**Community** Sustainability Planning	St. Catharines, Ontario (2011)
		Regional Integrated Economic Diversification	Whistler, BC (cited in Bizikova et al., 2008)
		State-level Energy system supply and demand adaptation	Queensland, Australia (cited in CSIRO, 2010)
Climate Risk Management and Disaster Risk Reduction	Focusing on needed changes in decision environments in response to changing climatic extremes	**Regional** Disaster Management	Caribbean Disaster DRM (cited in Government of Canada, 2010)
		Community Participatory Risk Assessment	Red Crescent/Red Cross (van Aalst et al., 2008)

Moving from actor-based agency to leadership involves power, power relations, and contextual intelligence (Nye, 2010; Savoie, 2010), as described previously (section 2.5) in the contingency approach to leadership theory. Often, the intervention of super-agents or "*knowledge brokers who serve in leadership positions*" (Dengler, 2007: 430) is needed to bridge science, local, and policy knowledge power spaces. Individuals who work to broker knowledge and awareness for action (Cook et al., 20143) across scales (Ernston et al., 2010; Galaz et al., 2011) are examples of this. Super-agents are often characterized as working at the boundary (Lynch et al., 2008) of a particular problem domain. More on the notion of power for climate change adaptation will be presented in the next section. In summary, climate adaptation leadership involves collaborators in adaptation processes, who become actors and subsequently exercise agency (in an action situation) within an action arena (Ostrom and Ostrom, 2014). This can take multiple forms in multiple situations, as presented in section 2.5.1 (Mintzberg, 2013) and create fluid leadership approaches, such as CLT (Uhl-Bien et al., 2007), as shown in section 2.5.2.

Singular, charismatic individuals are certainly seen in the provision of political leadership for climate change. Former City of Toronto Mayor David Miller and former City of London Mayor Ken Livingstone have been identified as examples of this type of leadership (Boyle, 2010). Stan Choptiany, Mayor of Saint Andrews, New Brunswick received an international visionary award for his work on climate change adaptation (GOMC, 2015). As discussed previously, while leadership is traditionally thought to be exercised by individual actors, it can also be attributed to teams of individuals, as well as organizations (Kouzes and Posner, 2007).

Research has also been done on leadership contexts where two individuals explicitly exercise complementary social influence to create a common vision and deliver results. A

variety of terms have been applied to this kind of allance, such as co-leadership (Heenan and Bennis, 1999; O'Toole et al., 2002; Nhamo, 2009), dual leadership (Gronn 1999) or, in education, co-principalship (Eckman, 2006).

Finally, the terms champion (Jenkins, 2009; Vasseur, 2010; Warren and Lemmen, 2014), extension agent (Cohen and Wadell, 2009; Hewat and Banda, 2010), or block leader (Burn, 1991; McKenzie-Mohr, 2011) have been used to describe local social influencers, with little or no formal authority, who work to achieve predominantly local community-based objectives. Opinion leaders, those who can influence local decision-making, either positively or negatively, would fall into this type (Crona and Bodin, 2010).

2.7.3 How Does Adaptation Leadership Occur?

The third question asks how adaptation leadership occurs, the contexts in which it operates and how it changes over time. Context includes consideration of multi-level interactions, power and collaboration. Fluidity relates to how particular leadership styles and functions change over time.

From a contextual perspective, there is quite often the need for place-based adaptation action (Wilbanks, 2003; Wilbanks, 2007; Mintzberg, 2015) that deal with the issue of power and how it is exercised. Spaces of power for action exist in the exercise of science, policy and local knowledge, and the ability of agents to successfully navigate these has been identified as important (Dengler, 2007). Contextual intelligence and enlightened power (Coughlin et al., 2005; Nye, 2010; Savoie, 2010; May 2013) are required to examine problems and create broad-based multi-level adaptation actions. There are often institutional barriers to adaptation (Moser and Ekstrom, 2010) that are power-based and require finesse. This process of knowledge brokering requires active collaboration (Kløcker Larsen et al., 2012) and participation (Bizikova

et al., 2009). A key aspect of this collaboration is the idea of learning from the past and sharing

best practices to address current adaptive challenges (Cohen et al., 2006).

In terms of how climate change adaptation leadership changes over time, those aspects of

CLT previously discussed – political/administrative, enabling, adaptive, connective and

dissemination leadership (Uhl-Bien et al., 2007; Meijerink and Stiller, 2013) can be required at

different stages of the application of adaptation practices. For instance, a high degree of

innovation and entrepreneurialism (Huitema and Meijerink, 2010) might be required in early

stages to deal with emergent issues (adaptive leadership). Later in the process, effective

managing (Mintzberg, 2013) might become more relevant (political/administrative leadership) as

the adaptation process becomes institutionalized and more structured decision-making (Wilson

and McDaniels, 2007; May and Plummer, 2011) is required. Finally, the recognition of the need

to effectively engage and recognize the differing needs of followers (Collins, 2006) in such areas

as mentoring (Steen et al., 2009) and succession planning (Gebelein et al., 2010) may be

important throughout (enabling leadership). This enabling is also true of leadership that involves

creating and sustaining partnerships and alliances (Heifetz, 1994; Gray, 2008).

2.7.4 What Constitutes Effective Adaptation Leadership?

Lastly, the conceptual framing considers the question of what constitutes effective

adaptation leadership. If specific leadership attributes and skills can be identified, then more

effective climate change adaptation practice can be developed. More effective practices can

potentially lead to more effective adaptation initiatives. For the purposes of this discussion, this

relates primarily to planned policy initiatives, strategies and actions (Smit et al., 2000; Lim and

Spanger-Siegfried, 2005). The important role that vision and creating value play in leadership

activities has already been discussed (Kouzes and Posner, 2007; Black et al., 2011). So too, has

the need for more collaborative leadership considerations (Gray, 2008). A further important aspect is the effective translation of knowledge into action (Cook et al., 2013).

Moser and Ekstrom (2010) suggest that effective climate leadership can be a way to diagnose and overcome barriers to adaptation. These barriers relate primarily to removing challenges that exist around understanding the adaptation leadership challenge, planning and decision-making for effective response and finally, managing for adaptation, including evaluating progress (Burch, 2008; Moser and Ekstrom, 2010; Eisenack et al., 2014).

Additionally, when leadership is discussed within organizations, strategies around effectiveness also tend to include the ideas of succession planning, mentoring and talent management, and leading by example. Succession planning involves the conscious process of preparing an organization for transition of key personnel (Groves, 2007; Gebelein et al., 2010; Conger, 2010; UKTSO, 2011). Mentoring and talent management involves the identification of persons with leadership potential and provides a structured process for leadership development opportunities (Steen et al., 2009; Gebelein et al., 2010). Leading by example involves an individual or organization's outward display of leadership attitudes and actions, sharing those with others and personal reflection (Kouzes and Posner, 2007). In Canada, leading by example has been suggested as a key element in moving forward with adaptation (Burton, 2008). Effective climate change adaptation leadership, therefore, should explicitly consider succession planning, intergenerational knowledge transfer, mentoring and talent management, and leading by example.

The four questions presented, in combination with the general definition of leadership developed in this Chapter, can now be used to focus research activities on the process of climate change adaptation leadership in the Atlantic Region of Canada, as described in section 1.3.

Specific embedded instances of the application of climate change adaptation leadership can be consistently compared using the questions developed. To what ends is adaptation leadership being directed? Who or what is leading the climate change adaptation activity? How does adaptation leadership occur? What constitutes effective climate change adaptation leadership? The general anatomy of climate change adaptation leadership, as developed in section 2.6, provides the foundation for teasing out findings in relation to the dissertation research questions identified in Chapter 1.

Figure 3 is a mapping of the research questions presented in section 1.2 to the overall structure of the conceptual framing. The four general anatomy questions form specific quadrants intended to inform climate change adaptation leadership practice. Dissertation research questions identified in section 1.2 are placed in specific quadrants.

This Chapter began with a review of climate change adaptation and its place in climate governance. Then, it examined current scholarship on leadership as it relates to climate change adaptation practice. A conceptual framing was developed from which to study climate change adaptation leadership. The framing starts from an agency-based view of leadership (Pfeffer, 2000). From there enhancements are made to suggest that climate change adaptation leadership includes both technical and adaptive challenges (Heifetz et al., 2009; O'Brien and Selboe, 2015), is a collaborative enterprise (Gray, 2008), deals with complexity and complex adaptive systems (Uhl-Bien et al., 2007), and is comprised of a variety of important functions and tasks (Meijerink and Stiller, 2013). Leadership, for the purposes of climate change adaptation, is an evolving and dynamic process, involving multiple actors and institutions, collaborating under changing and increasingly uncertain, external and internal constraints. In addition, it can be situated within a professional climate change adaptation practice. Leadership is something that can be learned,

that is "… a behavior rather than a personality trait" (Drucker, 1985, 26), but to be useful, must also be applied. In support of this framing, the next Chapter describes the methodology and methods used to evaluate the fluidity of climate change adaptation leadership.

Figure 3 – Mapping of Research Questions to Conceptual Framing
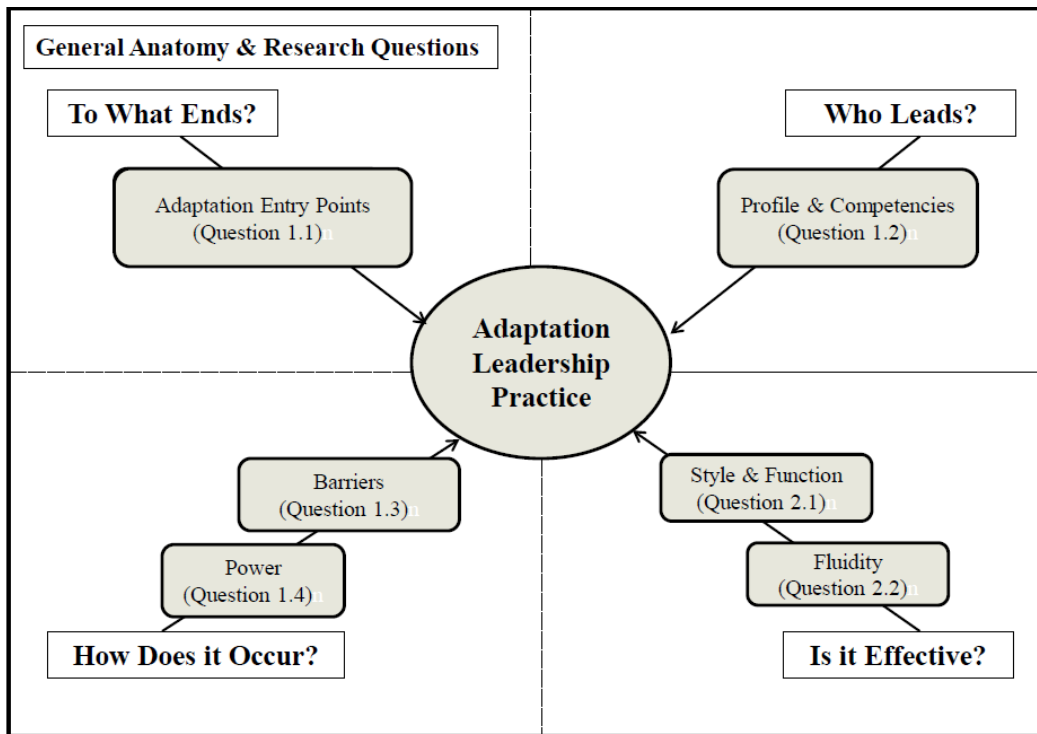
CHAPTER 3 – METHODOLOGY AND METHODS

Treating leadership interactions, processes and outcomes
as analytical rather than normative concepts
will significantly improve the scientific robustness
of environmental leadership research
(Evans et al., 2015)

3.1 Background

The purpose of this chapter is to set out the research methodology used in this

dissertation. The research takes place in a Canadian regional context, as described in section 3.3.

Foundations for the project were developed as part of the literature review presented in Chapter 2

as well as preliminary ideas explored elsewhere (May, 2013; May, 2015). The conceptual

framework presented in Chapter 2 poses key framing questions related to the general anatomy of

climate change adaptation leadership. These key framing questions in turn are used in order to

examine two specific research objectives and six dissertation research focus questions identified

in Chapter 1. These questions interrogate climate change adaptation leadership processes, as

well as climate change adaptation practice effectiveness.   In the following sections, the

methodology selected is set out and the regional case study area described. This is followed by a

discussion of the four main methods used to collect data – key informant interviews, literature

review, participant observation and site visits. Then, six research challenges are discussed and

how they were addressed during the research. Finally, the last section presents considerations

related to data analysis.

3.2 Regional Case Study

Using a regional approach (Unwin, 1994) and explanatory case study (Yin, 2012)

research analyzed processes of climate change adaptation leadership in a specific setting - the

Atlantic Region of Canada. While there is a certain descriptive element to parts of the case study, the primary focus was on making observations that explain how the exercise of climate change adaptation leadership takes place. Through a deductive (Héritier, 2008) and comparative (Mair, 2008) approach, the relevance of various theories of leadership development were observed by examining a number of discrete leadership situations, or embedded cases, within the larger case study area. More detail on the regional case study area – the Atlantic Region of Canada is provided in the next section.

Case studies are useful because they assist in the understanding of complex processes (della Porta and Keating, 2008) and outcomes (Yin, 2012). The development of a specific theoretical framework is used as a lens for analyzing these case contexts. Middle range theories develop through a process of problem exploration, thought trials and elaboration of selection criteria (Weick, 1989). The resultant middle range theory can then be tested by examining a limited number of carefully selected contexts to explain the specific phenomena of interest (della Porta and Keating, 2008). By combining case study analysis with complexity theory, integrated systems can be studied to explore patterns, dynamism and comprehensiveness, while still focusing on defined system properties (Anderson et al., 2005). In this dissertation, embedded cases which involve specific instances of climate change adaptation leadership form finer grain contexts in support of the broader regional case study. Embedded case selection was based on an information-oriented, maximum variation strategy (Flyfbjerg, 2006). A case's inclusion was not determined by random selection, but by focusing on the anticipated richness of information available (della Porta, 2008) from which to draw conclusions on leadership. Consideration was also given to the anticipated variety of leadership observations possible between cases. As such, the embedded cases were identified within the research process and not predetermined

beforehand (della Porta, 2008). These embedded cases are described in more detail in the following section.

Case study research is not without challenges. Common challenges include: internal or logical variability, construct validity, external validity, and reliability (Gibbert et al., 2008). First, internal variability refers to the relationship between variables and results (op cit.,1466). This was addressed through the use of a clear research framework, pattern matching, and multiple sources of evidence to substantiate claims. Second, construct validity is concerned with the quality of conceptualization and operationalization of concepts (op cit., 1467-1468). This was achieved both by the prior testing of certain portions of the conceptual framework in another Canadian location (May, 2015) and maintaining a clear and replicable chain of evidence which follows the established methodology. Third, external validity is the ability to generalize results for their application to broader contexts (op cit., 1468). In this research, the conceptual framework was clearly tied to the existing scholarship and incorporated previous findings in the area of climate change adaptation leadership (Meijerink and Stiller, 2013; Eyzaguirre and Warren, 2014; Stiller and Meijerink, 2016). Also, the use of embedded cases and clear rationale for case selection strengthened external validity. Finally, reliability is the absence of random error (op cit., 1468-1469). In order to develop reliability, a clear case study protocol was applied, including an audit and check function for data presented, and maintaining a complete case study database. In summary, case study research, with the necessary rigor, is an effective strategy for analyzing complex, integrated systems (Anderson et al., 2005). The research questions identified in Chapter 1, after having been placed in the conceptual research framework in Chapter 2, lend themselves to a case study approach.

The first research objective deals with climate change adaptation leadership processes. Question 1.1 is related to what adaptation entry points are used as catalysts for climate change adaptation leadership. Embedded cases can look across a number of different adaptation entry points to identify similarities that help explain how leadership emerges and also guide future leadership interventions for climate change adaptation. Question 1.2 examines the competencies demonstrated by climate change adaptation leaders. A case study approach can examine a number of different contexts to develop an inventory of these leadership tools, skills and abilities. Question 1.3 addresses barriers to climate change adaptation and how those were overcome. A wide range of related, yet different experiences, can explore existing research on the specific barriers to adaptation and which are the most challenging for leaders. The last question related to climate change adaptation processes, Question 1.4, deals with power through an examination of authority and influence in multi-level settings. By examining embedded cases within a broader regional case study perspective, identification of cross-level power dynamics can be observed across a number of different adaptation entry points. This enhances understanding of how power is exercised, particularly as it relates to contextual intelligence.

The second research objective asks questions related to the effectiveness of climate change adaptation practice. Question 2.1 examines which aspects of leadership theory are most useful for enhancing climate change adaptation. Case studies are useful in this instance to document findings in a number of different leadership contexts and inform recommendation for development of climate change adaptation practice. Question 2.2 adds the dimension of time to explore how leadership may fluidly change as adaptation processes unfold. Exploring a number of embedded cases allows for cross-case comparison and identification of exemplars that demonstrate this fluidity in climate change adaptation leadership.

Finally, from a methodological perspective, review of qualitative climate change research advocates a mixed-methods approach (Nielsen and D'haen, 2013). Comparative, actor-centred case research has been recommended to help study, explain and overcome barriers to adaptation (Eisenack et al., 2014). As well, there has been the tendency in adaptation science to make methodological selections based on perceived differences between research and practice approaches (Hinkel and Bisaro, 2016). As has been developed in earlier chapters, the intent of the research described here is to do both. The methods described in section 3.4 are consistent with these methodological perspectives.

Within this regional case study approach and using multiple sources of evidence (Yin, 2012), a data corpus was constructed. A specific analytic device, progressive contextualization (Vayda, 1983), was applied to examine the importance and strength of various multi-level influences. Progressive contextualization is a way to examine multi-level phenomena by selecting a research entry point (level) and then examining the phenomena in either wider or denser contexts, as data are generated (Vayda, 1983). This approach has the flexibility of being able to: observe climate change adaptation leadership entry points (e.g. municipal, provincial or federal initiatives); substantiate outcomes achieved; map leadership emergence over time; compare it to other sources of evidence such as documentation; and observe how leadership overcomes barriers to adaptation. With the data corpus analyzed as described below, there was an opportunity to make analytic generalizations (Yin, 2012) related to climate change adaptation leadership, both theory and practice.

3.3 Case Study Area – The Atlantic Region of Canada

Research was funded through a Canadian Social Science and Humanities Research Council (SSHRC) Insight Development Grant, in conjunction with The Partnership for Canada-

Caribbean Community Climate Change Adaptation (ParCA) Project. ParCA has been a multi-agency collaborative research consortium, funded by the Canadian International Development Research Centre (IDRC) and the Canadian Social Sciences and Humanities Research Council (SSHRC) (ParCA, 2016). The project worked with communities in Atlantic Canada and the Caribbean to conduct community-based vulnerability assessments as a catalyst for climate action (ParCA, 2016). My research relied on expertise of investigators involved in the ParCA project. In addition, investigators from another project, the C-Change International University Community Research Alliance (ICURA) Project - Canada-Caribbean Coastal Climate Adaptation Strategies also funded by IDRC and SSHRC, were consulted (C-Change, 2016).

The Atlantic Region of Canada consists of the Provinces of New Brunswick, Nova Scotia, Newfoundland and Labrador, and Prince Edward Island. Figure 4 is a map of the regional case study area, along with key embedded cases. A description of each of these embedded cases can be found in Table 7, the next section and Appendix 2. The Atlantic Region was used to examine the role of leadership in climate change adaptation practice for a number of reasons. The Region has a total population of 2.34 million, a number of large urban centres, such as the Halifax Regional Municipality, a significant number of rural, coastal communities, and a diverse economy tied to the natural resources sector: fisheries, agriculture, forestry, mining, and tourism (Vasseur and Catto, 2008: 122-23).

Climate change is continuing to affect all these sectors (Warren and Lemmen, 2014). Fisheries must respond to changing fish stock distribution in response to changes in temperature and salinity (Warren and Lemmen, 2014). In addition, tourism infrastructure remains vulnerable to the impact of coastal flooding and attendant erosion from both extreme weather events and sea level rise (Warren and Lemmen, 2014: 141). Adaptive capacity within the region is uneven.

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Atlantic Canada has a high degree of adaptive capacity when it comes to terrestrial ecosystems, water resources, transportation, energy, and urban communities; other sectors such as marine ecosystems, forestry, and rural communities have a lower adaptive capacity (Vasseur and Catto, 2008: 161). In general, sound climate change adaptation practices can make use of mainstreaming, such as no regrets strategies for infrastructure design or planning instruments, such as legislation or by-laws to respond to adaptive challenges (Vasseur and Catto, 2008). Various jurisdictions within the Atlantic Region are currently in the process of exploring these principles, instruments and tools (Eyzaguirre and Warren, 2014). For instance, the Province of Nova Scotia required municipalities to develop climate change adaptation plans as a condition of receiving federal gas tax revenue (Nova Scotia, 2011). The Atlantic Canada Adaptation Solutions Association (ACASA) is developing a costing tool for infrastructure decision making under changing climatic conditions (UPEI, 2015).

All four Atlantic Provinces have been progressive in their comprehensive response to climate change. Each province has developed its own climate change action plan, and is either in the implementation phase, as in the case of Nova Scotia, or in the update and review phase, as is the case in Prince Edward Island (Government of Canada, 2014). On the international stage, the Provinces are collective signatories to the New England Governors/Eastern Canadian Premiers Climate Change Action Plan (Government of Canada, 2014). They have also signed the Atlantic Energy Framework for Collaboration (Government of Canada, 2014). Of further interest, provinces have developed innovative policy mechanisms to promote increased climate change vulnerability assessment and adaptation planning. New Brunswick administers the *Environmental Trust Fund Act*, which makes funds from container recycling available for

environmental protection, restoration and sustainable development projects (New Brunswick, 2011). Communities, such as the Town of Saint Andrews, have accessed the funds to "*continue*

Figure 4 – Embedded Cases – Atlantic Region of Canada

1 – Cape Breton RM Marconi Trail Climate Change Adaptation Plan
2 – Atlantic Canada Adaptation Solutions Association
3 – Halifax RM Urban Forest Master Plan
4 – Colchester-Cumberland Wind Field Inc.
5 – City of Charlottetown Integrated Community Sustainability Plan
6 – PEI Task Force on Land Use Planning
7 – Town of Saint Andrews Integrated Planning
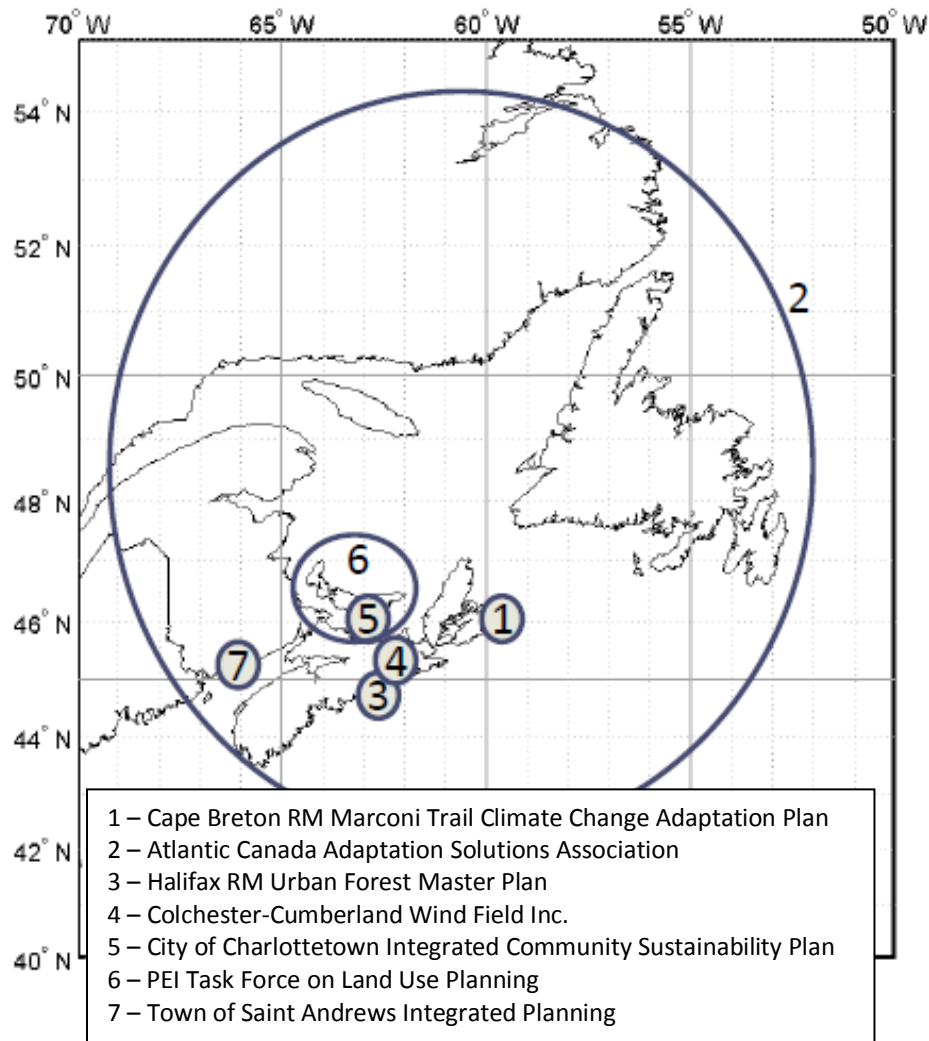
MAP SOURCE: http://www.novaweather.net/blank_atlantic.gif

to develop a strategic path forward under a changing climate" (New Brunswick, 2016). Nova

Scotia, through an amendment to the *Canada-Nova Scotia Agreement on the Transfer of Federal*

Gas Tax Funds mandated that, in order to access these funds, communities had to incorporate

both climate change mitigation and adaptation considerations into their Integrated Community Sustainability Plans (Nova Scotia, 2011).

Finally, the Region, as a collective, participated in one of six Regional Adaptation Collaboratives (RACs), funded under the federal Climate Impacts and Adaptation Program, administered by Natural Resources Canada (NRCan, 2016). This particular RAC, the Atlantic Climate Adaptation Solutions Association (ACASA) has been in existence since 2009 (ACASA, 2016). First coordinated by Nova Scotia and later by the University of Prince Edward Island, ACASA works cross-provincially, and also with federal government departments and agencies, municipalities, academia, the private sector, and other organizations to move forward with climate change adaptation initiatives (Eyzaguirre and Warren, 2014). ACASA has been particularly successful in innovative collaboration and knowledge transfer to increase adaptation effectiveness (Dexter, 2012).

Preliminary investigation suggested that leaders in the Atlantic Region of Canada have developed unique approaches to the challenges of climate change adaptation. As a result, key individuals have been recognized internationally for their leadership efforts in climate change adaptation (GOMC, 2015). Preliminary research also show that key organizations have developed innovative tools to assess, visualize and select appropriate adaptation options, such as the Coastal Impact Visualization Environment (CLIVE) (UPEI, 2014). Agencies have developed inter-provincial and national working relationships (ACASA, 2016). Leaders are engaging communities, academic institutions, businesses and non-government organization on climate change decision-making (ACASA, 2016). Further, leaders in the Atlantic Region of Canada have shown interest in learning about climate change adaptation leadership (May, 2012). This preliminary review suggested that the Atlantic Region of Canada was a suitable choice for a

regional case study on climate change adaptation leadership. The research objectives identified were systematically explored within this context.

3.4 Embedded Case Selection

Marconi Trail Climate Change Adaptation Plan is a sub-plan of the Cape Breton Regional Municipality (RM)'s Climate Change Plan. The development of municipal plans was mandated under a particular policy innovation - Nova Scotia's Municipal Climate Change Adaptation Program (MCCAP). The fact that these plans were a prerequisite ro accessing shares of federal gas tax revenue acted as a catalyst for their development by municipalities. Cape Breton RM was the last municipality in Nova Scotia to adopt such a plan. This embedded case allows the downstream impacts of a particular policy innovation to be examined by asking how innovation at one governance level influences another. One of the priorities developed under the plan was to collect stakeholder perspectives and review community-based mapping, a fairly typical adaptation approach. The difference was that a particular non-profit community organization, the Atlantic Coastal Action Program (ACAP) Cape Breton was contracted to conduct this adaptation assessment on behalf the regional municipality. From a multi-level governance perspective, this entails involvement from the federal, provincial, municipal, and community levels. It is unique that a non-governmental organization was contracted with coordinating an examination of adaptation activities. For this dissertation, it provides an opportunity to explore how leadership from this unique governance vantage point could make use of soft and smart power strategies to collaborate with other partners. In addition, ACAP was able to make use of best practices sharing from others, which provided a leadership perspective on knowledge transfer. It is also a way to explore how knowledge brokerage between science, policy, and local power spaces can be used to influence local climate change adaptation action.

Atlantic Canada Climate Adaptation Solutions Association (ACASA) is an innovation network developed through a federal program focused on creating national adaptation collaboratives. Natural Resources Canada provided support and seed money to fund groups of actors in certain geographic regions of Canada for the purpose of developing a collaborative approach to moving forward with concrete adaptation action. It is an exemplar of multi-level, multi-agency governance, collaboration and complexity in this regional case study. A network of champions was formed of representatives from all provinces in Atlantic Canada, various academic institutions, consultants, and non-government agencies. This embedded case provides an opportunity to examine the development of leadership in innovation networks and how CLT is useful for making analytic generalizations. In addition, it provides a way to identify issues of power, contextual intelligence, knowledge brokerage, and strategies developed to overcome leadership barriers. Further, the temporal aspects of climate leadership can be observed as the network moves from creating a common understanding and mandate, to analyzing climate change adaptation challenges, and developing specific action to address these challenges. Work of this nature is typically conducted by either in-house staff or private consultants.

Halifax Regional Municipality (RM) Urban Forest Master Plan is a multi-year initiative of the Halifax RM to promote and sustain urban forest management practices within its jurisdiction. Prompted by several extreme weather events, e.g. Hurricane Juan and loss of key iconic urban canopy components, Halifax RM entered into a long term, multi-year relationship with researchers from Dalhousie University with a stated purpose to increase urban forest resilience. From a multi-level governance perspective it provides perspective on how international standards and conventions are manifest in local action. Another unique aspect of this plan is that sustained funding has been incorporated as a core element of a dual leadership,

municipal-university partnership.   Coupled with this are aspects of leadership that foster training, mentoring and talent management for entry level staff. The embedded case allows for exploration of how dual leadership is used to coordinate effort and collaborate on common objectives and outcomes across organizational interest areas (government and academia). In addition, it is an opportunity to explore how innovative science research (e.g. neighbourhood-based urban canopy management) is translated into embedded policy innovation.

Colchester-Cumberland Wind Field Inc (CCWFI) is a for-profit, community social enterprise that is the first of its kind in Nova Scotia. Established near Tatamagouche, its business aim is to develop wind power as a viable energy alternative for local residents. This requires local support and buy-in. This embedded case is an example of how business can influence the successful integration of climate change considerations into broader community sustainability. From a multi-level governance perspective, the proponents work within an entangled regulatory regime, requiring the consent of municipal, provincial and federal agencies necessary in order to make the company's vision and profitability a reality. This entails overcoming the various barriers to an evolving climate governance environment - energy feed-in tariffs. Being first of its kind, and an example of early adopter innovation, the lessons learned from the dual leaders of CCWFI are important for the broader dissertation case study because it is a way to explore how pioneering innovation is conceived, developed and implemented. This embedded case also provides an opportunity to explore how two leaders within an organization approach collaboration and coordination, and use their relative strengths to sustain their business over time. One key aspect of this is through succession planning and mentoring.

City of Charlottetown Integrated Community Sustainability Plan (ICSP) is a municipal integrated community sustainability plan which incorporates climate change adaptation and

mitigation into local government priority setting. From a multi-level governance perspective, the plan incorporates requirements of provincial and federal levels of government. Consultants helped to frame the work of the City's sustainability committee for local community engagement. In this embedded case, political leadership is the driving force in setting a vision for local implementation. This involves setting up the organizational leadership structure to develop the sustainability plan and ensure its continued implementation. There is an opportunity in this case to observe how leadership style and function change over time in order to ensure that the essential ingredients are available for community development. It also allows for an examination of the role of team leadership in a broader organizational setting.

PEI Task Force on Land Use Planning (TFLUP) is a provincial quasi-judicial review that was struck to develop a coherent and comprehensive provincial land use policy for Prince Edward Island. During deliberations and community engagement, the task force recognized that climate change considerations touched almost all of their key priority areas – climate change is a threat multiplier. These include such areas as agriculture, forestry, fishing, and tourism as part of comprehensive land use planning. The mainstreaming of climate change adaptation into various provincial economic sectors is highlighted in this case. From a multi-level governance perspective, the task force was required to consider and address the integration of federal, provincial, community and business interests. In this embedded case, political leadership is provided by provincial appointees. A secretariat of employees and consultants are empowered to complete required work using organizational and team leadership. In this case, there is an opportunity to examine leadership during a highly structured governance process, with limited flexibility for adaptation innovation. It is a way to explore leadership emergence, even within a rigid power structure.

Town of Saint Andrews Integrated Planning is an approach used by political leadership to weave climate change adaptation into all aspects of municipal operations. In this case, the focus is on leadership in community resilience and emergency risk management. From a multi-level governance perspective, the Town of Saint Andrews is ultimately responsible for the safety and security of its citizens, however it is reliant on other levels of government, such as international, provincial, federal, and related agencies (New Brunswick Power) to achieve its mandate. This embedded case provides insight into how singular individuals in the political sphere, such as mayors and councillors, provide guiding leadership for climate change adaptation. The case also gives an opportunity to explore how issues of succession and transition are managed, as well as what structural innovations are available to leave a leadership legacy. In this case, the legacy is the creation of a standing committee of council – a citizen's authority on climate change.

In summary, the seven embedded cases were selected to highlight a variety of leadership technical and adaptive challenges. They all address some aspect of how contextual intelligence is used by leadership to overcome barriers in science, policy, and local power spaces. They are also illustrative of a range of multi-level climate governance scales, levels, and time frames. Further, the cases encompass a number of diverse leadership styles, functions, and overall approaches. The advantage of this strategy is that through using an information-oriented, maximum variation strategy (Flyfbjerg, 2006), the widest net can be cast to make comprehensive observations on the development of a sound climate change adaptation leadership practice.

3.5 Methods

The research for this dissertation took place from March 2015 to June 2016 and was approved by the University of Waterloo Office of Research Ethics (ORE 20524). A project web site, the Canadian Climate Change Leadership Network (CCCLN), was developed to disseminate research findings for the broader climate change adaptation leadership community (CCCLN, 2016). The research built upon exploratory research on climate change adaptation leadership that was conducted from 2009 to 2012 as part of a previous Canadian project on community climate change adaptation in the Niagara Region of the Province of Ontario (Gafarova et al., 2010; May and Plummer, 2011, Chynoweth et al., 2011, Pickering et al., 2011, Kløcker Larsen et al., 2012, May, 2013; Baird et al., 2014; May, 2015).

As discussed, a regional, embedded case study approach was used to solicit perspectives from climate change adaptation actor-leaders. Interviews were an important way to deepen knowledge of a particular community (Bray, 2008). Opinions and experiences aided in strengthening climate change adaptation practice. Interviews were supplemented with other specific research methods such as literature review, participant observation and site visits. Each method is presented in the following sections.

3.5.1 Key Informant Interviews

The primary data collection method was the key informant interview approach. The solicitation of information from key informants has been adapted from its original use in cultural anthropology to be used more widely in other branches of the social sciences (Marshall, 1996a). Key informants, by definition, possess detailed knowledge of a particular process and outcome. As such they are selected for an interview based on a number of factors including: their role in

the community, knowledge and access to information, willingness to participate, communicability, and impartiality (Marshall, 1996a).

In this regional case study, and prior to selection of candidates as key informants, an initial e-mail survey was conducted of thirty-three (33) individuals involved in either the ParCA or C-Change projects. They were asked, based on their experience, to identify individuals in the field of climate change adaptation in the Atlantic Region of Canada who might be suitable candidates to interview. Respondents to this initial survey were asked to nominate those they considered leaders, champions or entrepreneurs who have been successful in developing and implementing concrete climate change adaptation initiatives, including removing barriers to action. In making choices, respondents were asked to consider all governance levels, from international to community level, as well as non-government officials and those in the business community. In addition, certain other knowledgeable individuals involved in climate change activities in the Atlantic Region were contacted, based on recommendations of this e-mail survey. These individuals had a long-standing relationship with climate change adaptation, research, and community-based activities in the Atlantic Region. One such individual was the Executive Director of a Canadian university climate change centre. Another was a Canada Research Chair from the Atlantic Region who works in the area of indigenous health and climate change. These thirty-three (33) sources identified sixty-four (64) potential candidates. This process satisfied three of the requirements set out by Marshall (1996a) with respect to: role in the community, knowledge and access to information, and communicability.

Forty-six (46) leaders were contacted by e-mail and asked if they would participate in an interview. Of these, twenty-nine (29) responded and were interviewed as part of the project. More detail on specific interviewees is presented in section 4.2. The overall number of

interviewees provided an adequate level of coverage for the regional case study. For instance, in a previous case from Northern Hesse, Germany, three (3) climate adaptation officers in leadership positions were interviewed (Stiller and Meijerink, 2016). In research on adaptive capacity in Nova Scotia, a broad set of thirty-six (36) actors participated in interviews (Brown, 2015a). In another, 41 (forty-one) Canadian municipal employees participated in semi-structured interviews on a similar topic (Burch, 2010).

The positive response of key informants satisfied the factor of willingness to participate (Marshall, 1996a). Impartiality was more difficult to ascertain and left to the interview stage for further consideration. These key informants represented a broad range of the climate change adaptation practitioner community. They all worked in some key area of multi-level climate governance (Jagers and Stripple, 2003). They also reflected a diversity of organizational types from across the Atlantic Region of Canada. Organizational types included: academic, business, consulting, federal, First Nations, international, municipal, non-government organizations, and provincial. Key informants performed various roles, having some responsibility for navigating science, policy and local knowledge power spaces for action (Dengler, 2007). They were identified as leading in some way, across the continuum developed in section 2.5.1. More detail on the diversity of leaders interviewed is provided in section 4.2.2 and Appendix 3.

Interviews took place during two phases of field work. From May to June 2015, twenty-three (23) key informants were interviewed. Six (6) were subsequently interviewed between January and February, 2016. The interview protocol (Appendix 4) was administered and documented via either taped interviews (26 instances) or analytic memos (3 instances). The interview protocol was continuously validated through five revisions, after ongoing methodological reflection. The taped interviews were subsequently transcribed and coded. The

protocol was used to identify relevant climate change adaptation leadership findings in support

of the six research question previously discussed.

3.5.2 Document Review

The analysis of supplementary documentary evidence was important for understanding

policy processes. It provided a historical record of deliberations, actions taken, and in some

cases, evaluation of particular interventions. This evidence took a number of forms, including

meeting summaries, background reports, record of decisions, written notes, web site information

or presentation slides. In addition, documentary evidence acted as a boundary object and recall

device during the interview process itself. Specific examples of the first type from this

dissertation include documents such as the Halifax Regional Municipality Urban Forest Master

Plan (HRM, 2013), the Cape Breton Marconi Trail Climate Change Adaptation Plan (ACAP,

2015), federal program evaluations (Environment Canada, 2008), detailed Contribution

Agreement binders for specific adaptation projects (UPEI, 2016a; UPEI 2016b) and web site text

describing adaptation programs (ACASA, 2016). Examples of the second type are project

summaries for community-based economic costing of adaptation options (UPEI, 2015) and

internal documents used to promote provincial adaptation best practices (Nova Scotia, 2015).

This document review served a number of purposes. First, it substantiated specific

climate change adaptation entry points as described in the conceptual framing (section 2.7).

Second, it provided context for the specific embedded cases presented in section 3.3. Third, it

provided a means of triangulation for data collected during key informant interviews (section

3.4.1) in support of the conceptual framing. All documentary evidence reviewed that contributed

to overall research findings on climate change adaptation leadership formed part of the data

corpus and is cited in the References section of this dissertation, as appropriate.

3.5.3 Participant Observation

During the research, participant observation was used to further inform the assessment of climate change adaptation leadership styles and functions as described in section 2.5. In particular, it was method to observe how others view a leader's behaviour. From an analytical perspective, relevant parts of the coding structure on leadership in Appendix 5 provided the structure for note taking. Participant observation was a way to contextualize the exercise of leadership and "*delve into the complex expressions of human life in a non-quantifiable fashion*" (Bray, 2008: 305). This included observation and note-taking related to climate change adaptation leaders identified in section 3.4.1. Observations were captured via analytic memos after each instance and compared to the data corpus. Climate change adaptation leaders were accompanied to situations in which they were observed carrying out their assigned duties. For instance, one of the key informants (KI007, 2015) was accompanied to make a presentation at an annual meeting of the Cascumpec Bay Watershed Association Inc. (P001, 2015). The purpose was to demonstrate a climate change sea level rise visualization tool to potentially affected residents, landowners, farmers and fishermen. This allowed for observations to be made on how the science of climate change impacts and knowledge is shared with local community members. It was also useful to observe the exercise of leadership skills in practice. Another informant (KI001, 2015) was interviewed by a local radio station on current municipal adaptation legislation in Nova Scotia (P002, 2015). The audio recording provided important background on a provincial adaptation program and how leaders convey messaging to the general public about climate change adaptation in coastal areas. Two other informants (KI004, 2015; KI005, 2015) were observed in an on-line video describing the challenges and successes of their community wind energy project (P003, 2015). They were subsequently observed interacting with peers and

protégés at a conference, which assisted in triangulation of leadership concepts which arose out of their key informant interviews (P004, 2015). Five informants (KI007; KI010: KI021; KI023; KI026) were observed, in 2015, at a climate change conference in Charlottetown, Prince Edward Island. These leaders presented their climate change adaptation experiences at three different sessions of the conference (P005; P006; P007). The conference provided an opportunity to observe climate leaders in action and document how they shared their experiences with climate change adaptation on Prince Edward Island. Finally, in 2016, a facilitated meeting was held at the University of Prince Edward Island's Climate Lab to review leadership experiences with two leaders (KI028; KI029) from the University's Climate Lab and ACASA coordination team (P008). This provided insight into the challenges faced during the second and third phases of the RAC funding process and reflected on what lessons were learned going forward. Findings of relevance from participant observation are cited in Chapters 4 and 5, as appropriate, and included in the References.

3.5.4 Site Visits

During the course of the research, there was an opportunity to accompany key informants identified in section 3.4.1 to sites of particular interest in order to develop an understanding of the context of specific climate change adaptation entry points, as described in section 2.7.1. Field observations provided important background and context in understanding the types of adaptation decisions taken, the urgency for action, the need for multi-level governance responses, and context of the adaptive or technical leadership challenge faced. Three visits were made as part of research into three of the embedded cases identified in section 3.3. During the first site visit, a climate change adaptation leader (KI012, 2015) was accompanied to the Cousin's Shore area of northern Prince Edward Island (V001, 2015). This provided an

understanding of the adaptive challenges and institutional hurdles faced by the province in developing a comprehensive land use policy for Prince Edward Island. The second visit was made with a key informant (KI002, 2015) to review a proposed harbour redevelopment in the Town of Saint Andrews, New Brunswick (V002, 2015). This site visit highlighted the challenges inherent in conducting a coast infrastructure upgrade in light of increased incidence of extreme storm surges and sea level rise. The third was an unaccompanied visit to a location exhibiting shoreline erosion and social vulnerability at Victoria-by-the-Sea, Prince Edward Island where a maladaptive shoreline hardening climate response was observed (V003, 2015). This visit supported observations of the way that local communities can identify maladaptation responses and self-organize to address adaptive challenges of climate change. All three site visits were captured via analytic memo, appended to the data corpus and referenced, as appropriate in Chapter 4 and Chapter 5.

3.6 Data Analysis

Analysis of the data corpus was done via a two-cycle, manual coding process consistent with the view that coding is cyclical and benefits from a variety of different coding styles (Saldaña, 2013). Different coding styles allowed the data to be analyzed in different ways, yet supportive of the particular overall research objectives (Saldaña, 2013). In some cases, a third pass was made of selected portions of the data corpus to clarify results derived. The coding structure is detailed in Appendix 5. The first cycle involved a combination of Attribute, In Vivo and Snowball coding. This was done to classify adaptation entry points and key informants, based on a number of different attributes (Attribute), identify concepts or ideas not captured in the initial Codebook (In Vivo) and identify any potential additional interviewees (Snowball). A second cycle was then completed and involved Structural/Hybrid coding with a second In Vivo

examination. The purpose of this cycle was to analyze the interviews in much more detail, in accordance with the approved interview protocol (Structural/Hybrid), and to further capture additional ideas or concepts not identified in the first cycle (In Vivo). Definitions for each type of coding are described in Table 5.

Results of the interviews were entered into an Access 2010 relational database, with a structure that was specifically developed for the project. The database contained five tables with specific fields to capture, from the coding structure, all elements required to answer the research questions developed: adaptation project details (Question 1.1), key informant attributes (Question 1.2), leadership attributes observed (Questions 1.3, 1.4, 2.1 and 2.2), illustrative quotations from the data corpus (Questions 1.3, 1.4, 2.1 and 2.2), and additional potential participant/leaders for interview (Question 1.2). As mentioned previously, the selection of climate change adaptation leadership entry point was informant-led. Based on the interview results, relevant documentary sources, which supported the key informant interviews and substantiated the adaptation entry point, were appended to the data corpus as a content field and analyzed in the same manner as the interviews. These documentary sources were either suggested by the key informants or subsequently identified and located as part of the research process. A number of queries, along with accompanying reports were generated within the Access 2010 program to analyze and summarize the data corpus. This analysis was developed in order to investigate the research questions identified and suggest key basic and organizing themes for further analysis (Attride-Stirling, 2001). For instance, a query related to a profile of key informants interviewed was generated from the Key Informant Table as follows:

Table 5 – Key Informant Interview and Documentation Coding Process

Cycle	Coding Description	Definition
First	**Attribute** (adaptation entry point) (informant profile)	Basic descriptive information which provides essential participant data for future management and analysis (Saldaña, 2013)
	In Vivo 1 (general ideas and concepts)	Words or short phrases from a participant's own language used to prioritize and value the participant's own voice (Saldaña, 2013)
	Snowball (identify additional KIs)	Participants make recommendations on useful potential candidates for further study (Marshall, 1996b)
Second	**Structural/Process Hybrid** in accordance with Codebook (based on approved interview protocol)	Content-based segments or phrases which relate to specific research questions AND actions which have a specific time dimension (Saldaña, 2013; Saldaña, 2013, 77)
	In Vivo 2 (emerging ideas and concepts)	Words or short phrases from a participant's own language used to prioritize and value the participant's own voice (Saldaña, 2013)

SELECT [1KeyInformantT].Gender, [1KeyInformantT].CareerExp, [1KeyInformantT].Training, [1KeyInformantT].MLGExp, [1KeyInformantT].GeogFocus FROM 1KeyInformantT

A query related to whether climate change adaptation is more concerned with technical or

adaptive leadership challenges summarized data from the Leadership Table as follows:

SELECT LeadershipT.[TechBehav], LeadershipT.[AddtlConcepts], LeadershipT.[KeyInfID] FROM LeadershipT

Queries of the data corpus were subsequently developed as Access 2010 Reports and presented

in graphic format (see Chapters 4 and 5).

3.7 Challenges Faced

In conducting this study, six general challenges were faced. They were related to: how to

generate broader insights from specific contexts, how to make leadership concepts

understandable, how to elicit true and honest responses, interview fatigue, the compressed time for fieldwork, and avoiding confirmation bias. All were considered at the outset, and managed throughout the fieldwork and interviews, as described in the following paragraphs.

One of the key challenges of this research approach was how best to provide useful broader insights and inferences from different cultural and geographic contexts. The selection of relevant adaptation interventions (entry points) was informant-led. Participants were given the latitude to discuss any climate change adaptation initiative that they were familiar with. It was then up to the investigator to explore the specific cultural and geographic context and seek out other sources of evidence related to the adaptation initiative selected.

A second challenge was how best to translate the academic terminology and concepts of adaptation, leadership, and governance into understandable language for key informants. Care was taken in constructing the survey instrument to use plain language wherever possible. Further, based on interviewer experience, the interview protocol was subject to five revisions to clarify language, make more efficient use of interview time and eliminate redundant questions.

Thirdly, the ability to elicit true and honest responses when questioning the presence or absence of leadership was a challenge. This was especially true given that the interviews were longer than interviewees were accustomed to (1 – 1 ½ hours). In addition, a number of interviewees could be considered as elite informants (Yin, 2012). They had previous experience steering or influencing interview situations. They also dictated the timing of interviews. Vigilance and care was used in identifying and responding to these cues. The interview protocol was administered as strictly as possible. In some cases, the interviewees covered topics not related to the project. Careful note-taking was used to complement the digital script, including the developing informant profiles as soon after the interview as possible.

A fourth challenge was related to the idea of interview fatigue. A number of key informants had been involved in the broader ParCA or C-Change projects, as well as others, from the beginning and had participated in a number of research interventions already. Generally though, the topic of leadership was of personal interest to all key informants. Interview fatigue was not as great a challenge as expected. Most were more than willing to show their support for the project.

Fifth, a limitation identified at the outset was the compressed time for field work. It was felt it precluded the degree of relationship and trust building within communities and with key informants which a deeper ethnographic study would afford. This was overcome by relying on the opinions and suggestions of others who had been part of the broader ParCA or C-Change projects. These individuals were able to provide community contacts and potential interview nominees. Interviews were arranged at a time and location where the informant felt most comfortable. A second week of field work was added in February 2016.

Sixth, the avoidance of confirmation bias was always a consideration during the data coding and analysis process. This was addressed through strict adherence to the coding protocol. In addition, certain codes (e.g. those related to contextual intelligence) were revisited a second time to confimr that a specific data point met a certain criteria. In other instances, key informants were re-interviewed to confirm an understanding of previously recorded statements. Also, for certain adaptation entry points, multiple interviewees were queried on the same situation to validate the coding decisions made. In this way, confirmation bias was explicitly considered.

In summary, the research methodology and methods described in this chapter were used to examine a regional case study, using embedded cases. The conceptual framework of climate

change adaptation leadership developed in Chapter 2 was used to interrogate the two objectives

and six research questions presented in Chapter 1. Chapters 4 and 5 present the research

findings.

CHAPTER 4 – ADAPTATION LEADERSHIP PROCESSES

It's about behavioural change.
Changing process.
Changing approaches.
Changing values.
Deciding - because that vision might be a value change.
(KI023, 2015)

4.1 General

Findings for objective 1 are presented in this Chapter and are organized around questions related to processes of the exercise of climate change adaptation leadership in the Atlantic Region of Canada. Figure 5 summarizes the linkages between research questions 1.1 – 1.4. Sections in this Chapter examine: the climate change adaptation entry points or adaptation objectives used to frame visioning, sense making and social influence (Kløcker Larsen et al., 2011); a profile of climate change adaptation leaders surveryed; the technical and behavioural competencies (Steen et al., 2009) used to lead adaptation initiatives; the constraints or barriers that leaders were faced with and had to successfully overcome (Moser and Ekstrom, 2010); the ways in which leaders used both formal and informal authority - power for climate change adaptation (Nye, 2010), and finally, the contribution of this exercise of this power, as demonstrated through adaptation innovation.

Findings related to objective 2 are presented in Chapter 5 and address observations related to both climate change adaptation leadership style and those functions performed by individuals in climate change adaptation leadership positions. In addition, observations on climate change adaptation leadership fluidity over time are addressed. These research questions are informed by the previously examined points of view that leadership is a continuum

(Mintzberg, 2013), from section 2.5.1, and also a way to navigate complexity (Uhl Bien et al., 2007; Meijerink and Stiller, 2013; Stiller and Meijerink, 2016), from section 2.5.2.

Figure 5 - Research Questions Addressed in Chapter 4
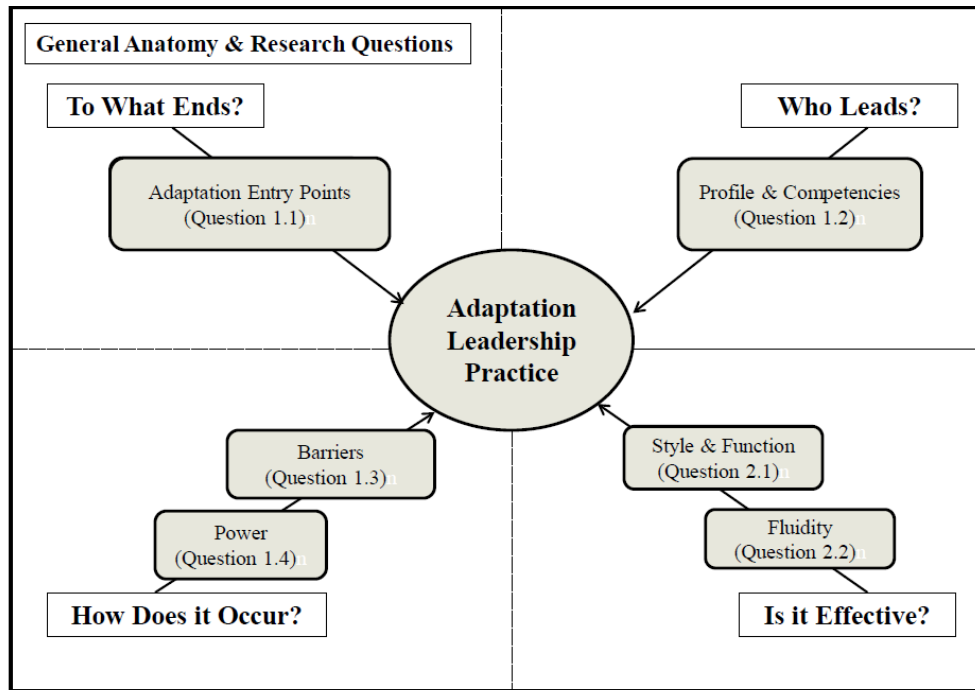
4.2 Climate Change Adaptation Leadership Processes

Research objective 1 was designed to reveal climate change adaptation processes through the lens of leadership and how leadership influences the process of adaptation from planning to implementation and evaluation. Through the research methods presented in Chapter 3, data were collected on specific adaptation entry points used by those in leadership positions. Research also examined leadership competencies that are important for addressing adaptive and technical challenges, including barriers that climate change adaptation leaders had to overcome. Finally, the research used the perspective of power to investigate how the dynamics of authority and influence were navigated in the search for successful outcomes in complex adaptation decision

environments. This research is relevant in that it addresses gaps in the current literature related to the practice of climate change adaptation leadership.

4.2.1 Adaptation Entry Points

The interview protocol was designed and developed to allow key informants the flexibility to reflect on specific climate change adaptation leadership interventions of personal relevance, and are thus not mutually exclusive. Table 6 summarizes the twenty-two (22) climate change adaptation leadership initiatives identified by key informants. A detailed list is contained in Appendix 6. The purpose of adaptation initiatives selected by key informants include all of the seven general types identified above and in Chapter 2.

Table 6 – Summary of Climate Change Adaptation Leadership Entry Points Referred to by Key Informants (N = 22 entry points; N = 29 key informants)

Climate Change Adaptation Entry Points	Frequency
Adaptation Planning	4
Adaptive Capacity	2
Resilience	1
Vulnerability Reduction	1
Maladaptation Avoidance	1
Mainstreaming	8
Sustainability	3
Climate Risk Management and Disaster Risk Reduction	2

The most frequently used climate change adaptation entry point related to the strategy of mainstreaming. This was observed in diverse contexts, such as as in supporting the City of Charlottetown's regulatory activities, e.g. waterfront development review (City of Charlottetown, 2012) and the work of the Prince Edward Island watershed protection planning process (PEIWA, 2016). The Atlantic Canada Adaptation Solutions Association (ACASA) served as a leadership catalyst for contexts that crossed entry points, such as adaptation planning, in the case of its overall progamming (ACASA, 2016), the development of adaptive capacity, in

the case of its decision support tool project (UPEI, 2016a), and maladaptation avoidance through

its large economic study project (UPEI, 2016b). Nova Scotia's Adaptation Work Plan had a

specific mandate for the development of climate change adaptation leadership (Nova Scotia,

2015). Adaptation entry points related to sustainability, e.g. the City of Charlottetown's ICSP

(City of Charlottetown, 2010) and the CCWFI (Vass, 2013), were also identified as useful

opportunities for observation of leadership.

      In order to provide added insights on the adaptation entry points summarized in Table 6,

there was an opportunity to use the embedded cases identified in section 3.3 and Figure 4 to

explore the adaptation entry points in more detail. For the purpose of this dissertation a

condensed list of seven (7) initiatives were identified as embedded case studies within the

Atlantic Region of Canada (see Figure 4). Table 7 presents this condensed list. Embedded case

studies were chosen for closer examination if they possessed a number of attributes. These

attributes included: the level of detail provided by informants, i.e. did they allow for full

examination of questions developed with the conceptual framework; the availability of multiple

leader perspectives on adaptation entry points, i.e. can multiple perspectives on the same

embedded cases be derived; and the quality of documentary or other evidence for coding

purposes in order to corroborate climate change adaptation leader opinions and perspectives,

including government reports, documents and related peer reviewed sources. In addition to these

common attributes, a choice was made to include embedded cases so as to reflect a cross-section

of different multi-level governance settings and leadership types as identified by key informants.

      In relation to the Atlantic Region of Canada, answers to the general anatomy conceptual

framing question "*To what end is leadership focused?*" (see Figure 5, upper left quadrant) were

very much dependent on the adaptation entry point chosen in a specific context. For instance,

the Marconi Trail Climate Change Adaptation Plan study (ACAP, 2015) was a result of a

broader Cape Breton Regional Municipality Climate Action Plan (CBRM, 2014), which itself

Table 7 – Embedded Case Studies Based on Climate Change Adaptation Leadership Entry Points

Entry Point	Examples	Multi-Level Governance Type	Leadership (Individual Organizational Team)	Brief Description
Adaptation Planning	Cape Breton RM Marconi Trail Climate Change Adaptation Plan	Municipal/ NGO	All Three	Project to identify climate change adaptation options in support of the Cape Breton Regional Municipality (RM) Climate Change Adaptation Plan, conducted by the regional hub of the Ecology Action Centre (ACAP, 2015; CBRM, 2014)
Adaptive Capacity	Atlantic Climate Adaptation Solutions Association (ACASA)	Multi-Level	Innovation Network	Federally-funded Canadian project to collaboratively develop climate change adaptation solutions in the Atlantic Region of Canada (ACASA, 2016; NRCan, 2016)
Resilience	Halifax RM Urban Forest Master Plan	Municipal Academia	Shared Leadership	Multi-year plan developed between the Halifax RM and Dalhousie University to incorporate neighbourhood-level analysis and implementation plan for the urban forest (HRM, 2013; Steenberg et al., 2013)
Sustainability/ Mainstreaming	Colchester-Cumberland Wind Field Inc.	Business	Shared Leadership	For-profit community wind energy enterprise in Tatamagouche, Nova Scotia (Vass, 2013)
	City of Charlottetown Integrated Community Sustainability Plan (ICSP)	Municipal	All Three	Plan developed by the City of Charlottetown to integrate sustainability principles within its existing Official Plan to guide decision making and development (City of Charlottetown, 2010)
	PEI Task Force on Land Use Planning (TFLUP)	Provincial	Organizational Team	Provincial, quasi-judicial inquiry to examine land use practices on PEI and guide future strategic statements of provincial interest (TFLUP, 2009)
Climate Risk Management and Disaster Risk Reduction	Town of Saint Andrews Integrated Planning	Municipal	Individual	Initiative to incorporate future climate change considerations into water and emergency plans using a risk-based approach (St. Louis & Killorn, 2014)

was mandated by the Province of Nova Scotia under its Municipal Climate Change Adaptation Plan legislation (Nova Scotia, 2011). The multi-level, multi-partner adaptation approach of the ACASA was a forum for an integrated innovation network of climate change adaptation leaders to enhance adaptive capacity (NRCan, 2016; ACASA, 2016). Halifax Regional Municipality used its Urban Forest Master Plan to build "*resilience to climate change into the future urban forest*" (HRM, 2013: 37). In addition, mainstreaming of climate change adaptation within other strategic initiatives, such as in the case of Prince Edward Island's Task for on Land Use Planning (TFLUP, 2009) was the lever to play a leadership role. Also, broader sustainability/mainstreaming activities, such as the community wind energy project initiated by CCWFI (Vass, 2013) and the City of Charlottetown's ICSP served as platforms for the exercise of leadership (City of Charlottetown, 2010). Climate risk management and disaster risk reduction was exemplified in the integrated planning approach of the Town of Saint Andrews, New Brunswick (St. Louis and Killorn, 2014).

In addition, the various climate change adaptation entry points used as embedded cases for the broader regional study for the Atlantic Region of Canada reflected various approaches to the type of leadership applied to climate change adaptation, described in sections 2.5 – 2.7. The embedded cases in Table 6 reflect a continuum of these leadership types that influenced why a particular adaptation entry point was chosen. In the case of individual leadership, as represented by the Town of Saint Andrews, the challenge of seeing climate change as an important problem to be addressed was stated as: "*The understanding of climate change was academically interesting to me. But there was also an opportunity to teach it in a way that – when you reach a certain age, you're able to see connections…*" (KI002, 2015). For the CCWFI, co-leadership was used to move forward with a sense of urgency: "*we can push it together. Or one is more*

skilled and can push there - and leaves it free over here [gestures with hands]. *Time is of the*

essence. It's easy to waste your time" (KI004, 2015). In the case of the Prince Edward Island

TFLUP, organizational leadership was used to provide an arms-length assessment of a multi-

level planning and development challenge. "*It* [the Task Force] *had freedom to navigate ... to*

start a conversation on a wider level. At a broader level. And the idea was to capture that

broader scope" (KI023, 2015). In the case of the Cape Breton Marconi Trail exercise,

individual, organization and team leadership were important. "*You can't really miss one of those*

three and have success, at least in our scale that we were looking at" (KI006, 2015). Innovation

networks were included as a specific type of embedded case because of their usefulness in

exploring leadership in network governance and collaborative leadership. The ACASA was

specifically designed to perform the function of moving from research to action through

collaboration and best sharing best practices (KI032, 2016). More detail on these various

leadership perspectives are provided in sections 4.2.2 and 5.2. For this section though, it can be

noted that regardless of the climate change adaptation entry point selected, the application of

leadership concepts, ideas and principles were necessary in order to operationalize and sustain

adaptation initiatives.

4.2.2 *Climate Change Adaptation Leader Profiles*

In developing the conceptual framework for this study, it was recognized that climate

change adaptation leadership, while primarily individual actor/agent-based, also includes aspects

of group, team, and organization leadership concepts. As well, climate change adaptation

leadership involves an element of complexity. Table 8 summarizes the overall level of

individual experience as reported by the twenty-nine (29) key informants. Attribute coding

revealed that key informants can be placed in a number of stages of leadership development,

depending on number of years of career experience. These categories were: early (0 – 10 years of experience), middle (11 – 20 years), and late (21 – 30 years), based on Morrow and McElroy (1987). A fourth category, late/post, was added later in the coding to capture four informants who had already finished a full career and were currently embarking on some form of further leadership work at the time of the interviews.

Table 8 – Profile of Informant/Leaders (N=29)

Stage	Women	Men
Early	7	1
Middle	2	5
Late	4	6
Late/Post	1	3
TOTAL	14	15

Early career leadership could occur in parallel with ongoing academic studies. As one informant described it, "*I started with the City when I was still doing my Masters and my thesis research was on climate change adaptation and coastal studies - sea level rise ... I was the contact between the researchers and the municipal government at the planning office as well as the councillors*" (KI021, 2015). At this stage there were opportunities for learning important technical skills. "*I was hired as an intern to complete and facilitate community workshops, to conduct mapping exercises with community members*" (KI006, 2015). Also, by participating as part of a team in climate change adaptation, coordinating positions provided valuable experience. One early career leader learned the value of this – "*I am the glue that holds the whole thing together*" (KI001, 2015).

Climate change adaptation leaders in mid-career were often part of team-based and collaborative relationships. They began to see the interconnectedness of individuals and programs. This perspective was reflected by the following statement: "*We are enablers and*

sharers of information. And we work across government to look at how various departments are meeting government's goals and objectives around climate change, both on the mitigation side as well as on the adaptation side" (KI009, 2015). They could often draw on previous experience to assume leadership roles in adaptation. One interviewee described this varied experience in the following way: "*I have a background in community planning, environmental planning and coastal zone management with a particular focus on coastal adaptation. I'm in the right neck of the woods for that* [working in provincial climate change unit]" (KI014, 2015).

Late career climate change adaptation leaders were often called on to lead complex, integrated climate change impact and adaptation assessment and provided a key focus for decision-making. One leader described their project in this way: "*we targeted more the practitioners, people who are actually on the ground working because we wanted to introduce new ideas to them but also use their local knowledge to help inform what we are doing*" (KI037, 2015). Late career practitioners often developed, through experience, a way of making sense of complex problems. "*I'm a fan of bringing good technical information onto a table and after helping people understand what it means, allowing them to wrestle over the preferences around outcomes*" (KI016, 2015). In addition, there was the perspective of a legacy responsibility with respect to applying an climate change adaptation leadership role – "*at the end of the day when I'm gone, at least I have left something that the community has that it can, you know, that they can turn to in case, you know, in whatever different situation and scenarios*" (KI010, 2015).

Those in the late/post stage of climate change adaptation leadership were in a unique position where perspective provides an opportunity for contribution. They saw their position as more than fulfilling a specific role. As one put it, "*The understanding of climate change was academically interesting to me. But it was also an opportunity to be able to teach it in a way that*

- when you reach a certain age, you are able to see connections and have an ability to bring observations" (KI002, 2015). They also identified shortcomings in previous attempts to facilitate intergenerational knowledge transfer through mentoring. For example, as one leader put it, "*There have been too many gaps in the continuum of staff – you know, the hiring spurts which leave huge gaps in between – of years when you have no new blood coming in that can take advantage of the mentorship of the older people*" (KI018, 2015).

In general, the ratio of women to men was highest for leaders in the early stage of their career. From the perspective of multi-level governance experience, all but three of the informant/leaders (KI022, KI031 and KI032) possessed experience at multiple levels and in multiple roles, either in government, non-government organization, business, consulting, or academic. Appendix 7 is an array of this multi-level governance experience of each informant. Experience in different multi-level situations was an attribute that could help climate change adaptation leaders develop contextual intelligence and navigate multiple adaptive challenges and demands. It may also be significant in crafting implementation strategies that allow for moving forward with collaborative climate responses.

The embedded cases, as shown in Table 7, also demonstrated diversity with respect to leader profiles and their various interactions. This diversity is presented in the following paragraphs.

Cape Breton RM Marconi Trail Climate Change Adaptation Plan: The informant in this case, KI006, was an early career leader. KI006 worked for a regional NGO as a project coordinator. Their role was to facilitate the development of the climate change adaptation plan under contract to the regional municipality. Prior to this, they had also gained experience at the provincial and municipal government levels. Leader KI006 characterized the leadership

challenge as one of bridging policy and local knowledge in an integrative way, through working with strong local community champions (KI006, 2015).

Atlantic Canada Adaptation Solutions Association (ACASA): This case was informed by a group of eleven (11) leaders, who spanned a number of experience categories. These leaders played a variety of roles in supporting the development of a collaborative knowledge-to-action adaptation initiative. They were also the key link or conduit from their home organizations to ACASA. KI007 was a late career leader who served as director of a university research unit. Their experience, in addition to academia, had involved international, national and provincial levels, as well as the consulting sector. In addition to their formal leadership responsibilities as director, they also acknowledged that more distributed forms of leadership were sometimes necessary to manage the operational requirements of ACASA (KI007, 2015). KI009 was a middle career leader who was manager of a provincial government environment department. Federal, provincial and municipal level experience rounded out their expertise, as did work in the academic sector. From their perspective, the importance of ACASA was the ability, through networking and relationship building, to adapt best practices from other jurisdictions to their specific challenges (KI009, 2015). KI011 was a middle career leader who worked for the provincial government as a public safety manager. In addition to provincial level experience, they had also worked in the academic and consulting sectors. In terms of ACASA, KI011 stressed the incremental nature of the various projects funded and the fact that it provided foundations for future adaptation action (KI011, 2015). KI014 was a middle career leader who, in his role as a senior policy advisor, advised on development of provincial adaptation legislation. Their experience was in federal, provincial and municipal governance. They saw their leadership role as collaborating in ACASA to build over provincial adaptive capacity; part

of this was through acting as a conduit to local communities on adaptation projects (KI014, 2015). KI017 was a middle career leader and private consultant at both the provincial and municipal levels. They had additional experience in an academic setting. For KI017, leadership was specifically focused on building community adaptive capacity and evaluating progress on climate change adaptation (KI017, 2015). KI026 was a middle career leader and manager of a provincial environmental unit. Their experience was at the federal, provincial and municipal governance levels. For KI026, ACASA was a key driver for making changes to provincial climate change legislation. They were also keenly aware of the need, in their leadership position, to identify and engage local community champions for climate action (KI026, 2015). KI027 was a late career leadership professional, who worked for the Canadian federal government on climate change adaptation. Their experience spanned the federal and provincial governance levels in the area of legal and policy development, as well as in the academic, NGO and business sectors. For KI027, leadership meant enabling the ACASA network by developing procedural mechanisms and opportunities for collaboration between different actors interested in adaptation. KI028 was a late/post career leader who worked as a program manager for a university research unit. They had gained experience in federal and provincial multi-level governance settings, as well as in the academic sector. For KI028, leadership revolved around developing the collaborative network, ensuring adaptation tools were transferable between ACASA members and making sure the science behind adaptation decision making was sound (KI028, 2016). KI029 was an early career leader who worked as a project manager for ACASA. Their experience was in a federal and provincial government setting, with recent experience in academia. Leadership, in their role, was focused on providing network accountability, coordination and evaluation (KI029, 2016). KI032 was a late career leader program manager for

the Canadian government, responsible for national climate change adaptation programs. Their governance experience was at the federal level. For KI032, their leadership role in ACASA was through providing seed funding, sharing of resources to leverage action, and developing venues for ongoing collaboration among members (KI032, 2016).

Halifax RM Urban Forest Master Plan: The informant in this case, KI016, was a late career leader. KI016 was a professor at a local university, who, in addition to academic experience, had worked at the international, federal, provincial, municipal levels, as well as in the consulting sector. In this case, they provided leadership in research and technical support to a long-term municipal planning initiative. The lng term success of this planning process was credited to a strong co-leadership relationship with a specific local senior planner, which was built on the development of mutual trust (KI016, 2015). The opportunity to mentor less experienced team members in real-world problem solving was another important aspect of this embedded case.

Colchester-Cumberland Wind Field Inc. (CCWFI): This case involved two leaders, KI004 and KI005. KI004 was a late/post career leader with a background in business, finance and public administration. KI004 had also gained multi-level governance experience at the federal, provincial and municipal levels. KI005 was a late career leader, with a background in engineering and business development. KI005 had similar experience as KI004, at the federal, provincial and municipal levels. Both leaders were co-principals of a community wind energy development company. Since the corporation was one of the first of its kind in Nova Scotia, these leaders had to create a unique business model through learning by experience, persistence, and an appetite for risk (KI004/KI005, 2015). As a result of their success, these informants were well respected as industry leaders and role models (P004, 2015)

City of Charlottetown Integrated Community Sustainability Plan (ICSP): In this case there were two leaders interviewed, KI022 and KI031. KI022 was an early career leader who worked as a municipal sustainability officer. This formed the basis of their multi-level experience. They credit their success in part because of their ability to identify, engage and support departmental champions in following through on sustainability initiatives (KI022, 2015). KI022 had been recognized by peers for youth leadership (21Inc., 2016). KI031 was a late career leader with similar governance experience at the municipal level. Their position was that of a departmental manager seconded to the ICSP project. Recent training and experience in project management was identified as a transferable skill for leading the initial phases of the ICSP process.

PEI Task Force on Land Use Planning (TFLUP): The informant in this case, KI023, was a middle career leader. KI023's background was as a land use planner in the provinces of PEI and Ontario. They served as the secretariat coordinator for the task force whose mandate was the creation of province-wide development and land use guidelines. Their multi-level governance experience was at the provincial and municipal level as well as in the private consulting sector. KI023 credited their leadership success to: strong collaboration (as opposed to more traditional consultation), transparency in data sharing, reframing conversations in a non-confrontational manner, and peer mentoring (KI023, 2015).

Town of Saint Andrews Integrated Planning: In this case, KI002 was a late/post leader who was the elected mayor of a town in New Brunswick. Their experience was at the international, provincial and municipal levels. As the senior political leader in the town, they were responsible for all matters related to the administration and governance of the municipality, including areas of safety and security, emergency response, environmental issues, planning, and

development. Climate change considerations had been integrated across various municipal functions and responsibilities. KI002 stressed that leadership not only flows from formal authority as mayor, but also through informal networking and development of partnerships, both within and outside of the community (KI002, 2015). KI002 had been internationally recognized for leadership in community climate change adaptation (BoFEP, 2016b).

4.2.3 Competencies

In presenting the next two tables it should be noted that the conceptual framing and interview protocol were developed to identify climate change adaptation leadership competencies.

Key informants identified a number of specific technically-based tools they used in scoping the challenges of climate change adaptation and identifying appropriate solutions. The interview protocol was used to summarize tools through a ranked inventory of specific adaptation practices. Table 9 is a ranking of the tools identified. A complete list of the unfiltered, one hundred and forty-four (144) specific tools is contained in Appendix 9. Table 9 synthesizes results as analyzed via the coding process described in section 3.6 and elaborated in Appendix 5.

The top six (6) technical tools, mentioned ten (10) times or more by informants were collaboration techniques, data visualization/technology applications, stakeholder engagement techniques, project management, policy/legislation processes, and hazard/risk management. In those tools mentioned less frequently, there were some novel approaches climate leaders used, including citizen science to aid in assessment, and near real-time monitoring of climate impacts, social marketing, and climate analytics to make effective use of climate data collected. For example citizen science (KI024, 2015) and social marketing (KI012, 2015) concepts were both

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used by the Prince Edward Island Watershed Protection Plan network to monitor stream quality, infrastructure condition and elicit landowner buy-in to sustainable land-use practices across the province. The use of climate analytics and indicators, i.e. creating long-term usable climate data for decision-making, was incorporated into the long term mandate of the Bay of Fundy Environmental Partnership (BoFEP)'s St. Croix Estuary Monitoring Project (KI018, 2015).

Table 9 – Adaptation Leadership Technical Tools Identified (N = 144)

Tools Identified	Frequency
Collaboration techniques (Formal/Informal)	25
Data Visualization, GIS, LIDAR, GPS Applications	18
Stakeholder Engagement Techniques	16
Project Management	13
Policy, Legislation, Regulatory Processes	12
Risk Management, Hazard & Vulnerability Assessment	11
Adaptation & Resilience Techniques	7
Climate Science & Applications	6
Environmental Monitoring & Restoration	6
External Sources of Information	6
Basic Research Methods	5
Sustainability Techniques	4
Citizen Science	3
Climate Analytics including Indicators	3
Communication & Social Marketing	3
Business Planning, Asset Management	2
Consulting Processes	2
Mainstreaming	2
TOTAL	144

The highest-ranked technique overall related to both formal and informal collaboration. Examples of formal collaboration included such commonly accepted techniques as maximizing effectiveness of meetings, conferences and conference calls. This was highlighted by leaders in the ACASA project (KI026, 2015; KI028, 2016; KI029, 2016). Examples of informal collaboration included relationship building and informal networking. For instance, this was

identified as important as part of the implementation phase of the City of Charlottetown's ICSP (KI022, 2015). One of the informant/leaders stressed that perspectives on collaboration were different in academia vs. government settings, with on-the-ground collaboration requiring more skill and expertise for leading concerted local adaptation action (KI027, 2016).

In addition, other novel topics, such as citizen science, social marketing and the consulting process were identified as important for climate change adaptation leaders. The first two spoke to the need for leadership in creatively addressing the adaptive challenge of climate change (O'Brien and Selboe, 2015a). The last example related to skills in overcoming climate change's technical challenges. One informant leader expressed it this way, *"I don't do any projects now without making sure I can hire a good manager that can manage the overall project"* (KI010, 2015).

In answering the general anatomy conceptual framework question "*How does climate change adaptation leadership occur?*" (Figure 5), informant/leaders also identified more experiential or behaviour-based competencies that were important for climate change adaptation leadership success. Table 10 is compilation of these results, with a complete list of the one hundred and nine (109) instances provided in Appendix 9. The table synthesizes results as analyzed via the coding process described in section 3.6 and elaborated in Appendix 5.

The most commonly cited climate change adaptation leadership competencies were related to bridging for results, collaboration, and communication. Bridging involved a primary focus on practical results, evidence-based decision making, the integration of science, local and policy knowledge, as well as the ability to navigate different levels both within and between

Table 10 - Adaptation Leadership Behavioural Competencies Identified (N = 109)

Competency	Frequency
Bridging for Results	13
Collaboration	11
Communication (up and out, public awareness)	9
Facilitation	8
Networking/Relationships	8
Negotiation (Balancing Interests)	7
Contextual Intelligence	6
Trust-Building (Credibility, Transparency)	6
Consultation (Engagement)	5
Consultant Mindset (Multi-tasking)	4
Dialogue-Deliberation (Puzzling)	4
Multidisciplinary Perspective	4
Perseverance (Persistence, Determination)	4
Sharing Stories	4
Creativity (Ingenuity, Innovation)	3
Mediation	3
Self-Education (Reflection, Learn by Experience)	3
Accountability (Reporting)	2
Strategic Thinking	2
Analytic Ability	1
Passion (Ambition, Drive)	1
Risk-Taking	1
TOTAL	109

organizations. Informants described this concept using the following terms: "*bridge scientist*" (KI016, 2015) in the case of the City of Halifax RM Urban Forest Master Plan, "*connector/conduit*" (KI014, 2015) when discussing the ACASA, "*community organizing*" (KI001, 2015) for the work of a non-government organization working on local shoreline adaptation projects and "*community development*" (K010, 2015) for vulnerability assessments and First Nations. Bridging for results was observed during observation of one participant (KI007, 2015) on Prince Edward Island (P001, 2015) where a climate change visualization tool was used to generate discussion of challenges faced by a local watershed association. This competency was also closely connected to the idea of networking/relationships, which was also

ranked highly. Networking/relationships was stressed not only during key informant interviews but also during panel discussion at a conference on climate change (P005, 2015). Collaboration was used by leaders to identify not only the need to work together in a spirit of cooperation (KI027, 2016) but also navigate the difficult challenges of sustained action through this process of working together. As one informant put it, "*the highest level of community collaboration is where the group agrees on a common vision and then agrees to rules that bind the group decisions*" (KI023, 2015).

It was also observed that collaboration as perceived by the academic community was much different than in the policy/local knowledge area, which was much more complex. One leader working in the policy action space put it this way:

> *"Collaboration in the academic setting is very different from collaboration in the industry setting or the government setting in that collaboration is done as a - when you are in industry or a government setting, you are doing something with the aim of getting something done – it's a dynamic. You don't mind putting yourself out there because the file has to move so you can advance a thought, you can advance a theory, you can risk and create something like the* [Adaptation] *Platform – see how it works, change it as you go … Collaboration in the Academy is a different thing. As academics, you and I would sit here and talk, we would talk and we would go away and write up our stuff and then you might get a line in a paper and you would have thought that as collaborating"* (KI027, 2016).

Collaboration in the expanded sense of this climate leader was related to the competency of negotiation and balancing of different interests in reaching decisions "… *because they all own a part of it*" (KI027, 2016). The ability to lead through facilitation was also a part of this. In Nova

Scotia's Adaptation Work Plan, facilitation was described this way: *"It's been kind of a courtship process"* (KI025, 2016). Communication as it relates to both internal and external/public awareness was also seen as important. The same leader expressed the view that *"we have to talk about this stuff in language that resonates with our departments and others"* (KI025, 2015).

As with technical tools, there were a number of unique and creative behavioural competencies cited. For instance, sharing stories was seen as an important climate change adaptation leadership competency. This was demonstrated by one participant (KI007, 2015) during a walking tour of vulnerable shorelines in Prince Edward Island (P007, 2015) and also by another participant (KI010, 2015) during a climate change conference on Prince Edward Island (P006, 2015).

In delving further into the interrelationship between competencies, the tables were further cross-tabulated via the coding structure in Appendix 5. This filtering process is presented in Table 11 which adds the codes related to climate change adaptation leadership tasks. These tasks were framed as cognitive, structural, processual (process-oriented), and networking. Most of the technical competencies identified fell within the cognitive task category. These include skill areas typical of the climate change field, e.g. data visualization, risk management and vulnerability assessment, mentioned earlier in this section. However, most of the behavioural competencies were within the process-oriented task category. One skill thread, collaboration, occurred in technical-structural (formal collaboration), technical-processual (informal collaboration), and behavioural-processual. Relatively underrepresented in this this assessment were structural leadership tasks and tasks related to networking leadership.

For further insight, when the embedded cases were examined, all four collaborative technical leadership competencies were reflected in ACASA, the Halifax RM Urban Forest Master Plan, CCWFI and the Town of Saint Andrews integrated planning approach. In the case of the City of Charlottetown ICSP, technical-structural, technical-processual and technical-networking were present. Technical-cognitive and technical-networking were observed in the PEI TFLUP. Technical-cognitive and technical-structural skills were used in the Cape Breton RM Marconi Trail Plan.

When the embedded cases were viewed from a behavioural perspective, behavioural-cognitive and behavioural-networking leadership competencies were used in the Cape Breton RM Marconi Trail Plan. All four behavioural types were observed in the ACASA, LUTF and Town of Saint Andrews cases. Behavioural-structural and behavioural process competencies formed part of the Halifax RM Urban Forest Master Plan. Behavioural-processual was cited in the CCWFI and City of Charlotteown cases.

4.2.4 Leadership Barriers

One way to identify what constitutes effective climate change adaptation leadership is through examining the barriers to adaptation that leaders had experienced and how they overcame them. Specific questions related to leadership barriers are presented in Appendix 10. Figure 6 presents a summary of the relative distribution of one hundred and fifteen (115) recorded instances of barriers (understanding, planning/decision making and managing), as presented in the typology of Moser and Ekstrom (2010). Along with the graph are specific recorded instances in each of the three areas (Figure 6). The specific barriers identified are listed in Appendix 11.

Table 11 – Cross-tabulation of Technical and Behavioural Competencies with General Collaboration Tasks (after Gray, 2008)

Tasks	Technical	Behavioural
Cognitive manage meaning through visioning and framing	• Data Visualization, GIS, LIDAR, GPS Applications (18) • Policy, Legislation, Regulatory Processes (12) • Risk Management, Hazard & Vulnerability Assessment (11) • Adaptation & Resilience Techniques (7) • Climate Science & Applications (6) • Environmental Monitoring & Restoration (6) • Basic Research Methods (5) • Sustainability Techniques (4) • Citizen Science (3) • Climate Analytics including Indicators (3) • Mainstreaming (2)	• Dialogue-Deliberation (Puzzling) (4) • Sharing Stories (4) • Creativity (Ingenuity, Innovation) (3) • Strategic Thinking (2) • Analytic Ability (1)
Structural meet the need for coordination and information exchange via social networks	• Collaboration techniques (formal) (16) • External Sources of Information (6)	• Communication (9) • Multidisciplinary Perspective (4)
Processual (Process-oreinted) ensure that the interactions among team members are constructive and productive	• Project Management (13) • Collaboration techniques (informal) (9) • Business Planning. Asset Management (2)	• Bridging for Results (13) • Collaboration (11) • Facilitation (8) • Networking/Relationships (8) • Negotiation (Balancing Interests) (7) • Contextual Intelligence (6) • Trust-Building (Credibility, Transparency) (6) • Consultant Mindset (Multi-tasking) (4) • Perseverance (Persistence, Determination) • Mediation (3) • Self-Education (Reflection, Learning by Experience) (3) • Accountability (Reporting) (2) • Passion (Ambition, Drive) (1) • Risk-Taking (1)
Networking broker and boundary span between actors	• Stakeholder Engagement (16) • Communication & Social Marketing • Consulting Processes	• Consultation (Engagement) (5)

Figure 6 – Leadership Barriers to Adaptation (N = 115)
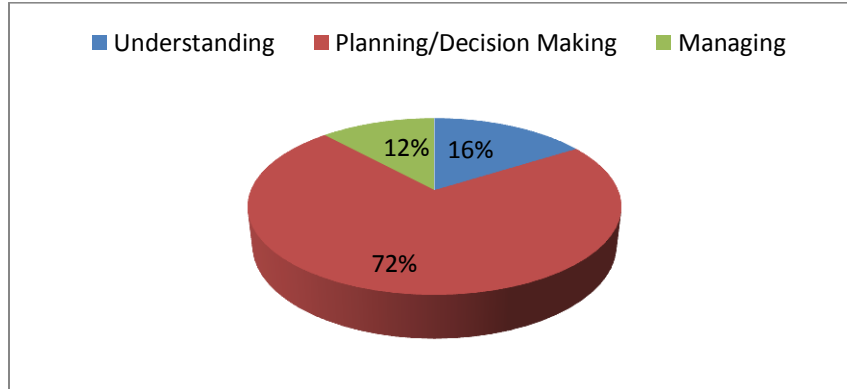
The most frequently cited barriers related to the area of planning and decision making. This included demands on small municipalities with limited tax base in the case of local adaptation on Prince Edward Island (KI024, 2015), shifting the conversation away from related issues such as greenspace and public access to include climate change adaptation, in the case of the City of Charlottetown's waterfront development plan (KI021, 2015) and the coordination of multi-agency adaptation activities, such as in the case of ACASA (KI028, 2016; KI029, 2016). As one leader described the early stage of ACASA, *"... it was multi-headed, if you will. I guess with the four different provinces involved and NRCan – I remember at a meeting one time in Halifax, I think where it was like a lot of folks were together and, you know, they said it was akin to herding cats"* (KI011, 2015). Ten (10) of the twenty-nine (29) leaders interviewed were navigating a new adaptive challenge, which involved working and making decisions collaboratively, e.g. leaders involved in ACASA projects. One ACASA leader described their challenges this way, *"We spent probably seven or eight years involved in the ACASA projects. And whiz academics and others produced really great research which did not actually lead to as many people as hoped taking up the mantle of climate change adaptation completely"* (KI025, 2015). The fact that planning and decision making were the most frequently cited barrier classes

was not surprising as some of the ACASA leaders interviewed mentioned that they were still in the early to middle stages of selecting and developing adaptation options (KI009, 2015; KI014, 2015; KI015, 2015). Figure 7 provides a summary of these planning and decision making barriers.

Specific barriers cited include institutional challenges. As applied in this analysis (see Appendix 10), institutional leadership barriers encompass a wide range of activities. Moser and Ekstrom (2010) frame the question as: *"How do institutional mission, policy agendas, historical legacies, procedural rules, social and professional norms, or even customarily consulted information sources shape the assessment?"* (Moser and Ekstrom, 2010: Supplementary Table). Institutional barriers to climate change adaptation involved having to deal with shifting priorities, such as moving forward with Nova Scotia's Adaptation Work Plan (KI025, 2015), re- engaging

Figure 7 – Planning and Decision Making Leadership Barriers (N = 83)
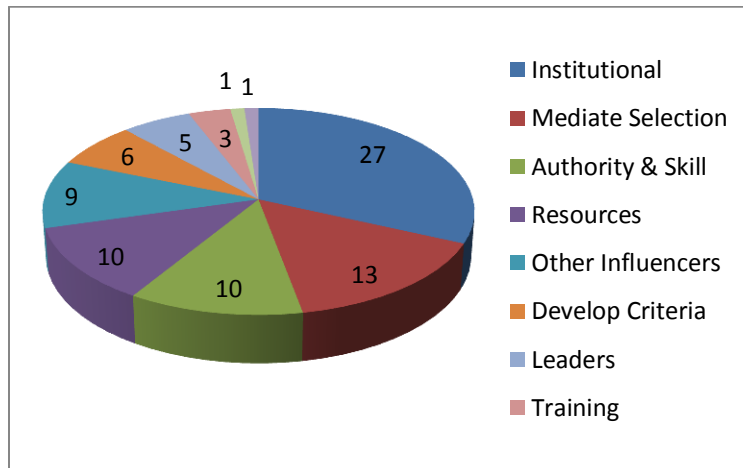
partners after policy staff turnover (KI018, 2015; KI037, 2015), identifying and updating stale legislation in the case of Prince Edward Island's existing land use policy (KI023, 2015; KI026, 2015), and developing horizontal and vertical linkages to break down silos, such as with ACASA (KI011, 2015). How to mediate the selection of preferred options for adaptation involved how

decisions on adaptation priorities were made, e.g. the mechanisms used to develop common

focus and direction across organizational boundaries with their own priorities, such as with the

various members of ACASA (KI011, 2015; KI014, 2015), maintaining policy relevance in the

case of the City of Charlottetown's ICSP (KI031, 2016), and coordinating stakeholder

engagement, as with the Cape Breton Marconi Trail Climate Change Adaptation Plan (KI006,

2015). Authority and skill barriers related to issues of legislative and regulatory responsibility.

For example, informants mentioned a lack of a coordinated national climate change adaptation

policy (KI027, 2016), as well as broader considerations of governance and non-confrontational

engagement, such as in the evolution of ACASA (KI007, 2016; KI028, 2016; KI029, 2016).

Resource barriers, as the name implies, involved having sustained financing for

implementation. The winding down of funding for ACASA was an example of a resource

barrier (KI017, 2015), as was the roll out of the Cape Breton Marconi Trail Climate Change

Adaptation Plan (KI006, 2015). Related to this was the barrier of maintaining commitment of

in-kind partners over several years (KI015, 2015). Funding was now allocated on a project-by-

project basis by NRCan, with ACASA as a conduit (KI027, 2016), e.g. the development of an

adaptation decision support tool for communities (UPEI, 2016a) and the large economic study on

adaptation costing (UPEI, 2016b) used a modified, targeted funding model. Resource barriers

also included functional/administrative hurdles to ensure the efficient allocation of funds.

ACASA experienced this from a number of perspectives. One example is related to different

funding cycles for each of the partner agencies and the difficulty of inter-agency transfer of

funds (KI029, 2016). This was partially overcome by designating the University of Prince

Edward Island (UPEI) as the project management coordinator and allocator of resources (KI007,

2016; KI028, 2016; KI029, 2016). Federal government cost-cutting was also seen as a resource

barrier to adaptation. This was observed by those responsible for federal climate science (KI037, 2015) and adaptation programs (KI027, 2016; KI032, 2016). The resourcing challenge was described this way: "*… being such a small piece of the puzzle under the Climate Action Fund - we're - some people would say budget dust - it's a small amount in comparison to the mitigation funds*" (KI027, 2016).

Further, there was also recognition that barriers exist in the engagement of other influencers to adaptation processes. These included the engineering profession, in the case of the PEI Adaptation Program (KI015, 2015; KI026, 2015), realtors and real estate developers in the Town of Saint Andrews (KI002, 2015), and vulnerable private landowners in the case of PEI Watershed Associations (KI024, 2015), the PEI LUTF (KI023, 2015), and City of Charlottetown (KI021, 2015).

The last major barrier identified was the question of how best to develop criteria for the evaluation of options. The availability of common decision tools and technical information was a challenge for ACASA (KI009, 2015; KI032, 2016), as was the availability of reliable costing data (KI017, 2015). These were being addressed through two NRCan funded projects on a community decision support tool (UPEI, 2016a) and a large economic study (UPEI, 2016b).

Two other planning and decision making barriers identified in Figure 7 involved leaders and training, each being mentioned one (1) time. The existence of leadership vacuums were identified by the Ecology Action Centre in its work as a project leader to identify other champions, at all levels, to engage in the development of community climate change action plans (KI001, 2015). When it comes to barriers related to training, knowledge of the skill sets that are required for success was identified by an early career leader, in the case of ACASA (KI015, 2015).

The second class of leadership barriers from Moser and Ekstrom (2010) related to understanding the climate change adaptive and technical challenges being faced. Figure 8 summarizes these results which are shown in more detail in Appendix 11. Knowledge was mentioned twelve (12) times as a leadership barrier. Aspects of knowledge barriers were: availability of information such as cost data for the ACASA large economic study (UPEI, 2016b; KI015, 2015), lack of understanding by politicians of the application of sustainability principles in the case of the City of Charlottetown (KI031, 2016), and how best to frame information on the complexity and breadth of adaptation, in the case of the national Climate Adaptation Program (KI027, 2016). Access to the most up-do-date research and the general availability of vulnerability and risk information were mentioned as barriers to the initiation of the ACASA process (KI009, 2015; KI014, 2015; KI015, 2015). In addition, in seven instances, leaders indicated that there continue to be barriers in dealing with the receptivity of climate change information, through climate skepticism, either from other bureaucrats, communities or the public at large. One interviewee mentioned climate change fatigue as a barrier to engaging in ongoing collaborative decision making processes – "*going back to the well*" (KI014, 2015) with the same group of proactive partners or agencies.

Figure 8 – Understanding Leadership Barriers (N = 19)
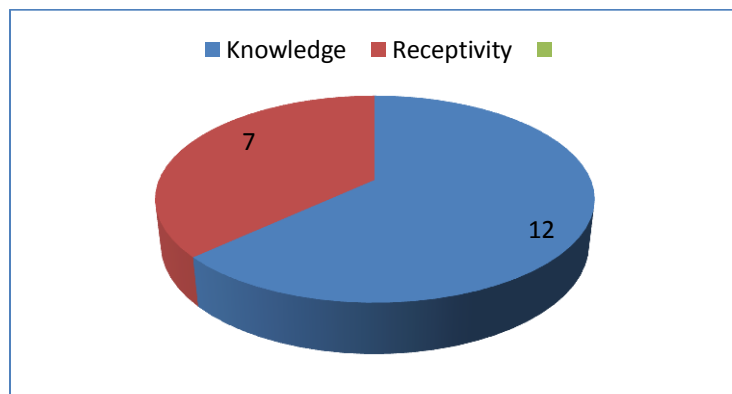
The third category of climate change adaptation leadership barriers from Moser and

Ekstrom (2010), as integrated into the conceptual framing for this dissertation (section 2.7),

related to managing the end result of planning and implementation. Figure 9 is a summary of the

data collected and presented in Appendix 11. This was the third most frequently mentioned

category. Leaders interviewed were just entering into this phase of the adaptation process.

Communication, both internal and external, was mentioned as a barrier, as projects were

implemented and there were requirements for knowledge transfer. Adaptive capacity of

implementation authorities, often small communities with part time engineering and planning

staff, was identified as a managing leadership barrier by ACASA (KI028, 2016) and the LUTF

(KI023, 2015). Cognitive biases through the emergence of resistance to change once planning

and decision making tasks were completed, and resulting frustration were identified when

discussing ACASA (KI025, 2015). Also, the amount of work required on behavioural change

was mentioned for ACASA (KI026, 2015). Sustained funding for adaptation through

implementation phases was mentioned as a managing barrier for the Cape Breton Marconi Trail

Climate Change Adaptation Plan (KI006, 2015). The requirement to continuously be involved in

evaluation over the longer term was also seen as a managing barrier by both the national RAC

program (KI027, 2016) and local ACASA members (KI017, 2015).

Figure 9 – Managing Leadership Barriers (N = 14)
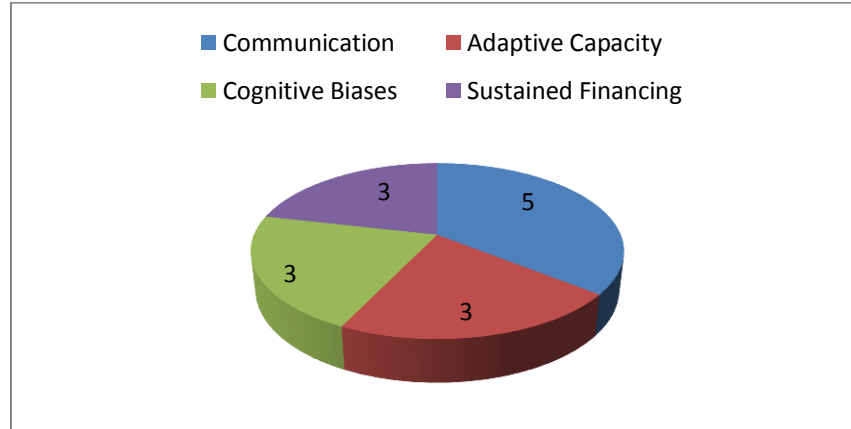
4.2.4.1 Bureaucratic Fault Lines

An institutional leadership barrier that is context-bound, as described in section 2.7.3 of

the conceptual framing, is that of a *"bureaucratic fault line"* (Savoie, 2013) or "*slab*"

(Mintzberg, 2013). Bureaucratic fault line describes a situation where there is lack of support at

some level of an organizational hierarchy that impedes the ability to shape an agenda, in this case

climate change adaptation. These fault lines arose in leadership situations related to continuity

of staff in senior positions, such as with the Province of Nova Scotia, where a supportive leader

was replaced with an unsupportive one (KI025, 2015), changing priorities at the political level

that stalled early gains in climate change adaptation, such as the case in Prince Edward Island

(KI026, 2015), unfamiliarity or unwillingness to tackle an issue by senior managers, an issue

experienced by the Ecology Action Centre (KI001, 2015), or failure by senior leaders to delegate

in the case of Nova Scotia (KI025, 2015). For example, "*One of the blows we got to the project*

was that one of these folks lost his job suddenly when the government cut back its department a

few months ago" (KI025, 2015).

Those climate change adaptation leaders with a high level of senior bureaucratic support

felt that adaptation projects were more successful (KI037, 2015; KI023, 2015; KI022, 2015) and

that bureaucratic fault lines were not an issue when organizational levels were aligned in terms of mission and delivery. One leader who was able to overcome this institutional barrier to action described their supportive relationship with the Director as a trusted "*wingman*" (KI023, 2015). Another described the higher level of political support received this way: "*… there are some little hubs of carefully loved and nurtured seeds of … innovation and creative thinking and they need leaders to kind of protect them from the winds of change*" (KI025, 2015).

4.2.4.2 Intergenerational Tension

Perceived intergenerational tension in approaching climate change adaptation leadership was another specific barrier identified in the data corpus. Queries of the data corpus highlighted distinct differences in the way that middle to late career leaders viewed this tension, as contrasted with early career informants. The middle to late interviewees focused on the continuity of knowledge and existing gaps. For instance, one middle career leader observed, "*What doesn't happen is we don't dust off those lessons learned when it comes to the next generation … It doesn't happen. We put it in a box…It gathers dust and we're not leveraging that…That has to change*" (KI014, 2015). This reflected a lack of concerted effort in systematically sharing stories and experiences as part of systematic evaluation (see section 5.2.2.2 for more on evaluation). In addition, it created in some minds a non-productive duplication of effort (KI037, 2015). That is, "*… as the younger generation comes on they forget what has been done before them and they have to reinvent the wheel... it's good to have another perspective on things, but sometimes you lose some of the kernels of truth that need to be reflected upon*" (KI018, 2015). Further, this was a source of frustration for those late career leaders, especially when it came to the academic focus of formalized education and the need to focus on solid, technical skills: "*These two young*

guys, they're in their 30s. They present very well. They're highly intelligent engineering technical types. They're wasting their time" (KI005, 2015).

Early career climate adaptation professionals focused on moving forward to create positive change immediately. "*I push the envelope all the time ... and always first to protect the resource. The economic part to me is secondary ...*" (KI006, 2015). Statements displayed the notion that part of leadership work involved mentoring: "*...as a girl, I want to definitely be a role model to other women...This is an intergenerational issue*" (KI024, 2015). Factors of early career climate change adaptation leader credibility were also faced in dealing with the broader community at large (P005, 2015). There was also an impatience when confronted with more senior colleagues and bureaucrats that are still not accepting of the existing climate science: "*... there was this one guy – I did this talk ... was rolling his eyes like you could hear his eyes moving ... how do you even work here?*" (KI001, 2015). The acknowledgement and handling of intergenerational tension as a barrier to climate change adaptation leadership is important if further work is to be done on developing evidence-based, relevant and meaningful mentoring and talent development programs.

4.2.5 Power

Responses varied to the question in the interview protocol (Appendix 4) related to spaces of power for action - "*Would you say that in generating knowledge, science, policy/government or local considerations were more important?*". The purpose of this question was to explore leaders' perspectives on the interaction of science, policy and local knowledge power spaces for action, specifically related to the concept of leadership as super-agency. Figure 10 is a summary of key informant responses.

Of twenty-eight (28) responses, nine (9) indicated that all three (3) power spaces were important for action on climate change adaptation. Seven (7) offered the view that what was most relevant is the policy to local knowledge connection. Those that chose only one of the spaces of power, i.e. science, policy or local, were lower [at either two (2) or three (3)]. The response of one leader, keenly aware of the science/policy/local knowledge linkages, expressed it this way: *"...the science/policy interface is something that we deal with on a daily basis ... it's kind of inherent. It's what we are doing in helping either communities or our clients ..."* (KI014,2015). Of this science to policy linkage another leader indicated, *"... What we were able to do is simplify the science into - here is the projection and here is the potential development. Where's the conflict? And what do we need to avoid?"* (KI021, 2015). Another expressed the challenge this way: *"...attempting to interpret science so the lay person can really understand what it means. And understand it in a practical yet balanced fashion ... and the local knowledge aspect was bringing the aboriginal and fishing communities into the discussion"* (KI018, 2015).

Figure 10 – Science, Policy and Local Knowledge Power Spaces for Action (N = 28)
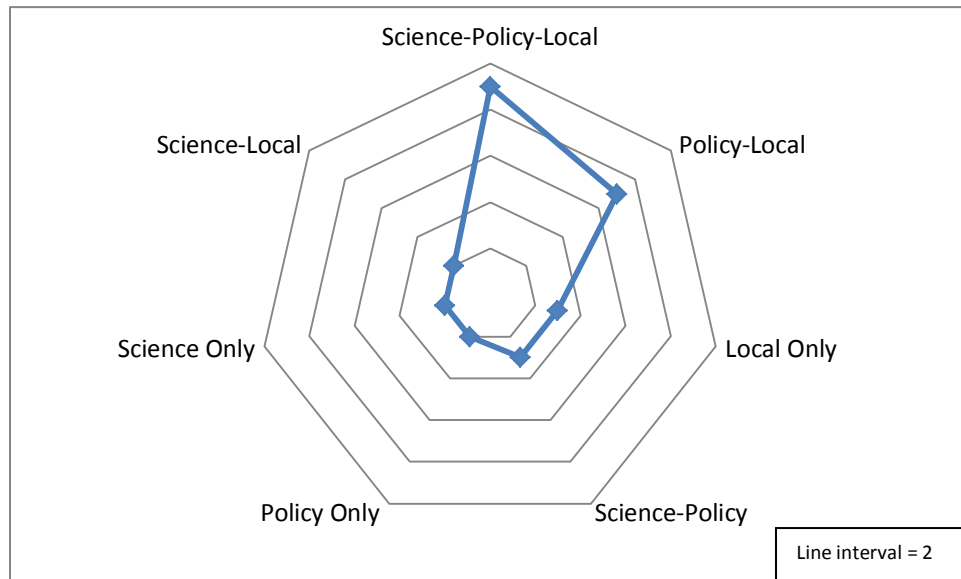
The challenge of integrating policy and local knowledge was illustrated by the perspective that *"... a lot of people on the ground, the practitioners, are too busy managing and doing and basing their actions on the knowledge they have at the time ... What we need is that introduction of the new research and the new thinking to the practitioners"* (KI037, 2015). Informants demonstrated a high degree of understanding of the importance of linkages between these spaces of power – they felt it is second nature to the work they are trying to accomplish. One of the leader's positions was actually created as a way to play this bridging role (KI010, 2015). In assessing the question of who leads adaptation, knowledge brokers in the science, policy, and local power spaces clearly play an important leadership role in climate change adaptation (see also Dengler 2007).

In addition, an understanding of different climate change adaptation contexts and the ability to use contextual intelligence were displayed in the interviews. In Chapter 2, contextual intelligence was presented as the ability to understand context so that hard (formal authority) and soft (informal influence) power can be effectively exercised. Seven (7) informant/leaders displayed an awareness of this distinction as part of their climate change adaptation practice in four (4) specific ways: identifying the most appropriate local champion and what message to use to engage them (KI001, 2015; KI008, 2014; KI009, 2015); selecting the right mix of skill sets and personalities for collaborative processes (KI015, 2015; KI026, 2015); being "*cunning*" in a "*courtship*" when approaching new stakeholders in terms of messaging (KI027, 2015); and, knowing when to let collaboration unfold and when to intervene in "*forcing marriages*" (KI027, 2016). In the view of one of the political leaders: "*Being mayor allows you to do things. Like hold public meetings. Like connecting with senior's groups or with the Chamber of - and with the*

business people or with realtors. Call a meeting and talk to them about different parts of how

you deal with it" (KI002, 2015).

Contextual intelligence was also relevant to the effective use of power resources (Korpi, 1985) more broadly. For instance, one informant/leader, who realized the scope of their formal authority spoke of the ability to capitalize on "*budget dust*" as a nuanced way to leverage adaptation action collectively through informal influence (KI027, 2016). In addition, it often required them to operate "*under the radar scope*" (KI027, 2016). Further, informal adoption of a sense of urgency and being "*fleet-footed*" in moving forward with action (KI027, 2016) was seen as important in influencing formal authority structures. These observations refelcted the idea that contextual intelligence had relevance to areas of the power discourse other than just knowledge power.

In exploring informant/leader perceptions of the end result of their exercise of power and influence, informants were asked the following question as part of the interview protocol: "*What do you feel has been the most valuable contribution of this process?*" The question was used as part of the evaluation section of the protocol to provide an opportunity for informant/leaders to reflect on specific adaptation outcomes achieved, any innovative solutions developed, and as a way to self-assess the value of their particular leadership intervention. The results were summarized from the data corpus, using the ten types of innovation presented in chapter 2. Figure 11 is the resultant graph of these responses.

Figure 11 – Innovation: Configuration, Offering, Experience (N = 55)
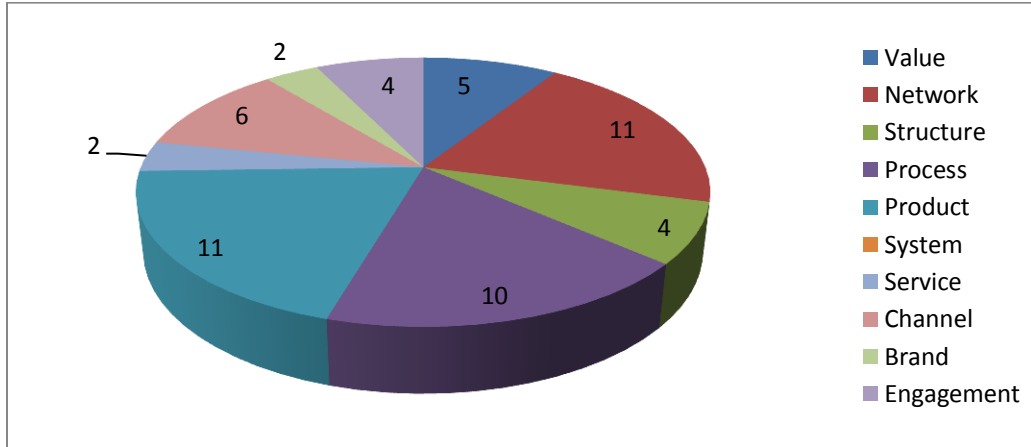
Adaptation leadership, when viewed across the innovation landscape, displayed all of the innovation types except for one - product system, that is, the development of complementary products and services in support of primary product offerings. Configuration innovation is the most frequently cited category. Within that, the three most frequently cited types of innovation were related to the development of products, using networks to create value and applying signature methods to enhance product development. Examples of innovation products included the Coastal Impact Visualization Environment (CLIVE) and Nova Scotia's Municipal Climate Change Adaptation Program (MCCAP). For network innovation (connecting with others to create value), the City of Charlottetown's ICSP, and ACASA were cited as examples of this type. Process innovation (using signature methods to enhance the creation of products) was mentioned for the Marconi Trail Adaptation Plan. In this case, the signature method was the coastal assessment guidelines developed by the Ecology Action Centre. Another example was the Halifax RM Urban Forest Management Plan, which incorporated Canadian Standards Association standards for sustainable forestry. In addition, the Nova Scotia Adaptation Work Plan used a complexity-based, cross-departmental engagement process using a journaling

software - SenseMaker®.   Further, in all of the embedded cases, multiple types of innovation were observed across the various initiatives. These innovations were perceived by leaders to influence adaptation success.

The *Marconi Trail Climate Change Adaptation Plan* capitalized on network, process and engagement innovation (KI006, 2015; ACAP, 2015). Network innovation involved having the regional government contract the regulatory consultation work to a local NGO. Process innovation was achieved through the use of another agency's best practices. Engagement innovation was demonstrated through the use of green mapping and participatory mapping exercises to develop priorities for climate change adaptation planning.

The *ACASA* was able to integrate network, structure, process, and engagement innovation into its work. Network innovation was accomplished through the creation of a unique, collaborative approach (KI027, 2016). Structure innovation was achieved through the development of a project vetting process that capitalized on various actor strengths (KI009, 2015). Process innovation was demonstrated through undertaking novel projects related to decision support tools (KI015, 2015) and infrastructure adaptation costing (KI017, 2015). Engagement innovation was achieved via unique interaction with relevant local communities (KI014, 2015).

In the case of *The Halifax RM Urban Forest Master Plan*, network, process and performance innovations were achieved. Network innovation arose through the dual leadership alliance between local government and academia (KI016, 2015). Process innovation arose through the incorporation of international forestry standards into decision making (KI016, 2015). Performance innovation was exemplified in the creation of a neighbourhood approach to urban forest resilience assessment (KI016, 2015).

CCWFI utilized value, network, product and engagement innovation as part of their business model. Value innovation was used in the development of their community energy offering (KI004, 2015). Network innovation created linkages with the broader energy grid (KI005, 2015). Product performance innovation was developed to demonstrate feasibility of the business model to shareholder in the community (KI004, 2015). Customer engagement innovation garnered community buy-in and eventual uptake of the CCWFI product (KI005, 2015).

In the case of the *City of Charlottetown ICSP*, value, network, and engagement innovation were all demonstrated. Value innovation was shown through the way in which sustainability was integrated into municipal operations in order to make the outward-facing ICSP a reality (KI022, 2015). Network innovation was demonstrated through a multi-stage conceptualization, development, and operationalization process (KI031, 2016). Engagement innovation was displayed through the way in which community members could participate and make recommendations to the municipality on sustainability issues, which led to the incorporation of culture into the ICSP.

The *PEI LUTF*, despite the appearance of a very structured, quasi-legal review process, capitalized on value, brand, and engagement innovation. Value innovation was demonstrated by the task force's ability to integrate climate change issues across various strands of provincial land use interest, such as: protection of water quality, agricultural land, coastal areas, and the rural landscape (TFLUP, 2009). Brand innovation was evident through the representation of various issues in statements of provincial interest (KI023, 2015). Engagement innovation was shown by the process that allowed the public to visualize and comment on land use issues of particular interest (KI023, 2015).

In the case of the *Town of Saint Andrews Integrated Planning* approach, network, structure, and process innovations were evident. Network innovation included fostering of unique collaborations both within and outside of the community (KI002, 2015). Structure innovation was shown through a process of employee engagement across the municipality, based on primary roles and responsibilities (KI002, 2015). Process innovation was shown through the development of a unique advisory climate change authority for the community (KI002, 2015).

4.3 Findings for Research Objective 1

This Chapter summarizes the finding of Objective 1 in relation to the exercise of climate change adaptation leadership in the Atlantic Region of Canada. Specifically, it presented findings on adaptation leadership processes in exercising climate change adaptation leadership. These findings correspond to the upper left, upper right, and lower left quadrants of Figure 5.

In the Atlantic Region of Canada, twenty-two (22) instances of climate change adaptation entry points were identified over seven (7) distinct climate change adaptation leadership strategic objectives. Mainstreaming as a strategy was identified most frequently, as were adaptation planning, sustainability and building adaptive capacity. Seven (7) embedded cases provided additional insight into how leaders select climate change adaptation entry points for creating a vision (Kløcker Larsen et al., 2012) and enabling action (Stiller and Meijerink, 2013). In some cases, these entry points were derived from leading within existing mandates and requirements for action, e.g. the Marconi Trail Climate Change Adaptation plan study (ACAP, 2015) and the Halifax Regional Municipality Urban Forest Master Plan (HRM, 2013); in others, adaptation entry points were derived through seizing opportunities and innovation, e.g. CCWFI (Vass, 2013) and the Town of Saint Andrews, New Brunswick (St. Louis and Killorn, 2014).

The profile of leaders involved in climate change adaptation reflected diversity, in terms of years of experience, multi-level governance exposure and project complexity. Ingredients for success such as the importance of gaining expertise in connecting communities with governments, playing a coordinating function, working collaboratively, and leaving a legacy were stressed by leaders interviewed.

When it comes to climate change adaptation leadership competencies, both technical and behavioural skills were seen as important. Specific demonstrations of leadership included collaboration, data visualization applications, stakeholder engagement, project management, policy/legislative approaches, and climate risk management. Other novel techniques, such as the use of citizen science and social marketing were mentioned. Behavioural competencies identified most frequently by climate adaptation leaders included the ability to bridge science and decision making for tangible results, collaboration both within and across organizations, facilitation, and communication.

Climate change adaptation leadership also involved identifying and overcoming barriers to understanding, planning/decision making, and managing the process of adaptation. The challenge of planning and decision making was mentioned by leaders most frequently. As part of this, barriers around limited local resource capacity and the development of new working arrangements related to collaboration were cited. Two important barriers were institutional challenges as well as the challenge of mediating the selection of options between competing interests. Another challenge was the engagement of other influencers, who hold power in adaptation planning and decision making. The second most frequently mentioned barrier was the understanding of climate change adaptation as an issue. Barriers related to the generation and dissemination of knowledge were identified, as was the continued need to deal with issues of

receptivity of climate change as an urgent priority. Barriers related to evaluation of success was the third most common response from climate change adaptation leaders. Knowledge transfer, adaptive capacity of implementing authorities, cognitive biases to change, and sustained funding were barriers of this type. As part of this analysis of barriers, two distinct types emerged from the data analysis: bureaucratic fault lines and intergenerational tension.

The last of the findings in Chapter 4 relates to issues of power – the exercise of authority and influence by climate change adaptation leaders. In general, when asked to reflect on the relative importance of science, local, and policy knowledge power spaces for action, most climate change adaption leaders identified links between two (2) or three (3) of the power spaces. In addition, related to the idea that understanding of context plays a role in climate change adaptation leadership – contextual intelligence was an important part of a leader's exercise of authority and influence. Finally, when exploring adaptation innovation, those that were able to capitalize on a number of different innovation types concurrently were able to achieve success in the implementation of their adaptation objectives.

Table 12 outlines key insights from the embedded case studies for Chapter 4. The next chapter examines findings related to research objective 2 - climate change adaptation leadership practice effectiveness.

Table 12 – Embedded Case Findings for Objective 1

	Embedded Case	Profile	Competencies	Barriers	Power	Innovation
1	Cape Breton RM Marconi Trail Climate Change Adaptation Plan	**Early** Municipal, Provincial, NGO	**Technical** Workshop GIS Legal requirements **Behavioural** Learn by experience Dialoguing Community connections	Financial resources for implementation	Policy Local	Network Process Engagement
2	Atlantic Climate Adaptation Solutions Association (ACASA)	**Early** (1) **Middle** (6) **Late** (3) **Late/Post** (1)	**Technical** Project management Facilitation GIS, LIDAR Stakeholder engagement Regulatory tools Vulnerability/risk mapping Visualization **Behavioural** Collaboration Negotiating Innovation Relationship building Multi-tasking Knowledge dissemination Consultant mindset Multidisciplinarity	Coordination Sustained funding Community capacity Competing priorities Maintaining scope Reliable data Getting research to decision making No common tools	Science Policy Local	Network Structure Process Engagement
3	Halifax RM Urban Forest Master Plan	**Late** Academic, Municipal, Provincial, Federal, International, NGO, Consulting	**Technical** Expert meetings Public engagement Regulatory tools **Behavioural** Bridging science Trust building Mediation Multi-discipline approaches	None	Science Policy Local	Network Process Performance
4	**Colchester-Cumberland Wind Field Inc. (CCWFI)**	**Late** (2) **Dual Business, Municipal, Provincial, Federal**	**Technical** Business planning Regulatory processes Stakeholder engagement Project management Risk management **Behavioural** Follow-through on commitments Reliability Persistence/Patience	Financial Technical Scalability Regulatory Local opposition	Local	Value Network Product Engagement

	Embedded Case	Profile	Competencies	Barriers	Power	Innovation
5	City of Charlottetown Integrated Community Sustainability Plan (ICSP)	**Early** Municipal, Consulting **Late** Municipal	**Technical** Community engagement Funding models Project management **Behavioural** Collaboration Coordination Facilitation Passion	Conceptualization of sustainability Organizational structures (integration) Communication Staff turn-over Political understanding	Policy Local	Value Network Engagement
6	PEI Task Force on Land Use Planning (TFLUP)	**Middle** Municipal, Provincial, Consulting	**Technical** Formal public consultation (theatre) Land use planning Visualization **Behavioural** Contextualization Information sharing Collaboration Evidence-based decision making	Limited tax base/capacity for action Climate change as threat multiplier Non-confrontational engagement Stale legislation	Policy Local	Value Brand Engagement
7	Town of Saint Andrews Integrated Planning	**Late/Post** Municipal, Provincial, International	**Technical** GIS Project management Workshops Story telling Asset management Infrastructure assessment Emergency response **Behavioural** Collaboration Networking Trust building Communication Creativity	Certain sectors e.g. real estate industry	Science Policy Local	Network Structure Process

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CHAPTER 5 – ADAPTATION LEADERSHIP PRACTICE EFFECTIVENESS

I think it's the trickle down
where you're creating a bunch of smaller scale leaders.
That's the really exciting part for me.
(KI022, 2015)

5.1 General

In the last Chapter, the dissertation focused on presenting findings relative to research

objective 1 on climate change adaptation leadership processes. This included identification of

those competencies that contribute to leadership success, the barriers to adaptation leadership

which exist, and the role that power plays in affecting innovative climate change adaptation

leadership outcomes (specific research questions 1.1 – 1.4). The focus of this Chapter now shifts

to a detailed investigation of findings related to research objective 2. The following sections

address findings related to how leadership theories on style, function and fluidity are relevant to

climate change adaptation leadership practice (see Figure 12, bottom right quadrant for links to

the conceptual framing from section 2.7). Observations on climate change adaptation leadership

over time, from the Atlantic Region of Canada, are used to consider what might constitute

effective strategies for climate change adaptation practice. In addition, the Chapter presents

observations on certain emerging themes: evaluation, mentoring, apprenticeship, and the

possibility of limits to the exercise of climate change adaptation leadership. This presentation is

intended to address research questions 2.1 and 2.2 as outlined in section 1.2.

Figure 12 – Research Questions Addressed in Chapter 5
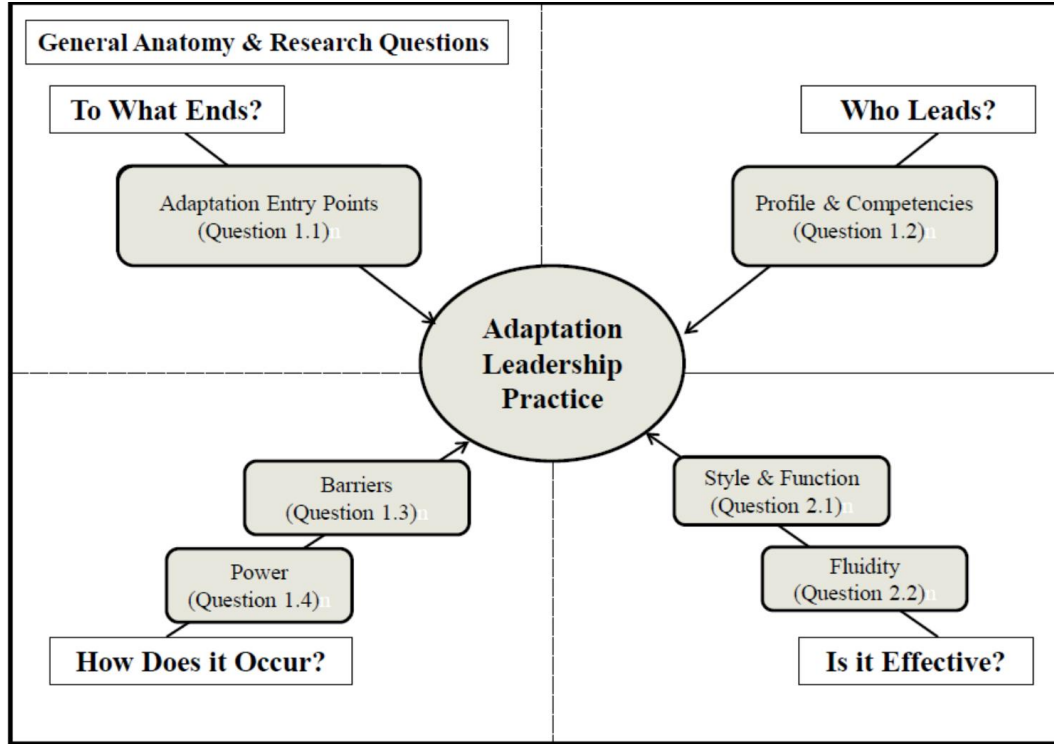
5.2. Links to Leadership Theory

When asked the question as part of the interview protocol, "*Do you think that the success of your initiative was due more to specific individuals, any teams you created as part of the process, or the sponsor organization?*" the responses varied. The purpose of this question was to assess which aspects of leadership theory informants felt were most relevant for climate change adaptation - individual, team-based or organizational leadership. Of forty-seven (47) instances recorded, individual leadership ranked the highest (with twelve (12) instances); organizational leadership was mentioned eleven (11) times; and team leadership was found important five (5) times. Nine (9) interviewees indicated that all three leadership styles are important.

Figure 13 – Area of Leadership Theory Most Important (N = 47)
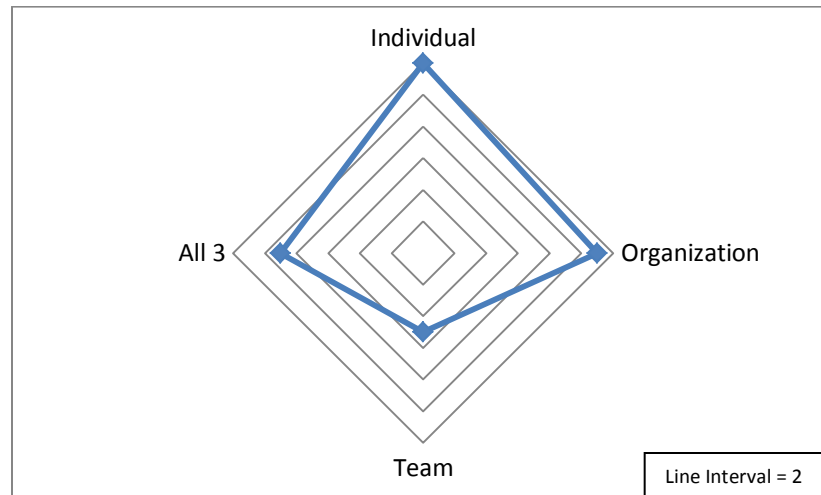
One of the key informants, a local mayor, was identified as an example of political leadership (KI009, 2015); in another case, it was an influential councillor who coordinated initial development of the City of Charlottetown ICSP (KI031, 2016). For senior level political support, one leader was identified who assumed the role of "*protector of an approach*" (KI025, 2015) and supported bureaucrats working on adaptation initiatives related to Nova Scotia's Adaptation Work Plan. Individual leaders were also seen as important for mentoring and the provision of advice, as in the case of a collaborative adaptation research project (KI021, 2015). Those mentioning other aspects of individual leadership spoke of local champions (KI009, 2105; KI026, 2015) or "*networks of champions*" (KI009, 2015; KI025, 2015). These views related to both ACASA, in the sense of implementation of climate change adaptation at the community level and the Nova Scotia Adaptation Work Plan, from the point of view of creating organizational change. Coordination of local initiatives also relied on the manager of a "*campaign*" (KI001, 2015), as reflected in the leadership approach of the Ecology Action Centre. Within collaborative networks such as ACASA, a "*primary instigator*" (KI011, 2015) was seen

as essential in playing a coordinating role. In other cases, a project manager provided individual administrative leadership. This was highlighted in the work of the Ecology Action Centre (KI001, 2015), the Mi'kmaq Confederacy of PEI (MCPEI) Integrated Resource Management office (KI010, 2015), and the development of the City of Charlottetown ICSP (KI022, 2015; KI031, 2016).

Within the discussion on roles of individuals, certain leaders made the observation that key to their success, as well as gauging the commitment of others, was the idea of "*leading by example*" (KI004, 2015; KI005, 2015; KI037, 2015). This involved being able to demonstrate personal commitment and credibility to the importance of a given climate change adaptation entry point. For instance, "*One of the first things I want to know if you're promoting electric vehicles is what kind of electric vehicle do you drive?* [pause] *It's really that simple*" (KI005, 2015). In the same interview, a personal challenge was made by one of the key informants to the investigator on the relevance of this dissertation to leadership by example: "*What is your leadership by example?*" (KI005, 2015). Personal commitment through visible action was a catalyst for further engagement and buy-in from others. This was highlighted during observation of two leaders (KI004, 2015; KI005, 2015) at an industry conference in Halifax (P004, 2015). In the words of one key informant: "*If we don't have leadership, the followers don't have anyone to follow*" (KI004, 2015).

In choosing organizational leadership, it was recognized by informants that some entities had played a leadership role by virtue of their essential participation in collaboration. Examples included the University of Prince Edward Island Climate Lab in the ACASA (KI026, 2015), the Bay of Fundy Environmental Partnership in the St. Croix Estuary Monitoring Project (KI018, 2015), the ACAP Cape Breton in the Marconi Trail Adaptation Assessment (KI006, 2015), and

the City of Charlottetown Parks and Recreation Department in the development of the City's

ICSP (KI031, 2016). In addition, other organizations were mentioned as having played a

leadership role in that they supplied important tools, techniques or guidance materials in support

of adaptation. These included the Ecology Action Centre (KI001, 2015), the Insurance Bureau

of Canada (KI009, 20150), the Federation of Canadian Municipalities (KI031, 2016) as well as

consultants hired as part of particular initiatives (KI015, 2015; KI031, 2016).

References to the importance of team leadership related to certain key concepts. One

concept was the setting of an overall planning context for action such as in the City of

Charlottetown's waterfront development review. This review used a team-based approach to

develop the necessary technical information for political decision making (KI021, 2015).   A

second team leadership concept was in providing the ultimate accountability for project

deliverables and key initiatives, e.g. the role of student researchers in providing multi-year

logistical support to the Halifax Regional Municipality Urban Forest Master Plan (KI016, 2015).

A third concept was the coordination of activities in support of project work plans, such as

fulfilling a secretariat role for multiple adaptation initiatives in multiple jurisdictions. The role

of UPEI in coordinating ACASA activities (KI028, 2016) was mentioned as an example of this

concept.

There were nine (9) key informants that felt it was difficult to select one type of

leadership and that all three types were applicable to the climate change work that they are

involved in. For instance, four informants (4) identified that individual leadership is necessary

for community buy-in (pushing), the organizational aspect for provision of backing and support

(legitimacy), and team leadership to actually deliver on project requirements (delivering) (KI006,

2015; KI026, 2015; KI027, 2016; KI037, 2015). This is exemplified by the Cape Breton

Marconi Trail Adaptation Plan project. "*It seemed that we needed all three components in order to get the end result that we were hoping for which is communities that felt more empowered that felt that at the end of the project they had something they could continue on with and that there was some really good dialogue and – but it wouldn't just fizzle out at the end of the project*" (KI006, 2015).

In reflecting on the relative importance of either technical or adaptive challenges for leadership intervention, most informants provided the opinion that leadership challenges were either adaptive (15 instances) or some combination of both technical and adaptive (12 instances). In justifying selection of adaptive challenges, informants mentioned that behavioural change was a key focus of leadership both within and outside of organizations. "*You know, with the ACASA it's trying to change behaviours within bureaucracies. You're trying to change behaviour within local and broader provincial societies*" (KI011, 2015). In the case of the City of Charlottetown, it involved a "*shift in mindset*" (KI021, 2015), particularly with councilors and decision makers in their consideration of staff and professional recommendations on the urgency of climate change adaptation. It also involved linking to broader social aspects of resilience for sustainability. In the words of one PEI leader, "*… the only way we're going to be resilient is if we're connected as a community and we have the social networking in place. To involve each other in those changes*" (KI024, 2015). Another leader found the application of social marketing techniques were essential in understanding how to address behavioural adaptive challenges (KI012, 2015).

In justifying the opinion that both technical and adaptive challenges are equally important, leaders stressed the temporal nature of these challenges - solutions to technical challenges were generally well developed and known; leaders had shifted their focus to solving

the adaptive challenges of climate change. Examples of this included the Town of Saint

Andrews (KI002, 2015), the work of New Brunswick on climate change adaptation strategies,

including ACASA (KI009; 2015), the integrated planning work of MCPEI (KI010, 2015), and

initiatives of the PEI Watershed Association Network (KI024, 2015).

In only one (1) instance was the technical challenge seen as the sole leadership focus.

This perspective came from one of the co-leaders of CCWFI, *"If you don't do the technical*

[challenges] *right, you're going to fail. I don't care how much people want it to work ... If that's*

not going to get done correctly, you will fail" (KI005, 2015). This comment related to the

application of sound engineering principles in the specification, design, building and operation of

wind energy infrastructure. This was supported by his co-leader: *"You have to have your*

equipment producing. It doesn't matter what it is" (KI004, 2015).

5.2.1 Leadership Style

Figure 2 of this dissertation, as presented in section 2.5.1, developed the view of the

exercise of leadership as a continuum, advocating a flexing of leadership styles. Climate change

adaptation leaders included in this dissertation were assessed along this continuum to capture

their predominant leadership style. Figure 14 recasts Figure 2 to summarize this assessment. It

is worth noting that this classification reflected a predominant leadership style. That is, some

leaders demonstrated more than one style, particularly those situated in collaborative network

contexts, and those involved in leadership contexts over time. A predominant style as reflected

in the data corpus was used for classification purposes in Figure 14. This style determination

was derived from a number of data sources, including: the interview responses of key informants

themselves, observations made by other key informants in the research study, as well as through

document review and participant observation. In three (3) instances, the key informants

themselves verified the accuracy of their placement on the leadership style continuum. In all cases, at least one other source was used to justify placement along the continuum. Appendix 12 provides a summary of specific sources of information used for each key informant. As mentioned above, these sources included: key informant interview, comments of other informants, documentary evidence, participant observation, and re-interview.

Figure 14 – Predominant Climate Change Adaptation Leader Style and Informant Career Stage (Early,Middle, Late, Late/Post) (N = 29)
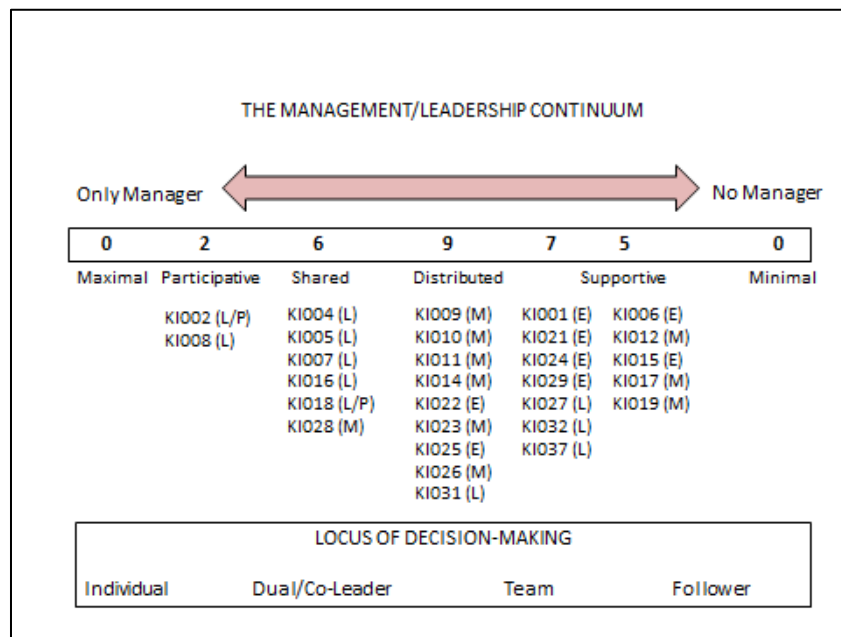
There is no observed climate change adaptation leader who fit the description of either a maximal, individual leadership style, or at the other end of the continuum, a minimal, follower style. Most leaders who participated in this project fell within a distributed or supportive style. Two (2) leaders were observed as charismatic leaders, demonstrating a participative, inclusive style. One leader was a mayor and another the president of a national fisheries association. Six

(6) leaders interviewed operated within in a shared, dual, co-leadership arrangement. This leadership style was demonstrated in the following climate change adaptation entry points: CCWFI (KI004, 2015; KI005, 2015), the Halifax RM Urban Forest Master Plan (KI016, 2015), the Bay of Fundy Environmental Partnership St. Croix Estuary Monitoring Project (KI018, 2015; KI018, 2016), and the latter stages of ACASA (KI007, 2015; KI028, 2015).

Twenty-one (21) climate adaptation leaders made use of a distributed or supportive leadership style [twenty-one (21) out of twenty-nine (29)]. A distributed style related more to providing leadership as part of an identifiable organization.   Examples of this included steering committee members of ACASA (KI009, 2015; KI011, 2015; KI022, 2015) and the City of Charlottetown's Sustainability Office (KI022, 2015). A supportive style was associated with working effectively as part of a team or with local champions to provide leadership on climate change. Examples of this were the Cape Breton Marconi Trail Adaptation Plan (KI006, 2015) and specific projects under ACASA, the development of a community adaptation decision support tool (KI015, 2015) and the large economic study (KI017, 2015). Leaders who were placed in an intermediate distributed/supportive style category recognized that they had assumed a leadership role, both within their organization and as part of broader collaborative efforts – a "*network of champions*" (KI025, 2015). Examples of this included the Province of Nova Scotia's Adaptation Work Plan (KI025, 2015) and the work of the Ecology Action Centre (KI001, 2015).

A further observation was made related to the career stage of a particular leader. This is indicated in Figure 14 by the letters in parentheses and described in section 4.2.2. With a caveat related to the key informant sample size, there was some evidence that the leaders who displayed a participative and shared style tended to be in a late/post or late career stage. Those with a

distributed or supportive leadership style were observed as being more homogeneous. The relevance of this will be discussed in more detail in Chapter 6.

The next three sections present further findings from the above analysis. These sections delve more fully into findings related to individuals who adopted a shared leadership style, engaged champions, and participated in networks of champions.

5.2.1.1 Shared Leadership

After the interview protocol was administered, results collated, and the data corpus analyzed, four (4) instances of dual or shared leadership arrangements were identified. In two (2) instances, both co-leaders were interviewed and responses compared (KI004 and KI005; KI007 and KI028). In two (2) other cases, for access and logistical reasons, only one of those in a shared leadership role was available for an interview (KI016; KI018). The following paragraphs provide a short summary of each of the four instances.

First, co-leaders KI004 and KI005 operated a community wind energy business in Tatamagouche, Nova Scotia - CCWFI. Community sustainability initiatives allowed for engagement in provision of local energy requirements using a for-profit business model (Vass, 2013). KI004 and KI005 approached leadership in a structured, collaborative manner, recognizing each other's strengths and talents. This relationship was recognized externally by their peers as well (P004, 2015).   KI004 approached projects as a layman, but with specific organizational, finance and business acumen (KI004, 2015). KI005 provided engineering problem-solving skills to CCWFI – "*If you don't do the technical right, you are going to fail*" (KI005, 2015). This dynamic often involved acting together using planned, scripted engagement in contexts such as meetings with regulators, communities or business partners (KI004, 2015). This type of strategy required a keen awareness of roles suited to each one's particular expertise

(KI004, 2015). They cited persistence, learning as you go, right-sizing, and understanding of risk as key factors in success (KI004 and KI005, 2015). They also saw peer mentoring as an important aspect of their leadership responsibility (KI004, 2015).

Second, co-leaders KI007 and KI028 headed the management team for a university climate research laboratory. This relationship involved ensuring both effective operation of the research unit as well as fulfilling secretariat responsibilities for ACASA. At the outset, there was initial individual leadership on the part of the Director (KI007) who was described as *"very pivotal in keeping us together as a group to deal with climate issues from the beginning….quite a driving force in that"* (KI010, 2015). In assuming the network coordination function of the ACASA, dual leadership was necessary to perform both strategic coordination and project management functions (KI028, 2016). Collaborative tasks in this leadership style were processual and structural, involving the development of transferable tools, and network development (KI007, 2016; KI028, 2016). This role with ACASA initially formed only one minor part of the laboratory's overall research program. As ACASA coordination shifted to the actual performance of collaborative tasks and delivery of tangible results (the University was legal signatory to the funding agency and therefore ultimately accountable), KI007 and KI028 assumed a more active role in engaging with the network. The division of tasks between the two leaders was consciously scripted as in the previous example for CCWFI, and sometimes cast as a "*good cop-bad cop*" arrangement, as the situation required (KI028, 2016). This shared leadership approach proved to be more effective as administrative demands at the end of the ACASA funding period for ensuring accountability had increased substantially (KI029, 2016).

Third, KI016 and co-leader were responsible for the successful implementation of the Halifax Regional RM Urban Forest Master Plan. KI016 was a university researcher and

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provided scientific input to the plan. He worked closely with a senior planner from the RM. KI016's initial involvement was in providing science in support of decision making: *"I'm a fan of bringing good technical information onto a table and after helping people understand what it means, allowing them to wrestle over preferences around outcomes"* (KI016, 2015). From the outset, a co-leadership team arrangement was struck for planning and execution. For instance, *"... sometimes he'd be leading a meeting, sometimes I'd be leading the next part of the same meeting and so on. It was extremely collegial"* (KI016, 2015). *"The way* [x] *puts it - when he and I are in the same location with the same group of people, he talks about what we're doing ... he introduces me and he says "*[y]*'s our conscience"* " (KI016, 2015). There was also an element of student engagement and mentoring as part of the process (KI016, 2015).

Fourth, KI018 and co-leader conducted an in-depth research study with community involvement in the St. Croix Estuary. Leader KI018, described as a citizen scientist was chairperson of an international, non-government environmental partnership network (KI018, 2015). Their co-leader was a late career fisheries biologist with the federal government. Their project carried out a retrospective analysis of one hundred years of temperature and salinity monitoring data in the St. Croix Estuary, New Brunswick (BoFEP, 2016a). As such, it required a collaborative approach between scientists, regulators, and local communities, to analyze and interpret the results. A decision was made to co-lead the project due to its specific science and engagement components (KI018, 2015). KI018 specifically saw their role as working across silos within the scientific community and putting scientific knowledge into the hands of the community in a useable fashion (KI018, 2015). A shared leadership approach allowed the science co-lead to work with their team to collate, interpret, and present the marine

environmental monitoring data (KI018, 2015). When it came time for facilitated community workshops, both leaders shared engagement responsibilities (KI018, 2015).

Looking across these four cases of shared leadership, the use of a shared or dual leadership model for climate change adaptation provided a number of distinct advantages. It allowed each co-leader to apply their specific skills to a certain aspect of a shared leadership challenge. It was also reflected in this dissertation in a number of diverse leadership contexts: a business social enterprise (KI004 and KI005), a collaborative innovation network (KI007 and KI028), the science/policy interface (KI016), and for science/local community engagement (KI018).

5.2.1.2 Distributed Leadership – Instigators

Figure 14 includes a group of nine (9) leaders that exhibited a distributed leadership style. They were observed as playing a leadership role within their particular organizations and work teams, yet also formed part of external collaborative innovation networks, e.g. the ACASA (KI009, KI011, KI014, KI026). In this sense, leadership style required both an inward and an outward leadership persona. They were also typically required to perform multiple leadership roles, e.g. leading corporate sustainability initiatives (KI022, KI031), special cross-departmental projects (e.g. KI023, KI025) or various community development projects (KI010). With the exception of one (1) leader (KI031), these leaders were early to middle career practitioners. The term instigator comes from a statement that another informant in this study made about a peer in the sub-set, referring to them as a "*primary instigator*" (KI011, 2015). The significance is that it described a leadership style that demonstrated leadership on both climate change initiatives and engagement in collaborative innovation networks.

5.2.1.3 Supportive Leadership- Extension Agents

Another sub-set of informant/leaders from Figure 14 saw themselves in a supportive leadership role. This group of five (5) were technically competent adaptation and sustainability professionals, who contributed to supporting adaptation projects. This support was provided at a variety of levels: community (KI006), watershed (KI012), provincial (KI015), inter-provincial (KI017), and internationally (KI019). As one leader put it, "*we work with the willing*" (KI012, 2015).

5.2.1.4 Distributed/Supportive Leadership – Mobilizers

There is another group identified in Figure 14 positioned between distributed and supportive leadership roles. These seven (7) leaders exhibited both instigator and extension agent leadership styles as previously described. The difference was observed in how these leaders saw their role as part of the climate change adaptation process. In providing a supportive leadership role, they saw themselves as mobilizing communities, organizations and networks to perform the necessary work for climate change adaptation. This role was fulfilled through either community organizing (KI001; KI024), convening networks and providing accountability (KI021, KI029), or creating necessary spaces for collaboration and conflict negotiation (KI027, KI032; KI027). This was described by one informant in this sub-set as "*vigilante work*" (KI024, 2015), often working outside of organizations to identify grass-roots concerns and bring them forward via appropriate governance mechanisms.

5.2.1.5 Champions

In addition, during analysis of the data corpus, the relevance of champions became a topic of leadership importance across all of the above observed leadership styles. The concept of

champion was not explicitly captured in the evolution of the conceptual framing on leadership as outlined in section 2.7, although it was captured in the literature review (see Appendix 1). Within the continuum of Figure 14, these types of strategic alliances fell across all leadership styles observed – participative, shared, distributed, and supportive. Informant/leaders mentioned the term champion in ten (10) of the twenty-nine (29) interviews. Some identified the importance of pre-champions (those interested and involved but yet able to demonstrate tangible results) (KI001, 2015). Mini-champions were actors capable of making small, incremental changes within a community or an organization (KI010, 2015; KI022, 2015). Others identified the value of key influencers within a particular community, not specifically tied to the political arena (KI002, 2015; KI004, 2015; KI024, 2015; KI026, 2015; KI028, 2016). In the case of provincial watershed stewardship associations they were *"community members who share similar concerns. And they've often fought for those concerns within government to get the attention on the issues"* (KI024, 2015).

Other key informant/leaders specifically cited political champions as being essential for success (KI009, 2015; KI022, 2015; KI031, 2016). Others described their mission as one of developing a network of champions, in the case of the Nova Scotia Adaptation Work Plan (KI025, 2015). Informants used the term champion in either the sense of being strategic (seven (7) instances) or tactical (three (3) instances). Strategic champions, those key individuals that were advantageous in preparing the way for climate change adaptation entry points were seen as important for the Mi'kmaq Confederacy of Prince Edward Island (MCPEI) (KI010, 2015) and the Nova Scotia Adaptation Work Plan (KI025, 2015). Tactical champions, those key individuals who assisted in some way in meeting project objectives, were identified as assets for

organizations such as PEI Watershed Associations (KI012, 2015; KI024, 2015) and the City of

Charlottetown Sustainability Office (KI022, 2015).

A champion's role was very much related to the particular role they played in a

community, organization or network. In discussing Nova Scotia's Adaptation Work Plan, this

role was characterized as follows: "*the champion's role ... is to support each other. Learn as*

much as possible about some of the ideas behind this approach ... and then figure out what kinds

of things they can gradually do in a day-to-day sphere of influence" (KI025, 2015). It was also

embedded in the actual perspective of the person, often a researcher, identifying those

champions. One leader described it this way: "*I think it's the trickle down where you're creating*

a bunch of smaller scale leaders that's the really exciting part for me" (KI022, 2015). Key

informants identified a number of nuances to the use of the term champions: pre-champions,

mini-champions, key influencers, politicians, and networks of champions.

5.2.2 Leadership Function

The last section presented results on the application of climate change adaptation

leadership styles. This section highlights findings that relate to the leadership functions

performed by climate change adaptation leaders. Figure 15 summarizes instances of the

demonstration of complexity leadership functions by informant/leaders. More detail is provided

in Appendix 13.

Connective and political-administrative leadership functions were the top two (2)

functions captured in the data. Instances of dissemination, enabling and adaptive leadership

were observed less frequently. Informant/leaders were seen to perform at least two (2) of the

five (5) aforementioned functions. Two (2) leaders performed all five (5) of the complexity

leadership functions (KI007; KI025). In general, leaders in the data corpus performed at least two functions (KI004; KI005; KI006; KI017; KI019; KI024; KI028; KI037). In situations of shared leadership, the number of leadership functions performed increased (KI004 and KI005; KI007 and KI 028). In addition, champions were used to enhance leadership coverage of certain functions (KI001; KI006; KI010; KI012; KI022; KI025; KI037).

Figure 15 – Demonstration of Complexity Leadership Functions (N = 90)

	Political - Administrative	Enabling	Adaptive	Connective	Dissemination
■ Series1	21	13	14	25	17
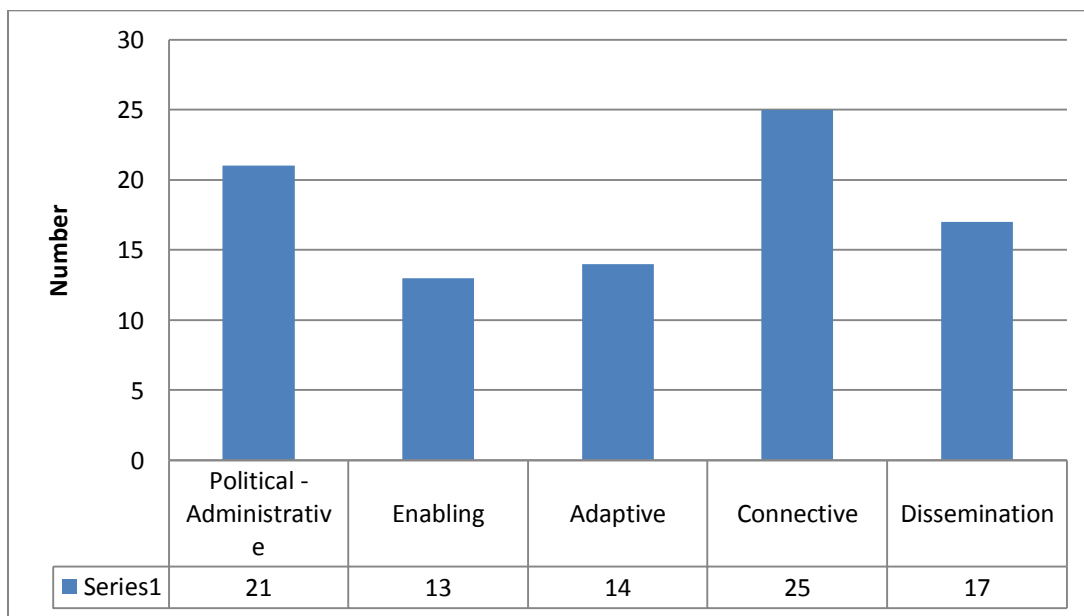
Figure 16 examines complexity leadership function further in relation to corresponding adaptation entry points. In cases of adaptation, adaptive capacity, and sustainability/mainstreaming, all five (5) complexity leadership functions were recorded at least once in all informant/leader interviews. The other four adaptation entry points did not correspond with all five (5) leadership functions and reflected the analysis of only one (1) case each – the Halifax RM Urban Forest Master Plan for resilience, ACASA Adaptation Costing Project for maladaptation avoidance, and The Town of Saint Andrews, New Brunswick for integrated planning and disaster risk reduction.

5.2.2.1 Temporality and Leadership Emergence

Since climate change adaptation is process, there was evidence to suggest that, in climate change adaptation entry points, leadership style and/or function changed over time. Three examples from the data corpus were identified: the City of Charlottetown, PEI, ACASA, and Town of Saint Andrews.

Figure 16 – Complexity Leadership Function by Adaptation Entry Point (N = 90)
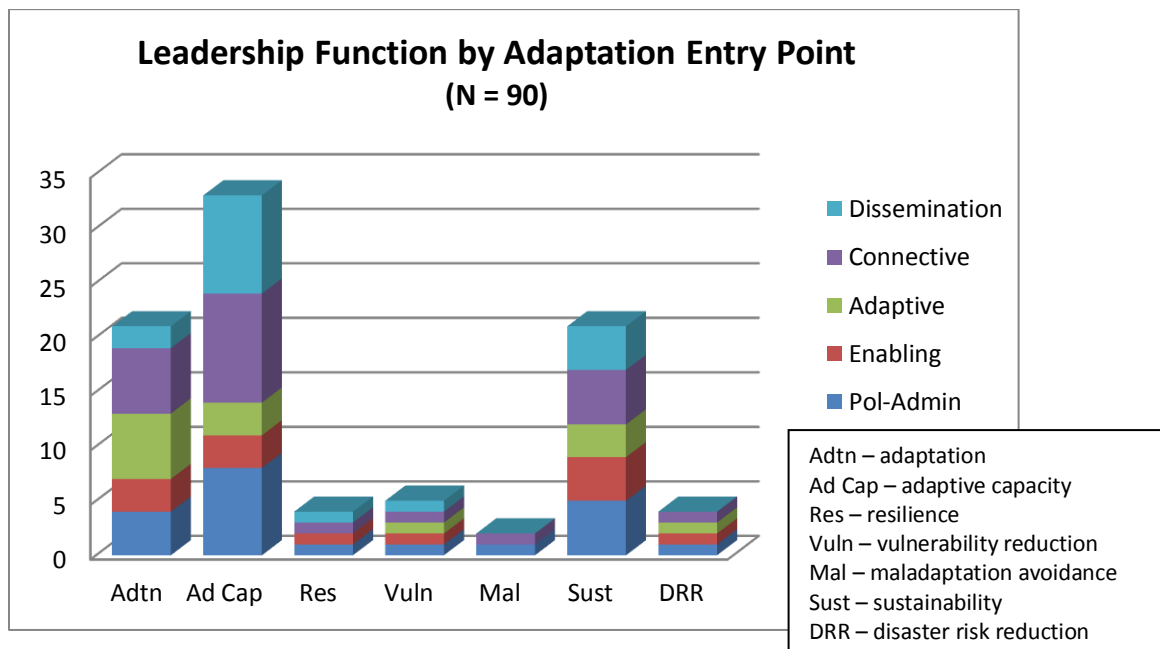
First, the City of Charlottetown's approach to mainstreaming adaptation through an Integrated Community Sustainability Plan (ICSP) revealed the emergence of leadership style and function over time (City of Charlottetown, 2010). Interviewees observed that during the initial phases of the process, shared leadership between the City's sustainability coordinator and a key political actor, a member of City Council, was important for bringing the issue of sustainability to the community's attention and creating a vision (KI031, 2016) (political-administrative and enabling leadership). This initial focus was followed by a very structured process of public

meetings, charrettes, and consultant input (connective leadership), requiring strong project management skills (KI022, 2015; KI031, 2016) (political-administrative leadership). A staff manager from the Parks and Recreation Department, with the requisite training, was assigned this role (KI022, 2015; KI031, 2016). Once the ICSP was developed and adopted by the political leadership of City Council, an enabling, connective leadership role was played by a full-time Sustainability Coordinator, who was responsible for integrating sustainability within the existing corporate culture (KI031, 2016) (adaptive leadership). Formal training on sustainability, focused communication and identification of departmental champions were an important aspect of this (enabling leadership).

Second, the development of the Regional Adaptation Collaborative (RAC) in the Atlantic Region was executed in a similar fashion. The initial organizational enabling leadership carried out by the federal government, even though described as "*under the radar scope*" (KI027, 2016), provided the impetus for the Council of Atlantic Premiers to assume a political-administrative and enabling leadership role (KI014, 2015). This led to the creation of a collaborative connective leadership platform, ACASA, a *"network of champions"* (KI025, 2015) which was subsequently taken over by the shared leadership team at the UPEI (KI007, 2015) (political-administrative leadership). Through this process, changes in adaptation focus could be initiated because of the initial success of the collaborative leadership of ACASA (connective and adaptive leadership). Subsequent specific projects (e.g. the large economic study and the decision support tool study), were funded through the RAC program, which expanded the connective and enabling leadership function within ACASA to other partner organizations (dissemination leadership) (KI017, 2015; KI027, 2016).

Third, the Town of Saint Andrews, New Brunswick, under the guidance of a singular, strong participative leader (KI009, 2015; KI018, 2015) was embedding climate change adaptation considerations within its operations by creating a citizens' authority. This distributed leadership authority acts as a standing committee of Council to advise the municipality on climate change matters (KI002, 2015). This political-administrative body was the end result of a number of incremental actions taken by political leadership through the exercise of smart power (KI003, 2015): working with seniors and sharing stories on flood experiences (enabling and connective functions); developing a dual relationship with an emergency contact at NB Power (connective and adaptive functions); integrating climate considerations into capital and asset management plans (political-administrative and enabling functions); and looking for creative funding solutions to conduct risk-based vulnerability assessments (adaptive function). As this participative leader said, *"A lot of times I look at what we're doing and who's the best person to talk to other people. Who has status within the community? Who's an influencer within the community?"* (KI002, 2015).

5.2.2.2 Evaluation

Evaluating climate change adaptation in this dissertation relates to how successful specific adaptation entry points were in meeting their stated objectives. These entry points are summarized in Appendix 4. A formal evaluation was not conducted of all the adaptation entry points cited. The interview protocol was used to elicit opinions from climate change adaptation leaders. Figure 17 shows the results to the question, *"Did the process incorporate an evaluation component to learn from the experience?"* Nineteen out of twenty-five responses indicated that there was some form of evaluation conducted as part of climate change adaptation initiatives. Some were mandated as part of funding agreements (KI027, 2016; KI007, 2016). One was

shareholder-driven (KI004, 2015). Others were partial, less formal and anecdotal (KI014, 2015; KI021, 2015; KI023, 2015; KI026, 2016; KI029, 2016).

Figure 17 – Instances of Evaluation in Climate Change Adaptation (N = 25)
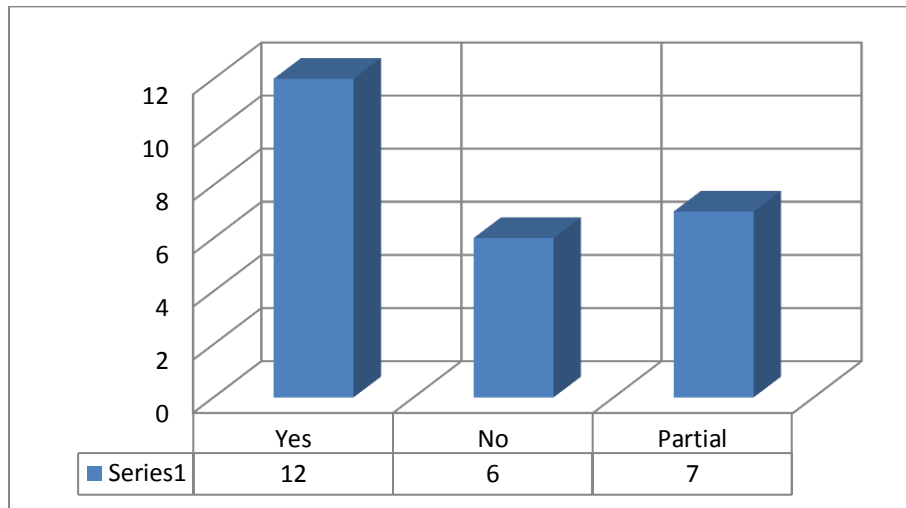
Leaders indicated that there was room for improvement in the way climate change adaptation evaluations were done (KI017, 2015; KI022, 2015; KI037, 2015). One leader described the initial evaluation of ACASA this way: "*I don't know if it* [the formal evaluation] *was particularly meaningful in that it was almost a cataloguing*" (KI026, 2016). Further to this observation, recent ACASA projects continued to identify key performance indicators that were output rather than outcome-based, e.g. the number of reports and related documents released, the number of new people engaged (meetings/consultations), website downloads and visitors, and number of tools created and released (UPEI 2016a).

5.2.2.3 Succession Planning

Another factor for ongoing adaptation success was in the area of succession planning. When adaptation is viewed as an ongoing process, constant focus is needed to ensure that

businesses, projects and networking organizations are sustainable. All of those interviewed saw

this as important, but some saw it as a particular challenge (KI002, 2015; KI010, 2015; KI025,

2015; KI037, 2015). Two of the leaders interviewed (KI004, 2015 and KI005, 2015) were

actively dealing with "*founder's syndrome*" (Crutchfield and MacLeod Grant, 2010). They

recognized that they have started a profitable enterprise, which needed to be sustained, and an

action plan explicitly developed to deal with the eventual intergenerational transfer of control.

5.2.2.4 *Mentoring*

Somewhat related to succession planning, was a recognition of the need for mentoring in

climate change adaptation leadership (KI010, 2015; KI018, 2015; KI021, 2015; KI037, 2015).

This was specifically mentioned by six (6) of the seven (7) early career women climate leaders.

Intergenerational tension has already been discussed in section 4.2.4.2 as an institutional

leadership barrier. Previously, Tables 9, 10, and 11 in this chapter summarized the tools, skills

and competencies that climate change adaptation practitioners believed was essential for

successful adaptation.

5.2.2.5 *Limits to the Exercise of Climate Change Adaptation Leadership*

Three key informants, in different contexts, used the same term – "*destruction of*

leadership" (KI005, 2015; KI025, 2015; KI037, 2015) to describe a hyper-adaptive challenge to

adaptation leadership. How initiative was either embraced or dampened had a significant impact

on the creation value and positive adaptation action. "*You can have one leader or you can have*

one person who can shut it all down" (KI037, 2015). Informants expressed the view that any

attempt to assume a leadership role was discouraged and not supported. This was either by a

particular individual in a given situation or institutional structures themselves. On leader put it

this way: "*You could probably go on* ad nauseum *about the ways in which government structures squash leadership. But that would be redundant. And you'd have to transcribe it, so I'll stop there*" (KI025, 2015).

5.3 Summary of Findings for Research Objective 2

This chapter presented the findings of research objective 2 in relation to the exercise of climate change adaptation leadership in the Atlantic Region of Canada. Specifically, it presented findings on climate change adaptation leadership practice effectiveness: links to leadership theory, leadership style, and function.

First, in linking climate change adaptation leadership to existing leadership theory, I found that no one area of leadership theory applies to all situations. Key informants identified the interrelated importance of individual, organizational, and team-based models of leadership in developing responses to climate change adaptation. This is consistent with the post-charismatic/post-transformational approach to leadership highlighted in section 2.5 and Table 1. In addition, interviewees identified that they were faced with adaptive challenges, or some combination of technical and adaptive challenges in approaching climate change adaptation.

Second, when examining the role of leadership style in climate change adaptation, key informants were mapped on a continuum based on the post-charismatic/post-transformational leadership approach. This continuum took into account the locus of decision making from a number of different leadership perspectives, from maximal to minimal individual control (Figure 14). Climate change adaptation leaders were observed at the participative/charismatic end of the continuum, through to shared (co-leadership), distributed (instigators), distributed/supportive (mobilizers), and supportive (extension agents) leadership styles. In addition, the role of champions was mentioned as an important ingredient in leadership success.

Third, climate change adaptation leadership functions were examined using the lens of a specific post-charismatic/post-transformational leadership theory strand - CLT. Within this theory, connective leadership and political-administrative leadership functions ranked the highest. Enabling, adaptive, and dissemination functions were also observed. These functions were seen to be enhanced through the use of shared leadership arrangements, as well as through the use of champions.

Fourth, through the examination of certain climate change adaptation entry points over time, the variability of leadership styles and functions was observed. In one example, the City of Charlottetown, a shared leadership arrangement using political-administrative, and enabling functions, was followed by a more structured distributed leadership style using connective functions. In a third phase, a supportive leadership style was used to continue work on sustainability, fulfilling adaptive and enabling functions.

Finally, research under objective 2 highlighted certain emerging issues for climate change adaptation leadership. These related to a continued need to more actively focus on evaluating the success of leadership interventions, development of succession plans that continue adaptation initiatives, and structured mentoring for climate leader protégés. In addition, several climate change adaptation leaders highlighted the potential for the destruction of leadership as a debilitating, hyper-adaptive challenge.

Table 13 presents key findings from the embedded case studies selected.

Table 13 – Embedded Case Findings for Objective 2

	Embedded Case	Theory	Style	Function	Temporality	Challenges
1	Cape Breton RM Marconi Trail Climate Change Adaptation Plan	Individual Organizational Team	Supportive (Extension Agent)	Adaptive Connective	Not indicated	Adaptation Action
2	Atlantic Climate Adaptation Solutions Association (ACASA)	Individual Organizational Team	Shared (2) Distributed (4) (Instigator) Distributed/Supportive (3) (Mobilizer) Supportive (2) (Extension Agent)	Political-Administrative Enabling Connective Adaptive Dissemination	Yes	Evaluation Sustainability
3	Halifax RM Urban Forest Master Plan	Individual Organizational Team	Shared	Political-Administrative Enabling Connective Dissemination	Not indicated	Not indicated
4	Colchester-Cumberland Wind Field Inc. (CCWFI)	Individual	Shared	Political-Administrative Connective Dissemination	Yes	Succession planning Destruction of leadership
5	City of Charlottetown Integrated Community Sustainability Plan (ICSP)	Individual Organizational Team	Distributed (2) (Instigator)	Political-Administrative Enabling Adaptive Connective Dissemination	Yes	Evaluation
6	PEI Task Force on Land Use Planning (TFLUP)	Organizational Team	Distributed	Political-Administrative Adaptive Connective	Not indicated	Interdepartmental silos
7	Town of Saint Andrews Integrated Planning	Individual Team	Participative	Political-Administrative Enabling Adaptive Connective	Yes	Succession planning

The next chapter of this dissertation provides a discussion of the relevance of findings in

Chapters 4 and 5. Specific questions for further research on climate change adaptation

leadership and climate change adaptation practice are offered.

CHAPTER 6 – DISCUSSION

We need very fluid leadership - people who can share power.
We need to encourage people working in this field.
Not to just learn about the climate science...
but also to reflect on the kind of leadership needed
in these difficult and challenging times.
(KI025, 2015)

6.1 General

The previous two chapters of this dissertation presented findings related to the two research objectives identified in section 1.3. These questions were designed to aid in the understanding of climate change adaptation processes by analyzing the role of leadership during the process of adaptation planning and implementation (*adaptation leadership processes*) and examining different climate change adaptation leadership contexts, in order to develop recommendations for strengthening practice-relevant climate adaptation (*adaptation practice effectiveness*). Climate change adaptation leadership has been systematically explored in a Canadian context. A regional case study perspective from the Atlantic Region of Canada fills certain gaps in the existing literature to enhance understanding of climate change adaptation leadership in a number of significant ways.

This chapter discusses the significance of these findings as they relate to the Atlantic Region of Canada specifically, and the Canadian climate change adaptation leadership context more generally. In reviewing findings from the research study, contributions to the literature on climate change adaptation leadership are emphasized. This includes identification of future directions for scholarly research at the intersection of climate change adaptation and leadership theory.

6.2 Fluid Leadership for Climate Change Adaptation

The results described is this dissertation utilized a regional approach and embedded case studies from the Atlantic Region of Canada and confirmed the view of climate change adaptation leadership as a fluid process presenting specific technical and adaptive challenges (O'Brien and Selboe, 2015a). These challenges were the primary leadership driver in the ongoing search for sound adaptation practices (Adger et al., 2007; Eyzaguirre and Warren, 2014). A research methodology that included observation of climate change adaptation leaders and their results highlighted those competencies which were being used regularly to develop institutional adaptive capacity (Gupta et al., 2010).

These findings contribute to the perspective elaborated by Evans et al. (2015) that leadership, despite being characterized as an elusive science (Rumsey, 2013b), is an important, analytical construct, which can inform climate change adaptation (Meijerink and Stiller, 2013; Mimura et al., 2014; Vignola et al., 2017). Climate change adaptation leadership can be analyzed through a rigorous evidence-based research approach (Pfeffer and Sutton, 2006). Pfeffer observes that social science research is key to reflecting on building power bases, embracing ambiguity, eschewing popularity contests, **adapting when the situation demands change** [*bolded for emphasis*], and mastering influence (Pfeffer, 2016). Fluidity, in this dissertation, was consistently described as "*smooth elegance or grace*" (Oxford, 2016), which relies on individual expertise and experience, rather than solely organizational position, to create a necessary climate of trust and mutual support (Woods et al., 2004).

Climate change adaptation leadership occurs within a problem context that involves uncertainty (Millly et al., 2008; Levin et al., 2012) and requires practical, skillful engagement (Eyzaguirre and Warren, 2014; O'Brien and Selboe, 2015b). Climate adaptation governance is

an emerging field (Keskitalo, 2010a) with multi-level governance challenges (Hooghe and Marks, 2001). Those responsible for leading climate change adaptation face a range of different barriers (Moser and Ekstrom, 2010) and practical challenges (Eyzaguirre and Warren, 2014) and must work within social limits to adaptation (Adger et al., 2009). Therefore an actor-centric influence, based leadership model, is an important concept for examining climate change adaptation.

Using a series of questions on the anatomy of climate change adaptation (Smit et al., 2000) and informed by the work on adaptation frameworks (Lim and Spanger-Siegfried, 2005), Canadian national assessments (Lemmen et al., 2008), the findings of the Intergovernmental Panel on Climate Change (IPCC) (Adger et al., 2007; Klein et al., 2007; Mimura et al., 2014) and other sources (Meijerink and Stiller, 2013; May, 2015; Stiller and Meijerink, 2016), a conceptual framing for climate change adaptation leadership was developed. This conceptual framing, presented in Chapter 2, was designed to generate observations that relate to what ends climate change adaptation leadership is focused, how the concept of agency is useful in examining who leads adaptation, how climate change adaptation leadership occurs and changes over time (context and fluidity of leadership approaches), and whether or not this leadership (May, 2015). In addition, questions can be asked regarding the efficacy of leadership in removing barriers (Moser and Ekstrom, 2010), collaboration (Gray, 2008), and sustainability through succession planning, mentoring, and talent management (Gebelein et al., 2010).

Chapter 2 set the stage by surveying current scholarship in climate change adaptation, climate governance, and adaptation practices. It continued with a survey of the leadership landscape, presenting a conceptual framework for examination of climate change adaptation

leadership.   Chapters 4 and 5 presented findings of the research in order to address the six

research questions and presented a number of particular themes that emerged from data analysis.

How does this research contribute to a further understanding of climate change adaptation

leadership? Climate change adaptation leadership has been systematically explored in a

Canadian context. A regional case study perspective from the Atlantic Region of Canada fills

certain gaps in the existing literature and enhances understanding of climate change adaptation

leadership in a number of significant ways. These are described in the next section.

6.3 Climate Change Adaptation Leadership Processes

From the point of view that climate change adaptation is a process (Smit et al., 2000) and

context-specific (Wilbanks, 2003), climate change adaptation leadership was examined in a

similar fashion. Sense making is an important component of climate change adaptation (Kløcker

Larsen et al., 2012). Specific adaptation entry points are identified and research questions

related to leadership competencies, adaptation barriers, exercise of power and influence, and

contributions addressed.

6.3.1 Adaptation Entry Points

There are a number of flexible ways in which climate change adaptation leadership

interventions can be conceptualized (Lim and Spanger-Siegfried, 2005). Key informants in this

research study reflect the range of climate change adaptation entry points, from structured

adaptation planning (ACAP, 2015), to the creation of adaptive capacity (NRCan, 2016), building

resilience (HRM, 2013), reducing vulnerability (St. Louis and Killorn, 2014), avoiding

maladaptation (ACASA, 2016), mainstreaming for sustainability (City of Charlottetown, 2010;

TFLUP, 2009), and climate disaster risk management (St. Louis and Killorn, 2014). In all cases,

leadership principles, as defined in this study (Pfeffer, 2000; Uhl-Bien et al., 2007 Podolny et al., 2010) are being applied to addressing climate change adaptive challenges (O'Brien and Selboe, 2015a).

From the twenty-two (22) climate change adaptation entry points explored in Appendix 6, seven (7) were examined in more detail, as shown in Figure 4. Table 14 highlights key climate change adaptation leadership insights from the embedded case studies discussed.

Project starting points allow leaders to begin "*journeys of inquiry*" (Kløcker Larsen et al., 2012:16) in creating meaning and value (Poldony et al., 2010). The seven (7) cases described illustrate the various ways in which leadership for climate change adaptation can be initiated, as a way to: achieve multi-level governance integration (Hooghe and Marks, 2001; Wilbanks, 2007); encourage collaborative innovation networks (Dhanasai and Parkhe, 2006; Gray, 2008); embed resilience thinking within community governance (Nelson et al., 2007); account for the inclusion of vulnerable populations (Ribot, 2011) and increase social resilience (Berkes and Ross, 2011); undertake climate innovation via businesses, outside of traditional governance networks (NTREE, 2012); stress the interrelationship between climate change and broader sustainability (Kates, 2011); and capitalize on recent extreme events as catalysts (Olsson et al., 2006) for participatory community risk management (van Aalst et al., 2008). These embedded cases illustrate the wide variety of choice that climate change adaptation leaders have in initiating enabling and adaptive functions offered by CLT (Meijerink and Stiller, 2013).

6.3.2 *Adaptation Leader Profiles*

Leadership, as used in this dissertation, is concerned with using personal competency and moral suasion to identify and apply best adaptation practices (Adger et al., 2007). It also relies on the post-charismatic/post-transformational view of leadership as situated around embedded

learning, distributed work arrangements, and learning from experience (Parry and Bryman, 2006).

In the Atlantic Region of Canada, climate change adaptation leaders are observed at various stages of their career development. As such, the influence they possess varies based on this experience. However, in all but three (3) cases, climate change adaptation leaders have gained experience in multiple levels of governance (Hooghe and Marks, 2001) and in multiple

Table 14 – Climate Change Adaptation Entry Points and Leadership Insights

Objectives	Focus	Key Leadership Insight	Example
Adaptation	Explicitly using the concept of adaptation to influence decision environments	Framing the leadership challenge as an adaptation issue, allows for multi-level governance integration (Hooghe & Marks, 2001) from community to regional to provincial and national levels	Marconi Trail Climate Change Adaptation Plan (ACAP, 2015; CBRM, 2014; MCCAP, 2014)
Adaptive Capacity	Building the capacity to adapt to future changes in decision environments	Using seed funding as a financial power resource (Korpi, 1985) catalyzes the development of regional collaborative innovation networks (Gray, 2008) and creates institutional adaptive capacity through vision creation, collaboration and entrepreneurialism (Gupta et al., 2010)	Atlantic Canada Climate Adaptation Solutions Association (ACASA, 2016; NRCan, 2016)
Resilience	Using the concept of resilience (either physical or social) to identify needed changes in decision environments	Strategic alliances (Heifetz, 1994) between communities and academia can use ecosystem resilience frameworks (Nelson et al., 2007) to embed considerations of climate change into existing strategic governance plans	Halifax Regional Municipality Urban Forest Master Plan (HRM, 2013; Steenberg et al., 2013)
Vulnerability Reduction	Identifying vulnerable systems to move forward with changes in decision environments	Leadership that incorporates the perspectives and needs of vulnerable populations (Ribot, 2011) leads to an increase in social resilience and inclusivity (Berkes & Ross, 2013)	Town of Saint Andrews (St. Louis & Killorn, 2014)
Maladaptation Avoidance	Avoiding changes in decision environments that will lead to maladaptation in future	Using innovation networks (Dhanasai & Parkhe, 2006) to lead regional studies on the economics of adaptation (UPEI, 2016b) considers maladaptation and the risk posed by path dependency (Barnett & O'Neill, 2010)	Atlantic Canada Climate Adaptation Solutions Association (ACASA, 2016)

Objectives	Focus	Key Leadership Insight	Example
Sustainability/ Mainstreaming	Integrating climate change considerations into current sustainable development instruments	Businesses play in integral role in multi-level governance arrangements (Hooghe & Markes, 2001), and in the absence of clear policy regimes, can create a climate of prosperity (NTREE, 2012) with integrated climate co-benefits (Klein et al., 2005)	Colchester-Cumberland Wind Field Inc. (Vass, 2013)
		Sustainability science, with its use-inspired focus (Kates, 2011), is a flexible way to blend broader multi-level policy priorities with stakeholder interests in decision making for climate change adaptation	City of Charlottetown Integrated Community Sustainability Plan (City of Charlottetown, 2010)
		Quasi-judicial bodies, when examining adaptive challenges that are local scale and place-based (Wilbanks, 2007), can influence climate governance (Jagers & Stripple, 2003) at broader levels	Task Force on Land Use Planning, PEI (TFLUP, 2009)
Climate Risk Management and Disaster Risk Reduction	Focusing on needed changes in decision environments in response to changing climatic extremes	Recent extreme climatic events can serve as windows of opportunity (Olsson et al., 2006) for participatory community risk management (van Aalst et al., 2008)	Town of Saint Andrews (St. Louis & Killorn, 2014)

roles (Christenson, 1985; Pitcher, 1995; Imperial et al., 2016). This impacts the way in which they embrace collaborative leadership. "*To be successful in these venues, leaders must assume a pivotal role in **surmounting the obstacles** [bolded for emphasis] inherent in transdisciplinary collaborations and in facilitating the emergence of major discoveries from these endeavours*" (Gray, 2008: S130). Specific barriers or obstacles of relevance to this dissertation are discussed in section 6.3.4.

The evidence described above of varied leadership experience, gained in different multi-level governance situations, creates the potential for climate change adaptation leaders to develop contextual intelligence (Nye, 2010; May, 2013). This experience further strengthens the ability to identify and overcome barriers to adaptation (Moser and Ekstrom, 2010). The next section on climate change adaptation leadership competencies elaborates on this idea further.

Further, in this study, there was an overall balance between women and men who participated as key informants (14:15). However, the ratio of women to men was higher in the earlier stages of leadership development (7:1). It is recognized that various structural and attitudinal barriers exist as obstacles to women leaders' advancement (Ely and Rhode, 2010). There is also literature within the climate change discourse that highlights the role of gender and environmental knowledge (McCright, 2010), vulnerability and power (Arora-Jonsson, 2011) and adaptation (Carvajal-Escobar et al., 2008; Vasseur et al., 2015). Research indicates that women in leadership positions are particularly adept at engaging in transformational leadership (Rhode, 2017). These enabling and connective factors are a key component of both CLT and contextual intelligence.

Since the area of climate change adaptation leadership is an emerging area of scholarship, gender considerations have implications for how inclusive climate change adaptation leadership development programs are structured, including competency profiles, mentoring, and apprenticeship (e.g. Ely and Rhode, 2010; Coughlin et al., 2005). Mentoring and sponsorship interventions are seen as demonstratively successful (Rhode, 2017). For example, the Association of Climate Change Officers has developed a Women's Climate Collaborative whose aim is to promote leadership, build a community of practice, and advance the field of adaptation, mitigation and sustainability (ACCO, 2016). In another example, the C40 Cities Women4Climate network is at the forefront of providing high level mentoring and support for women in climate leadership positions (C40 Cities, 2017). Competency profiles, mentoring, and apprenticeship will be discussed in later sections of this chapter. Scholars stress that: "*Business, professionals, and public policy schools should be at the forefront of teaching and research on gender, diversity, and leadership*" (Ely and Rhode, 2010: 403).

6.3.3 Competencies

One way to examine what constitutes effective climate change adaptation practice, and related to this the development of climate change adaptation leadership development programs is through consideration of competency-based assessments (Steen et al., 2009). Climate change adaptation leaders in the Atlantic Region use a variety of skills and tools as part of structured decision-making (Wilson and McDaniels, 2007). These tools and skills can be translated into core competencies for program development. The demonstration of specific technical and behavioural competencies (Steen et al., 2009) is captured in a first generation climate change adaptation leadership inventory (Appendices 8 and 9).

Technical competencies include formal techniques for collaboration and knowledge brokering (Kløcker Larsen et al., 2012). Informants in this dissertation expressed the importance of technical tools to assist in this brokerage process. These tools serve to create the basis of a platform for learning and the sharing of best practices (Cohen et al., 2006). Visualization, indicators or similar metrics and related technology applications (Perez and Yohe, 2005) provide tools to facilitate visioning and meaning-making (Cash et al., 2006; Podolny et al., 2010) necessary to bridge knowledge and action (Cook et al., 2013). Stakeholder engagement acumen (O'Brien and Selboe, 2015b) creates the potential to create a sense of communityship (Mintzberg, 2015). Project management skill (Gebelein et al., 2010) and an understanding of policy/legislation processes (Meijerink and Stiller, 2013) provide the glue for sustaining strategic decision-making (Hallegate, 2009). The application of hazard/vulnerability/risk management that acknowledges power and learning for adaptation (May and Plummer, 2011) places the focus on opportunities for the exercising collaborative leadership (Gray, 2008).

In a similar fashion, behavioural competencies also include bridging science, policy, and local knowledge (Dengler, 2007) for actionable results (Cook et al., 2013). This bridging highlights the role that leaders play at these boundaries for climate change adaptation (Lynch et al., 2008). Collaboration is also a competency that has behaioural aspects that leaders can use in navigating cognitive, structural, processual (process-oriented) and networking tasks (Gray, 2008), particularly in the orchestration of innovation networks (Dhanasai and Parkhe, 2006). A focus on internal and external communication highlights the communication and dissemination functions of CLT (Meijerink and Stiller, 2013).

By combining these technical and behavioural competencies, this dissertation presented a means to translate these competencies, documented through the case study, into a collaborative leadership competency framework (see Table 11 in section 4.2.3).

In addition to a focus on the more routine political-adminstative functions of leadership (Meijerink and Stiller, 2013), climate change adaptation leaders in the Atlantic Region of Canada created opportunities to experiment with a number of innovative competencies observed in other areas of environmental governance. These include policy entrepreneurialism (Huitema and Meijerink, 2010) in the use of citizen science (Silvertown, 2009) to promote place based approaches (Wilbanks, 2003; Wilbanks, 2007), creativity (Homer-Dixon, 2006) in the engagement of non-traditional stakeholders in collaborative decision making (Mintzberg, 2015) and passion (Kouzes and Posner, 2007) in leading by example on climate change adaptation (Burton, 2008).

The significance of this is that in building leadership programs for climate change adaptation practices, both types of competency are relevant for curriculum development (Conger, 2010; ACCO, 2011). The competencies identified can also be distinguished on whether or not

they are best learned in formal settings (e.g. familiarity with consulting processes), through experiential learning (e.g. mastering dialogue-deliberation) or some combination of both (e.g. mainstreaming climate change adaptation into existing instruments and tools). This initial suite of competencies is useful in constructing a comprehensive climate change adaptation leadership profile or competency dictionary. Section 6.4.1 of this chapter classifies some of these competencies within the main functions of CLT (Meijerink and Stiller, 2013) to present how this process might unfold.

6.3.4 Leadership Barriers

Specific leadership barriers to climate change adaptation exist, but can be understood through asking diagnostic questions related to the interaction of actors, context, and systems of concern (Moser and Ekstrom 2010). There are few studies, however, that examine how these barriers have been overcome (Eisenack et al., 2014).

In this dissertation, the most frequently cited barrier to climate change adaptation relates to planning and decision making (Moser and Ekstrom, 2010). Within planning and decision making for adaptation, climate change adaptation leaders in the Atlantic Region of Canada have had to overcome institutional challenges. Institutional barriers are related to "*institutional mission, policy agendas, historical legacies, procedural rules, social and professional norms, or even customarily consulted information sources*" (Moser and Ekstrom, 2010: Supplementary Table). While this is a broad diagnostic question, there are specific ways in which climate change adaptation leaders in the Atlantic Region of Canada overcame these barriers. For instance, shifting priorities within provincial jurisdictions, was overcome by the Province of Nova Scotia's Adaptation Work Plan (Nova Scotia, 2015) through the exercise of internal adaptive leadership to identify departmental champions for climate change adaptation (Meijerink

and Stiller, 2013); the re-engaging of partners after policy staff turnover required the development of strong collaborative leadership processual tasks (Gray, 2008); identifying and updating stale legislation in the case of Prince Edward Island's existing land use policy was overcome through political-administrative leadership (Meijerink and Stiller, 2013) that created "*Statements of Provincial Interest*" (PEI, 2013) and; the breaking down of silos within the ACASA innovation network (ACASA, 2016) required strong connective and dissemination leadership (Meijerink and Stiller, 2013) to develop and maintain horizontal and vertical member linkages.

Climate change adaptation leaders in the Atlantic Region of Canada identified two barriers to climate change adaptation not previously fully documented in the literature. These two barriers fall within the institutional leadership category. They are climate change adaptation barriers related to bureaucratic fault lines (Savoie, 2013) and intergenerational tension (Heenan and Bennis, 1999).

Bureaucratic fault lines describe a situation where there is lack of support at some level of an organizational hierarchy, that impedes the ability to shape an agenda, make progress on an issue, or garner organizational support (Savoie, 2013). It is also, more graphically, described as a "*slab*" (Mintzberg, 2013) which emphasizes a dampening and impermeability in stifling innovation. This disconnect between senior levels of an organization and front line staff creates confusion between political vs. customer/citizen accountability (Savoie, 2013). Policy entrepreneurship in governance is stifled in the development of new ideas, building of coalitions, exploiting windows of opportunity, and accessing multiple venues (Huitema and Meijerink, 2010).   Those climate change adaptation leaders in the Atlantic Region of Canada that have successfully dealt with this institutional barrier used either a personal distributed leadership

approach (Mintzberg, 2013) with senior levels of their organization or mention that there is an inherent organizational distributed leadership style already in place.

Intergenerational tension is a term used in this dissertation to describe observations that there is a generational mismatch between how early versus later career climate change adaptation leaders view each other. This tension creates an institutional barrier to climate change adaptation. On the one hand, mid to late career climate change adaptation leaders view it as an issue of succession planning (Groves, 2007) and mentoring/knowledge transfer (Steen et al., 2009; Gebelein et al., 2010). Early career climate change adaptation leaders tend to stress creativity (Homer-Dixon, 2000) and need to take community action immediately (Mintzberg, 2015), involving a high degree of passion (Kouzes and Posner, 2007).

The next most frequently cited barriers to adaptation were in the area of understanding, that is, detecting a problem, gathering and using information and redefining the problem context (Moser and Ekstrom, 2010). In the Atlantic Region of Canada climate change adaptation leaders faced two barriers related to understanding - knowledge generation for decision making and the receptivity of the climate change issue by their constituents. In the first case of knowledge barriers, for example, leaders indicated such challenges as some politicians' lack of understanding of key issues and principles. These barriers required not only the development of usable information, but also platforms for information presentation and dialogue. This was overcome in the case of the City of Charlottown by creating a shared leadership role (Eckman, 2006; Mintzberg, 2013) for sustainability planning between elected officials and senior staff (KI022, 2015; KI031, 2016). A second example was the barrier of accessing the most recent climate science and vulnerability/risk information. ACASA (2016) overcame this through the

development of collaborative leadership (Gray, 2008) and innovation networks (Dhanasai and

Parkhe, 2006) for sharing tools and techniques.

In some instances, there were barriers with respect to the receptivity of climate change

information by either the political sphere or communities at large. This was addressed in several

ways. One was in the creation of strategic partnerships (Heifetz, 1994) with community

champions (Lemmen and Warren, 2014) in the case of the Marconi Trail Climate Change

Adaptation Plan (ACAP, 2015). Another was the creation of innovative graphical techniques in

the case of Prince Edward Island (UPEI, 2016b) with an outreach component to allow residents

to visualize potential impacts of coastal erosion and sea level rise. A third was the challenge of

explaining the complexity and breadth of adaptation concepts, which was overcome by the

national Climate Adaptation Program (NRCan, 2016), through connective and dissemination

leadership (Meijerink and Stiller, 2013) in the creation of strategic alliances (Heifetz, 1994).

The last most frequently identified barriers to adaptation relate to managing climate

change adaptation initiatives (Moser and Ekstrom, 2010). Structural and process-oriented

leadership tasks had to be developed to address this. Communication and knowledge transfer

was identified as a barrier. This was handled by climate change adaptation leaders through

explicitly embedding dissemination leadership within the ACASA governance structure

(ACASA, 2016). Adaptive capacity within local communities with part time staff was also

identified as a resource barrier. Climate change adaptation leaders in the Atlantic Region of

Canada are addressing this through the use of collaborative networks (Dhanasai and Parkhe,

2006; Gray, 2008), to develop transferable and usable decision support tools (UPEI, 2016a) and

economic costing guidance for adaptation infrastructure decision making (UPEI, 2016b).

This section of the dissertation places the challenges faced by climate change adaptation leaders in the Atlantic Region of Canada within a barriers diagnostic framework (Moser and Ekstrom, 2010). It also contributes to the research gap of identifying how barriers have been overcome (Eisenack et al., 2014). Further, it points out the important role played by leadership in addressing climate change adaptation barriers. It highlights some relevant aspects of leadership theory that have contributed to success in overcoming these barriers (Heifetz, 1994; Dhanasai and Parkhe, 2006; Eckman, 2006; Groves, 2007; Kouzes and Posner, 2007; Gray, 2008; Steen et al., 2009; Gebelein et al., 2010; Meijerink and Stiller, 2013; Mintzberg, 2013; Warren and Lemmen, 2014; Mintzberg, 2015).

6.3.5 Power

Informants interviewed exhibited a high degree of understanding of the relevant linkages between science, local, and policy knowledge power spaces for action and the benefits of bridging, brokering, and boundary activities. These leaders acknowledged that, to varying degrees, collaborative leadership (Gray, 2008), was required as part of effective adaptation practices (Adger et al., 2007). Climate change adaptation leaders also identified features of transdisciplinary leadership in both Gray's small/co-located type, such as informal connections and face-to-face processes, as well as large and dispersed type, such as multiple champions, brokerage positions, and knowledge translators (op cit., S128). Leaders also understood the importance of utilizing different power resources (Korpi, 1985) as the context requires, to address issues of collaboration (powering) and solving common problems (puzzling) (Hoppe, 2011).

Climate change adaptation leaders who were part of this dissertation have developed or are developing contextual intelligence (Nye, 2010; May, 2013) to address the barriers identified

in the previous section. Contextual intelligence as used in this dissertation is defined as "*the ability to understand context so that hard and soft power can be successfully combined into a smart power strategy*" (Nye, 2010: 327). This ability to understand context is developed through an appreciation of the role of followers, the value of strategic networks, and overall political skill (Nye, 2010). This dissertation acknowledges the importance of this framing for climate change adaptation leadership and extends contextual intelligence to include the integration of scholarship on spaces of power for action (Dengler, 2007), the identification and use of power resources (Korpi, 1985), and policy making as a process of both powering and puzzling (Hoppe, 2011). It is further supplemented by the transdisciplinary collaborative leadership framework of Gray (2008) to provide a more fulsome a view of contextual intelligence and the use of smart power (Nye, 2010) for climate change adaptation leadership.

For Kellerman (2012), context , leadership, and followership, make up equal sides of a conceptual triangle with each being of equivalent importance. Followers, by her definition, can be characterized as either isolates, bystanders, participants, activists, or diehards, depending on their level of commitment to a particular leadership situation. Context provides a crucible in which leaders engage and develop necessary competencies (Bennis and Thomas, 2002). Within this crucible new forms of engagement are needed that account for both leadership and followership in intergroup as well as intragroup settings (Kellerman, 2012). Luttrell et al. (2007) provide further guidance on how this crucible can be conceived - the intersection of power, as presented in this dissertation, with specific places (multi-level governance interactions) and specific spaces (adaptation entry points). Figure 18 presents Gaventa's power cube. This characterization asks diagnostic questions that can be useful in developing leadership contextual intelligence:

- Power: is it visible, hidden or invisible?

- Spaces: is power exercised in spaces that are provided/closed, invited, or claimed/created?

- Places: is the focus of power at local, national, or global (or multiple) levels?

The implications of this for the present discussion are that in developing climate change adaptation practices, contextual intelligence can be explicitly considered by leaders in a systematic and useful fashion. For instance, in developing a climate change adaptation leadership intervention such as a multi-level innovation network (as exemplified by the ACASA embedded case), the questions above can be used to analyze context. From there, a desired governance structure can be created that explicitly considers both formal and informal aspects of power, such as formal authority, influence, moral suasion, network (Nye, 2010) as well as desired collaborative leadership tasks (Gray, 2008) and potential innovation outputs (Keeley et al., 2013).

Figure 18 - Gaventa's Power Cube and Contextual Intelligence (from Luttrell et al., 2007)
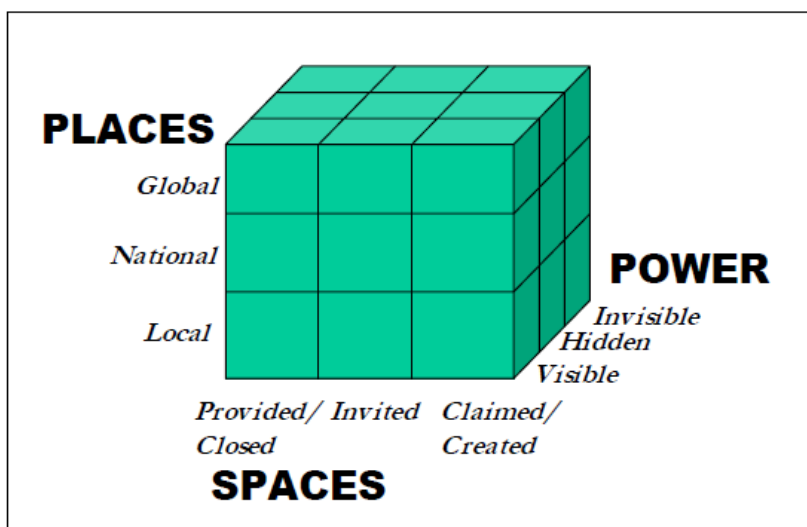
(*Source*: Gaventa, 2003)

6.3.6 Innovation

When reflecting on their leadership contribution to a particular adaptation entry point, climate change adaptation leaders identified successes in addressing both technical and adaptive challenges for adaptation innovation. These were placed in an innovation framework that mapped contributions made by leaders to ten adaptation innovation types. An example of a technical innovation was the development of visualization tools, such as CLIVE (UPEI, 2016b). An example of an adaptive innovation related to policy innovation (Huitema and Meijerink, 2010) was the framing of the Municipal Climate Change Adaptation Plan program of Nova Scotia (Nova Scotia, 2011). Another novel governance innovation was the creation of a citizens' climate authority in the town of Saint Andrews, New Brunswick (KI002, 2015).

When discussing innovation, other types of leadership behaviour were mentioned that primarily related to collaboration. Climate change adaptation leaders cited coordination, leveraging, adoption, relationship building, and enlightened discussion as their most valuable contribution. For instance, the federal Canadian Regional Adaptation Program's innovation network (Dhanasai and Parkhe, 2006) with the ACASA was cited as an example of this (KI026, 2015). The challenges raised by Gray (2008) for transdisciplinary collaborative leadership are reflected in the types of contributions cited. Often, however, these innovations are less tangible and more difficult to measure for evaluation purposes.

In addition, the results of adaptation occur over relatively long time frames (Walmsley, 2014). Adaptive innovation resulting from the exercise of climate change adaptation leadership faced policy evaluation challenges. These are inherent when embracing complexity and reflexivity in policy making: is complexity acknowledged and do leaders challenge established goals? (Huitema et al., 2011). In a Canadian context, there is opportunity for more focused

research in the area of adaptation innovation from both a technical and adaptive challenge perspective.

Through an explicit review of adaptation innovation (Keeley et al., 2013) it was observed that all types of innovation were important for leaders. When one considers climate change adaptation as an innovation process, network and engagement innovation are the first types that that come to mind. These types are in fact a hallmark of successful collaborative leadership. The research results in this thesis suggest that more explicit consideration of all ten (10) types of innovation, as well as their interrelationship, could increase the chances of successful climate change adaptation initiatives.

6.4 Climate Change Adaptation Leadership Practice Effectiveness

During the course of this research, a number of different leadership theory approaches were examined. These relate to both climate change adaptation leadership style, how leaders engage in the task of leadership, and functions, that is, what tasks leaders carry out (Glynn and De Jordy, 2010). In this framing, climate change adaptation leadership is viewed as a continuum of potential leadership styles which are context-dependent (Mintzberg, 2013). This is consistent with the post-charismatic/post-transformation view of general leadership theory (Parry and Bryman, 2006). Within this strand of leadership theory, CLT, as first examined by Uhl-Bien et al. (2007) and elaborated on for climate change adaptation leadership theory by Meijerink and Stiller (2013) are particularly useful. Specifically, CLT provides "*a framework for studying emergent leadership dynamics in relationship to bureaucratic superstructures*" (Uhl-Bien et al., 2007: 313) thus focusing on the tension between maintaining the status quo and creating new innovative organizational structures. CLT has also proven useful for disentangling leadership roles that multiple leaders may play within governance networks (Stiller and Meijerink, 2016).

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6.4.1 General Leadership Theory

Three questions have been addressed in the previous sections of this chapter: to what ends is climate change adaptation leadership focused, who or what leads climate change adaptation and how does climate change adaptation leadership occur? This section returns to general leadership theory to discuss the final avenue of exploration – What constitutes effective climate change adaptation? Some reflections on this question have already been discussed in section 6.3.6. Contributions cited in terms of the creation "*value and meaning*" (Poldony et al., 2010) are consistent with the post-charismatic/post- transformational leadership approach (Parry and Bryman, 2006) which embraces complexity and emergence (Uhl-Bien et al., 2007) and transdisciplinary, network-based collaboration (Gray, 2008). These leadership theories are further reflected by the fact that a number of leadership styles are used by climate change adaptation leaders in the Atlantic Region of Canada. These include: participative, shared, distributed, and supportive forms, and, in some instances, distributed/supportive styles (Mintzberg, 2013).

Shared leadership (Mintzberg, 2013), also identified as dual (Eckman, 2006) or co-leadership (Heenan and Bennis, 1999), is a special leadership style, or partnership, that shifts the locus of decision making power away from the individual to a more shared form. Co-leadership has been advocated as a way to address the adaptive challenge of climate change (Nhamo, 2009). Shared or dual leadership involves two "*people who can both command and follow, as the situation requires*" (Heenan and Bennis, 1999:19). Both leaders contribute to the fulfillment of leadership tasks (Zaccaro et al., 2013). In this dissertation, specific instances of dual leadership arrangements were observed, e.g. CCWFI (Vass, 2013), the Halifax RM Urban Forest Master Plan (HRM, 2013), and the University of Prince Edward Island's ACASA Secretariat (UPEI

2016a, UPEI 2016b). Pursuing co-leadership is a conscious decision that involves both sharing

responsibility and applying individual skills to address the complexity of climate change

(Nhamo, 2009). This is consistent with Gray's (2008) assessment of collaborative leadership.

As identified in this research, instigators of climate change adaptation exhibit a

distributed leadership style (Mintzberg, 2013). They are important for championing change

(Kotter, 2005) and act as climate change adaptation boundary workers who are attuned to

context, perspective, and the effective use of boundary objects (Lynch et al., 2008). They often

fulfill the role of super-agents (Dengler, 2007) to bridge science knowledge for local policy

action (Cook et al., 2013). Extension agents for climate change adaptation (Cohen and Waddell,

2009) play a supportive leadership role (Mintzberg, 2013). As observed in this dissertation, they

can work individually, as is the case of the Cape Breton Marconi Trail Adaptation Plan project

(ACAP, 2015), or as part of networks, in the case of the ACASA Decision Support Tool project

(UPEI, 2016a). Mobilizers for climate change adaptation display a distributed/supportive style

(Mintzberg, 2013), moving from instigator to extension agent as the context requires.

A final emerging theme in this dissertation is the acknowledgement by climate change

adaptation leaders that there is an important role played by champions in making significant

lasting change in organizational culture, community action and knowledge networks. The

champions identified by climate change adaptation leaders interviewed reflects the notion that a

dependent, dyadic relationship exists between leaders and champions. This relationship has been

identified as an important element within the climate change community.

The 2014 Canadian National Assessment identified a champion as *"...someone*

personally dedicated to the project, often a local community leader – who can bridge the gaps

between scientists, stakeholders and practitioners" (Canada, 2014: 75). Adaptation champions

are also seen to have the requisite initiative, enthusiasm and authority to implement change (Canada, 2014: 279). This is consistent with findings on community based processes that integrate scientists and decision makers (Vasseur, 2010; 2011). Local champions, particularly at the political level, are closely linked to the "*availability of resources and buy-in for adaptation implementation*" (Crawford-Boettcher, 2009). The presence of champions is seen as one important ingredient for climate change adaptation leadership (Meijerink and Stiller, 2013).

Use of champions necessitates the development of strategic alliances between individuals, and can be classified as: inter-personal, inter-firm (organizational), and developed for either tactical or strategic reasons (Graen, 2013). The implications from this dissertation is that champions may be one part of a dual leadership arrangement, heretofore unidentified in the climate change adaptation literature, and more akin to a strategic leadership alliance (Heenan and Bennis, 1999; Graen, 2013). As such, the role of the person identifying the champion (often a researcher) may be overlooked in such leadership arrangements. This is a potential area for future study.

Adopting a view of leadership as one that reflects a variety of leadership styles, has implications for developing competencies within a climate change adaptation leadership practice. Section 6.3.3 of this dissertation highlighted those technical and behavioural competencies used by climate leaders. Explicit development of competency in the various leadership styles, as presented in this dissertation, can be used as a way to expose climate change adaptation leaders to the various ways leadership is practiced. By starting with consolidating distributed and supportive leadership competencies, other styles such as shared or participative leadership can be explored later on in the career development process. Using this approach is consistent with the complexity heuristics framework of developing habits of mind (Rogers et al., 2013).

6.4.2 Complexity Leadership Theory

All functions of CLT (Uhl-Bien et al., 2007; Marion et al., 2013) are reflected in how climate change adaptation leaders approach adaptation entry points. Connective and political-administrative leadership functions are used most frequently.

Connective leadership functions constitute "*leadership activities aimed at realizing connectivity across different levels of government, policy sectors, and a large variety of actors. This is a prerequisite for realizing the administrative function within multilevel governance networks since parties need to reach an agreement on a shared vision and the pooling of resources which are needed for realizing that vision*" (Meijerink and Stiller, 2013: 252). This connective leadership is exemplified in this dissertation by the work of the Canadian RAC Program (NRCan, 2016) and ACASA (ACASA, 2016). Connective leadership is not without barriers as highlighted in section 4.2.4. However, leaders do recognize the positive policy implications of innovation networks (KI011, 2015). Arms-length bodies can provide arms-connective leadership for tackling a complex issue, particularly when climate change is seen as a threat multiplier.

Political-administrative functions "*… make necessary resources available, and monitor progress*" (Meijerink and Stiller, 2013: 253). In this research project this function can either be provided via a participative leadership style (KI002, 2015) in the case of the Town of Saint Andrews, or more shared leadership styles in the case of the current coordinating structured provided by UPEI to ACASA (KI028, 2016; KI029, 2016). In addition, all provinces have created specific sections within government to provide organizational leadership in climate change adaptation. These include the New Brunswick Climate Change Secretariat (KI009, 2015), the Prince Edward Island Climate Change Section, Department of Environment (KI011,

2015; KI026, 2105), the Nova Scotia Environment Climate Change Unit (KI014, 2015), and the

Newfoundland and Labrador Office of Climate Change (Newfoundland and Labrador, 2016).

These entities serve a distributed or supportive leadership function (Mintzberg, 2013).

Dissemination leadership involves "*translating newly developed ideas and practices into formal policies and institutions*" (Meijerink and Stiller, 2013: 253). This is exemplified in this dissertation through the work in ACASA and its role as an innovation network (Dhanasai and Parkhe, 2006) . It was specifically established as a collaborative effort (ACASA, 2016) as part of the broader RAC process "*to catalyze coordinated and sustained adaptation planning, decision-making and action, across Canada's diverse regions*" (NRCan, 2016). Dissemination leadership is demonstrated through a "*network of champions*" (KI025, 2015), who act as key instigators, mobilizers and extension agents, as described in section 6.2.2.1.

Adaptive leadership creates "*new ideas and innovative practices* [that] *result from fundamentally unpredictable interactions between individuals in the network*" (Meijerink and Stiller, 2013: 251). In the case of the Ecology Action Centre, mobilizers are engaging with non-traditional climate change champions, such as the volunteer emergency response sector, to create urgency and legitimacy for climate change adaptation (KI001, 2015). In a second example, the Nova Scotia Adaptation Work Plan is designed to create dialogue and action between existing silos within a bureaucratic structure (KI025, 2016; Nova Scotia, 2016).

Enabling leadership aims "*to create the necessary conditions for enabling adaptive leadership, and to manage the entanglement between administrative and adaptive leadership*" (Meijerink and Stiller, 2013: 247). While the entanglement between administrative and adaptive functions is evident, as documented in the previous discussion on barriers in sections 4.2.4 and 6.2.1.4, there has been acknowledgement by leaders interviewed for this research that

overcoming this entanglement is a key obstacle. For example, with respect to ACASA, this was

mentioned by federal (KI027, 2016; KI032, 2016), provincial (KI009, 2015; KI011, 2105;

KI014, 2015) and academic partners (KI007, 2016; KI028, 2016; KI029, 2016). In addition, one

Mayor saw disentanglement as one of their key roles in creating sustainable adaptation (KI002,

105). As well, in the case of the City of Charlottetown, the Sustainability Coordinator perceived

the management of disentanglement as one of their key roles in working across departments

(KI022, 2015).

The enhancements made to the CLT model by Meijerink and Stiller (2013) by adding

important political, connective and dissemination functions to Uhl-Bien et al. (2007), provide

depth in this dissertation for examining climate change adaptation leadership. The research

described here provides an opportunity to extend their work further by adding the initial

competency profiles to their model of CLT. Such an enhanced characterization of climate

change adaptation leadership through the development of a competency-based approach has

application for analysis of other Canadian leadership contexts, as well as graduate and post-

graduate academic programming, particularly as it relates to a discussion of apprenticeship,

which is described in section 6.6.

6.4.3 Temporality and Fluidity

Climate change adaptation leadership has a temporal dimension, requiring the use of

different functions and types at different points within a given adaptation entry point. This is

reflected in three embedded cases: the mainstreaming of adaptation within the City of

Charlottetown's ICSP (City of Charlottetown, 2010), the Atlantic Region's component of the

federal Regional Adaptation Collaborative Program (ACASA, 2016), and the approach to

climate change and disaster risk management employed by the Town of Saint Andrews, New

Brunswick (St. Louis and Killorn. 2014). The term fluidity was used by one of the leaders to

describe the process of leadership for climate change adaptation (KI025, 2015). Fluidity is used

here to capture that perspective in the sense of the ability to flow easily and, in particular with

"*smooth elegance or grace*" (Oxford, 2016, online). Fluidity is dependent on a clear awareness

of the various conceptualizations of contextual intelligence, leadership styles and leadership

functions (Woods et al., 2004), including how they might be applied to specific adaptive

challenges (O'Brien and Selboe, 2015a) in climate change adaptation practice (Adger et al,

2007).

In the case of the City of Charlottetown's ICSP (City of Charlottetown, 2010) as

described in section 5.2.4, political-administrative leadership initiated the process, connective

leadership continued the information gathering and sense making, which gave way to adaptive

and enabling leadership during the implementation phase. In another example, the Regional

Adaptation Collaborative Program (NRCan, 2016) displayed enabling leadership at its inception,

which allowed for connective leadership to develop as the innovation network matured. In

addition, the need for political-administrative leadership was identified, leading to the increased

role of the UPEI Climate Lab. Finally, the Town of Saint Andrews, starting from a distributed

and connective leadership style, developed the political-administrative leadership infrastructure

to embed and sustain climate change adaptation into the future.

These results are consistent with the observations of Imperial et al. (2016) related to

network governance and earlier work from the planning profession (Christensen, 1985). Both of

these studies posit that different roles are required at different times to address the challenges of

complexity and uncertainty. These include roles such as: "*pioneer, sponsor, thought leader,*

networker, steward, and facilitator" (Imperial et al., 2016; 129) or "*rule setter, administrator,*

bargainer, innovator and problem finder" (Christensen, 1985). This dissertation adds a number of additional leadership roles to this list, as described in section 5.2.2: instigator, mobilizer, and extension agent.

This view supports recent scholarship on climate change adaptation leadership which suggests tailoring and adjusting leadership style to the various subprocesses of the adaptation cycle (Vignola et al., 2017). From the perspective of this dissertation, approaching climate change adaptation leadership competency development through this multi-faceted lens is suggested.

6.4.4 Evaluation

Evaluation of climate change adaptation initiatives is still in its early stages, although some work has been done to guide research (Huitema et al., 2011). In Canada, with a focus on multi-level climate change adaptation governance, this is particularly challenging (Henstra, 2015). Adaptation programs often develop logic models to capture key areas of evaluation, e.g. the Clean Air Agenda for the Adaptation Theme (Environment Canada, 2010). Transitioning from less formal and anecdotal to more formalized evaluation of adaptation effectiveness will take concerted effort. Where formal evaluations are prerequisites for specific funding arrangements, they still tend to be presented as project outputs rather than more specific outcomes or longer term benefits (UKTSO, 2011). This was observed in the case of ACASA where metrics constituted outputs such as "*number of reports and documents released, number of new people engaged, number of reports downloaded, and number of tools created and released*" (UPEI 2016a; UPEI, 2016b). Further, as noted in section 6.3.6, climate change adaptation leaders identify their leadership contribution in non-technical areas such as

coordination, leveraging and relationship building that are less easy to conceptualize for evaluation. This dissertation identifies adaptation evaluation as an ongoing challenge for leaders.

Two further gaps in climate change adaptation effectiveness relate to the areas of succession planning and mentoring. Succession planning is important for ensuring the long term sustainability of adaptation initiatives. It is also important for the monitoring of adaptation effectiveness over time. Climate change adaptation apprenticeship and mentoring are viewed as important by leaders. One of the ways that this might be accomplished as part of a comprehensive climate adaptation practice would be through climate leadership apprenticeship. Apprenticeship is "*a work-study training method that teaches job skills through a combination of on-the-job training and technical training*" (Steen et al., 2009: 217). Effective mentoring is an important aspect of this apprenticeship (Henein and Morissette, 2007). This is further reflected in this dissertation, as intergenerational tension, as discussed in section 6.3.4, is seen as a particular institutional adaptation barrier.

Further, the destruction of leadership as an organizing research concept within the limits school of adaptation science could prove interesting for further inquiry. Under this view adaptation is limited by values, perceptions, processes and power structures within society (Adger et al., 2009), An adaptive challenge is, "*a challenge that draws attention to mind-sets including the assumptions and beliefs that underpin individual and shared attitudes and understandings of change itself* . [They] *are not only personal; they are political ..."* (O'Brien and Selboe, 2015a: 2). The findings of this dissertation suggest that, at least in some circumstances, leaders can be barriers to other leaders, thus imposing social limits to the exercise of climate change adaptation leadership.

6.5 An Archetype Climate Change Adaptation Leader

Archetypes are used in the leadership literature to provide guidance as to what constitutes the ideal or the optimal leader, manager or entrepreneur (Mayo and Nohria, 2005). An archetype is "*a very typical example of a certain person or thing*" (Oxford, 2017). The conceptual framing in section 2.7 used four questions to investigate climate change adaptation leadership. They were: *To What Ends is Leadership Focused? Who or What Leads Adaptation? How Does Adaptation Leadership Occur? What Constitutes Effective Leadership?* Research findings in relation to these four questions are used here to develop an archetypal climate change adaptation leader. I provide this overview of an archetype to synthesize findings presented. Through identifying the general characteristics of a climate change adaptation leader, it is then possible to develop evidence-based competency frameworks for both mentoring and apprenticeship.

A climate change adaptation leader uses flexibility in cognitive framing of meaning and sense-making for achieving adaptation objectives. They mainstream the particular policies and measures they are responsible for into development and business planning or sector decision making. They are not as concerned about the semantics of climate change adaptation as they are about contextualizing this adaptation to their particular adaptation challenge so that is makes sense to constituents.

A climate change adaptation leader acts either individually, or as part of broader work teams, organizations, or innovation networks. The number of years of professional career experience is not as important as is obtaining different multi-level governance experiences to explore how power is exercised in different settings, and how to best support collaboration. A leader understands the interrelationship of leadership, followership and context. They understand

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the complexities of collaboration and realize that it is a moral continuum requiring explicit framing and constant reflection as to its efficacy. Sometimes they play the role of *shared leader*, *instigator*, *mobilizer* or *extension agent*. These leaders possess a variety of technical and behavioural competencies that are applied to collaborative leadership tasks that are cognitive, structural, process-oriented, or network focused. If they do not have specific competencies, they seek them out through the creation of strategic alliances and ongoing leadership learning.

A climate change adaptation leader realizes that adaptation leadership, like adaptation itself, is a complex process. They have met and overcome any number of barriers to leadership action, including institutional barriers. These include having to navigate the potential pitfalls of bureaucratic intransigence, the generational divide, and those in power who would seek to destroy leadership initiative. They have developed or are developing contextual intelligence to understand their formal authority, its strengths and limits. This intelligence includes considering both technical and adaptive challenges as important for adaptation, as is their own sources of power for action. These leaders use collaboration as a mechanism to broker and bridge expertise in order to navigate boundary spaces for action. They capitalize on the relative strength of all players in multi-level governance networks, including those with differential power resources. They learn from these multi-level governance interactions. They understand the various innovation processes and types and use them to craft integrated adaptation innovation.

A climate change adaptation leader realizes, that to be effective, they must embrace complexity and collaboration and realize that their exercise of leadership fulfills a number of distinct functions that are fluid over time. They understand the value of and are competent in exercising participative, shared, distributed, and supportive leadership styles. They see this as constructive experimentation. They effectively apply evaluation techniques to monitor progress

and change course, if necessary. They realize the importance of planning for succession and mentoring of other climate change leaders. They see their professional development as an apprenticeship.

Appendix 14 suggests how this archetype might be applied to a hypothetical climate change adaptation organization.

6.6 Summary - Contextual Intelligence, Complexity, Fluidity, and Apprenticeship

A number of research strands from this dissertation can be integrated into a framework for developing a climate change adaptation leadership apprenticeship. This framework reflects the conceptual framing used to examine climate change adaptation leadership and key findings from the research related to contextual intelligence, complexity, and fluidity. Figure 19 presents the climate change adaptation leadership conceptual framing, developed in section 2.7 on the left hand side of the figure. The framing is combined with the dissertation research questions from section 1.2 in the middle of the figure. An example, from the middle section of Figure 19, is the diagnosis of barriers (Moser and Ekstrom, 2010), which relates to research question 1.3. On the right hand side of Figure 18 are concepts that emerged from this research that are useful for developing climate change adaptation leadership practice. They are: contextual intelligence (Nye, 2010; May 2013), technical and behavioural competencies (Steen et al., 2009), leadership style (Mintzberg, 2013) and function (Uhl-Bien et al., 2007; Meijerink and Stiller, 2013), and competency learning method format - formal *versus* experiential (Steen et al., 2009). In Chapter 7, research questions for further investigation will be mapped to this figure.

Figure 19 – Climate Change Adaptation Leadership Apprenticeship

Climate Change Adaptation Leadership Apprenticeship

To What Ends is Leadership Focused?

Who or What Leads Adaptation?

How Does Adaptation Leadership Occur?
- Hybridity
- Fluidity
- Temporality

Is it Effective?

Context

Entry Points

Barriers

Adaptation Practices

Competencies

Climate Change Adaptation

Leadership Styles

Leadership Functions

Evaluation & Contribution

Training

Mentorship

Succession Planning

Contextual Intelligence

Technical/Behavioural

- Participative
- Shared
- Distributed
- Supportive

- Political-Administrative
- Enabling
- Adaptive
- Connective
- Dissemination

Formal/Experiential

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CHAPTER 7 – CONCLUSION

> *"… leadership, the capacity to get things done, is a skill*
> *that can be improved like any other, from playing a musical instrument*
> *or speaking a foreign language to mastering a sport."*
> (Pfeffer, 2016)

7.1 Summary of Thesis and Research Objectives

The findings of this dissertation emphasize a fluid, hybrid approach to climate change adaptation leadership. Climate change adaptation leadership is informed by broader developments in post-charismatic/post-transformational leadership theory. This includes the influence of leadership style and function on meaningful and valuable outcomes. Through the collection of data from the Atlantic Region of Canada, analytic generalizations were made on the relevance of leadership to climate change adaptation practice. Findings reflect the notion that climate change adaptation leadership has characteristics of hybridity and fluidity that can be used to inform climate change adaptation leadership development and apprenticeship.

Chapter 1 began with a problem context that described the challenge posed by climate change and the role of leadership in climate change adaptation. The research setting and empirical context for a study in the Atlantic Region of Canada were set out. Two overarching research objectives, with six specific questions in support of a conceptual framing were presented. Research objectives were related to the assessment of *adaptation leadership processes* and *adaptation practice effectiveness*.

Chapter 2 presented a literature review of climate change adaptation, climate governance, adaptation practices, and leadership. In the section on leadership, the relevance of Mintzberg (2013), Heifetz (1998), Uhl-Bien et al. (2007), and Meijerink and Stiller (2013) were described. Climate change adaptation leadership was defined as a social influence process, operating under

constraints (Pfeffer, 2000) to create meaning and value (Podolny et al., 2010), incorporating best adaptation practices (Adger et al., 2007). This was further elaborated in a conceptual framing to guide research on climate change adaptation leadership. Figure 3 summarized this conceptual framing (after Pfeffer, 2000; Podolny et al., 2010; Smit et al., 2010; May, 2015).

Chapter 3 described the methodology and methods used to collect data for this research. A regional, embedded case study using multiple sources of data was used to explore the conceptual framing presented in Chapter 2 and applied in the Atlantic Region of Canada. The relevance of the case study area was described with a particular focus on climate change adaptation challenges. Then, the research methods were described, which included key informant interviews, literature review, participant observation, and site visits. The method of data analysis was described, including coding and preparation of a comprehensive data corpus. Finally, six research challenges along with specific mitigation strategies were described.

Chapter 4 highlighted the first set of findings related to research objective 1 on *climate change adaptation leadership processes*. Climate change adaptation entry points used by climate change adaptation leaders were summarized, which matched the conceptual framing. Seven embedded cases were further explored. Next, profiles of the climate change adaptation leaders were developed, which described gender, stage of career, and multi-level governance experience. Then, a review of the technical and behavioural competencies used by climate change adaptation leaders was made, which emphasized skills such as collaboration, bridging for results and communication. Next, the barriers that climate change adaptation leaders had to overcome were explored. Two particular barriers, bureaucratic fault lines and intergenerational tension were highlighted. After that, the chapter examined power, in particular spaces of power for action, as viewed by climate change adaptation leaders. The intersection of science, local and

policy knowledge spaces was emphasized, as was the use of contextual intelligence by climate change adaptation leaders. The chapter concluded by highlighting the contributions made by climate change adaptation leaders related to coordination, leveraging, and relationship building.

Chapter 5 presented results of analysis on *climate change adaptation leadership practice effectiveness*. First, the links to general leadership theory were made by assessing the relative importance of individual, organization or team perspectives for climate change adaptation leadership. This was followed by a consideration of technical versus adaptive challenges faced by climate change adaptation leaders, with an emphasis on adaptive challenges. Climate change adaptation leadership styles were explored. Findings indicated the use of participative, shared, distributed, supportive, and distributed/supportive styles. The importance of champions was also identified. Then, climate change adaptation leadership functions were explored using CLT. All dimensions of this theory, political-administrative, enabling, adaptive, connective and dissemination were demonstrated by climate change adaptation leaders. Finally, climate change adaptation leadership and temporality were examined, with three cases illustrating that leadership style and function change over time within specific climate change adaptation entry points. Chapter 5 concluded with observations related to need for more robust evaluation of climate change adaptation leadership, succession planning, mentoring, and the limits to the exercise of leadership.

Using a specific Canadian context, Chapter 6 discussed findings in Chapters 4 and 5. It situates these findings in light of an emerging climate change adaptation leadership practice, based on an explicit climate change adaptation apprenticeship. It focuses on leadership that is a hybrid, fluid exercise of social influence and meaning making. In terms of climate change *adaptation leadership processes* it discusses climate change adaptation entry points as starting

points for "*journeys of inquiry*" (Kløcker Larsen et al., 2012:16) and highlights the high degree

of choice and flexibility leaders have in approaching climate change adaptation. It places the

profile of climate change adaptation leaders in a multi-level, multi-role governance context that

makes use of collaborative leadership to surmount leadership challenges. It highlights the

increasing role of women in climate change adaptation leadership. Competencies used by climate

change adaptation leaders reflect the applicability of scholarship on collaborative leadership,

innovation networks and complexity leadership.

Then, leadership barriers to climate change adaptation were examined to substantiate the

applicability of a diagnostic approach. Specific enhancements were made to incorporate a

consideration of bureaucratic fault lines and intergenerational tension. Next, analysis of power

extended the perspective of contextual intelligence from the role of followers, the value of

strategic networks, and overall political skill to include spaces of knowledge power for action,

use of power resources, and recognition of both powering and puzzling as important for policy

making that moves from knowledge to action. It further confirmed the value of the

transdisciplinary, collaborative leadership approach for climate change adaptation leadership

practice.

In terms of climate change *adaptation leadership practice effectiveness*, the dissertation

presented CLT as a way to "*disentangle*" (Stiller and Meijerink, 2016) governance for climate

change adaptation. It highlighted the relevance of dual leadership, strategic alliances, and a

continuum of styles (Mintzberg, 2013) for climate change adaptation leadership. The chapter

also challenged the prevailing view of the role of champions for climate change adaptation, by

suggesting that champions are part of broader strategic alliances, and their role varies by

leadership intervention. It also highlighted the role of others, such as researchers, in identifying

who champions are. The chapter went on to suggest a way to integrate the various functions of CLT with the initial suite of competencies gathered in the Atlantic Region of Canada (Table 11).

Then, the temporality and fluidity of climate change adaptation leadership was elaborated as a means to further understand the interaction of context, leadership requirements, and their change over time (Imperial et al., 2016). Next, a discussion of the need for continued formalization of how climate change adaptation leadership is evaluated was undertaken. Finally, the chapter ended with a discussion of the adaptive challenges faced by climate change adaptation leaders related to succession planning and mentoring. A proposed organizing framework for addressing these was presented.

7.2 Research Contributions

The research that forms this dissertation contributes to climate change adaptation leadership theory and practice in a number of ways. Climate change adaptation leadership, as an analytical construct, is examined systematically in a Canadian context, using a conceptual framing which integrates the general anatomy of climate change adaptation with leadership theory. The specific leadership theories of relevance are CLT, collaborative leadership and innovation. This combined approach to adaptation and leadership creates the potential for using findings from the Atlantic Region of Canada to advance leadership development for climate change adaptation. The archetype presented can be scaled upwards, downwards and sideways to include the leadership needs of multi-level governance (Hooghe and Marks, 2001). Further, the research envisions a climate change adaptation leadership practice based on mentoring and apprenticeship.

First, the dissertation adds to the body of environmental leadership scholarship that treats leadership as an analytical challenge. Through validating the relevance of CLT for climate

change adaptation, a competency-based approach documents an initial suite of both technical and behavioural skills that climate change adaptation leaders are using. These competencies are mapped to a hybrid leadership model that combines complexity leadership, transdisciplinary-collaborative and innovation leadership theories. This development, in conjunction with foundational work in elaborating what constitutes climate change adaptation contextual intelligence, has direct applicability for the design of leadership development programs. In addition, the dissertation makes linkages with post-charismatic/post-charismatic leadership theory to advocate both hybrid approaches to selecting particular leadership styles and functions depending on the context, as well as a fluidity of these styles and functions over time.

Second, the dissertation highlights the untapped potential of considering climate change adaptation leadership as a shared or dual responsibility. There is little academic literature on environmental leadership that has systematically interrogated the phenomenon of dual leadership and how to develop competency in maintaining strategic alliances. In the same vein, this dissertation examines the role of champion as part of a shared leadership model. The identification of a co-dependent, dyadic relation between leader and champion extends the conceptual idea of champion to include a variety of roles in which champions might play in climate change adaptation leadership. The roles identified are: pre-champions, mini-champions, key influencers, politicians, and networks of champions. Champions can also be categorized with respect to the functions they play in climate change adaptation leadership. Champions are useful partners in inter-personal, inter-firm (organizational), tactical, or strategic situations (Graen, 2013). This dissertation also documents the role of innovation networks in fostering climate change adaptation leadership and how these innovation networks can be explicitly constructed.

Third, findings in the Atlantic Region of Canada related to the exercise of power validated the usefulness of contextual intelligence for climate change adaptation leadership. Contextual intelligence is given more fulsome description as an essential component of climate change adaptation leadership. Recommendations are made as to how contextual intelligence for climate change adapation can be developed. This treatment has practical applications in framing of climate change adaptation leadership practices using power-based considerations, such as developing competency-based profiles. A specific example of this is in the validation of power, risk management and learning/adaptation for adaptive collaborative risk management (May and Plummer, 2011).

Fourth, a diagnostic approach which investigates barriers to climate change adaptation (Moser and Ekstrom, 2010) can be usefully extended to examining climate change adaptation leadership. In the Atlantic Region of Canada, climate change adaptation leaders identified barriers in understanding, planning and decision making, and managing adaptation. More importantly, they described how they overcame these barriers in order to generate adaptation innovation which has been highlighted as a research gap (Eisenack et al., 2014). These findings can be used in an anticipatory way to enhance Canadian experience on "*learning with local help*" (Cohen et al., 2006: 331).

7.3 Reflections

As the study was intended to capture multi-level governance perspectives, in the initial phases of the study, it was challenging to engage with potential key informants at the federal level. This was due, in a large part, to communication and access-to-scientist protocols of the federal government in power at the time. In a later stage, late fall of 2015 and early 2016, this situation changed after a general election, and it became easier to access federal scientists and

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adaptation program managers. Without their perspective, this research would not have been complete.

Despite the fact that time in the field was limited in terms of fostering the connections and trust-building, key informants were open and willing to share their thoughts. This included their perspective on the technical and adaptive challenges of climate change adaptation leadership, barriers, successes, and evaluation of what could be done to improve adaptation interventions in the future. An important part of this was done at the beginning of the study when respected contacts from the Atlantic Region, leaders in their own right, were asked to nominate of potential contacts. This study took advantage of existing relationships that paved the way for successful interviews. In retrospect, the leadership views of these respected initial contacts could have been better captured in the research and incorporated into findings.

Fortunately, there was an opportunity for a second week-long field trip to Prince Edward Island in early 2016. By that time, the majority of findings were already developed. This fieldwork provided an opportunity to add key informants to the study, review the relevance of initial findings, and re-interview a key informant to discuss results of data analysis.

One of the research challenges identified in section 3.7 was the potential for elite key informants, familiar with the interview process, to manipulate and steer interviews thereby influencing the results. While the situation did arise on two (2) occasions, there was enough latitude in the interview protocol to recognize cues, reword questions, take interview notes, or triangulate responses by other means, such as participant observation or document review.

Finally, another research challenge identified in section 3.7 was how to develop useful, broader insights and inferences from different cultural and geographic contexts. At the same time, there was a need to develop a series of embedded case studies that were regionally

representative. In hindsight, there was the appearance of a lack of representation of one of the provincial contexts, Newfoundland and Labrador. This occurred, partially as a result of the lack of leader responses to the initial call for interviews. No one from the province indicated an interest to participate. It was also due to the way in which cases were determined (the process was informant-led). It should be noted that the province was an active member of the ACASA case study, so there was partial representation in this thesis. In terms of a First Nations perspective, although a specific embedded case was not selected for in-depth review, there was a relevant key informant who provided their views on leadership. In addition, other than CCWFI, there was no specific industry such as agriculture or forestry represented. In future, studies of climate change adaptation leadership in such a regional case study should be sensitive to this.

7.4 Questions for Further Study on Climate Change Adaptation Leadership Practice

This dissertation highlights six key questions for future study in the development of a sound climate change adaptation leadership practice. These questions are:

Research Question 1 (R1): How can the literature on **women and leadership** contribute to the development climate change adaptation leadership and sound adaptation practices?

Research Question 2 (R2): What specific institutional factors contribute to the development of **bureaucratic fault lines** which impede progress on climate change adaptation? How can this barrier be overcome?

Research Question 3 (R3): How can the **intergenerational tension** documented be explored to engage actors and design academic programs that address this? How can this tension be considered as part of climate apprenticeship and climate mentoring?

Research Question 4 (R4): How can the perceived **destruction of leadership** act as a hyper-barrier or structural limit to climate change adaptation?

Research Question 5 (R5): How can the concept of **contextual intelligence** be more effectively integrated into climate change adaptation leadership practice? How can it be operationalized?

Research Question 6 (R6): How can specific Canadian case studies, such as the Atlantic Climate Adaptation Solutions Association or similar Regional Adaptation Collaborative, be used to investigate emerging trends in the use of **innovation networks**, that includes climate change adaptation evaluation challenges, opportunities for developing best practices, and metrics of success?

Research Question 7 (R7): How can **succession planning** and **mentoring** be integrated into a comprehensive model of climate change adaptation leadership? Is there a role for **dual or co-leadership** models?

Research Question 8 (R8): How can the structure provided by Figure 18 be used to inform and improve existing climate change leadership knowledge for the development of a **climate change adaptation leadership apprenticeship** program?

The interrelationship of the above questions to the conceptual framing as developed in this dissertation is presented in one final schematic. Figure 20 is a representation of the interrelationship of key findings that emerged from this dissertation as a rubric for further investigation, along with a mapping of the eight research questions developed for further study. These research questions are mapped as they relate to apprenticeship (Steen et al., 2009) in climate change adaptation leadership as an overarching recommendation (research question 8). The conceptual framing adapted from Smit et al. (2000) and presented in section 2.7 and Appendix 1 asked four questions and are shown along the left hand side of Figure 19. Research question 1 on women and leadership (Coughlin et al., 2005; Ely and Rhode, 2010) relates to the

question of who leads climate change adaptation. Research question 4 on the destruction of leadership and social limits to adaptation (Adger et al., 2009) relates to the question - is climate change adaptation leadership effective? On the right hand side of Figure 19 are concepts from leadership theory that emerge as useful for developing climate change adaptation leadership practice. One is contextual intelligence (Nye, 2010; May 2013) as reflected in research question 5, in support of further research on the view of leadership as a continuum (Mintzberg, 2013) and comprising a number of functions to address leadership complexity (Uhl-Bien et al., 2007; Meijerink and Stiller, 2013). In the middle of Figure 19 there are a series of themes explored in this dissertation that support both the conceptual framing and these views of leadership. Research question 2 relates to the notion of a relevant institutional barrier to adaptation (Moser and Ekstrom, 2010) – bureaucratic fault lines (Savoie, 2013). Research question 6 highlights the need for further research on the evaluation of climate change adaptation entry points in Canadian contexts (Henstra, 2015). Finally, research questions 3 and 7 are intended to highlight certain adaptive challenges (O'Brien and Selboe, 2015a) for developing apprenticeship (Steen et al., 2009) in climate change adaptation leadership.

Figure 20 – Research Questions for Climate Change Adaptation Leadership Apprenticeship


```
              Climate Change Adaptation Leadership Apprenticeship
                                    (R8)

  ┌─────────────────┐    ┌──────────────────────┐    ┌──────────────────────┐
  │ To What Ends is │    │       Context        │    │ Contextual Intelligence│
  │ Leadership      │    │     Entry Points     │    │         (R5)         │
  │ Focused?        │    │       Barriers       │    │                      │
  └─────────────────┘    │        (R2)          │    └──────────────────────┘
                         │ Adaptation Practices │
                         │     Competencies     │    ┌──────────────────────┐
  ┌─────────────────┐    └──────────────────────┘    │ Technical/Behavioural│
  │ Who or What     │                                 └──────────────────────┘
  │ Leads Adaptation?│
  │      (R1)        │    ┌──────────────────────┐    • Participative
  └─────────────────┘    │ Climate Change       │    • Shared
  ┌─────────────────┐    │   Adaptation         │    • Distributed
  │ How Does        │    │ Leadership Styles    │    • Supportive
  │ Adaptation      │    │ Leadership Functions │
  │ Leadership Occur?│   │ Evaluation &         │    • Political-
  │  • Hybridity    │    │   Contribution       │       Administrative
  │  • Fluidity     │    │       (R6)           │    • Enabling
  │  • Temporality  │    └──────────────────────┘    • Adaptive
  └─────────────────┘                                 • Connective
  ┌─────────────────┐    ┌──────────────────────┐    • Dissemination
  │ Is it Effective?│    │      Training        │
  │      (R4)       │    │     Mentorship       │    ┌──────────────────────┐
  └─────────────────┘    │ Succession Planning  │    │  Formal/Experiential │
                         │     (R3, R7)         │    └──────────────────────┘
                         └──────────────────────┘
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7.5 Conclusion

This dissertation summarizes the results of a regional case study research approach using nested case studies from the Atlantic Region of Canada to examine climate change adaptation leadership. My research confirms that climate change adaptation and adaptation practices are better informed through the framing of leadership as a fluid, continuous and complexity-based process. My research adds to the existing body of environmental leadership scholarship by continuing to consider leadership as an analytic construct, invigorating discussion on the role of

shared leadership for climate change adaptation, highlighting a more complete characterization of the concept of champion, strengthening an understanding of innovation networks, adding depth to the concept of contextual intelligence for climate change adaptation leadership, and verifying the validity of the barriers approach to diagnosing the adaptive challenge of climate change.   My research also uncovers competencies that can be learned, reflected upon and incorporated into climate change adaptation leadership practice. Approaching the complexity challenge of climate change adaptation leadership does not mean being 'uncertainty avoidant' but rather perceiving uncertainty as a tool for promoting the emergence of knowledge, creativity and learning (Marion, 2013).

Scholars have characterized leadership as an elusive science, yet others deemed leadership as important for creating sustainable climate change adaptation in complex decision environments. Wicked problems, such as climate change, do not have to be intractable (Levin et al., 2012). What is required is a multifaceted, evidence-based analytical approach (Pfeffer and Sutton, 2006) with a complexity lens on the inter-relationship of leaders and followers and the contexts in which they operate (Rumsey, 2013b; Uhl-Bien et al., 2007). Within this perspective, agency and leadership operate as a fluid continuum (Mintzberg, 2013). Fluidity encompasses "*smooth elegance or grace*" (Oxford, 2016).

A Canadian political scientist, coincidentally from Atlantic Canada, in the title of his book, asks, "*POWER: Where is it?*" (Savoie, 2010). Power, the ability to use authority and influence, is not so difficult to situate once those who develop the skill to practically use contextual intelligence are identified (Nye, 2010). An understanding of climate change adaptation barriers (Moser and Ekstrom, 2010) and limits (Adger et al., 2009) can advance more rigorous and successful climate adaptation practices (Adger et al., 2007) that underscore the

importance of leadership and skillful engagement (O'Brien and Selboe, 2015b). Tailoring of leadership style to the different stages of the adaptation process is increasingly seen as important (Vignola et al., 2017). At the head of Chapter 6 is a quote from one of the key informants in this dissertation. It is fitting to close with their perspective of climate change adaptation leadership.

"We need very fluid leadership - people who can share power. We need to encourage people working in this field. Not to just learn about the climate science...but also to reflect on the kind of leadership needed in these difficult and challenging times" (KI025, 2015).

REFERENCES

21Inc. 2016. Profile. Ramona Doyle. [on line]
http://www.21inc.ca/index.php/en/programs/under-40-summit/pei-delegation/item/405-ramona-doyle

Adger, W.N. 2006. Vulnerability. *Global Environmental Change*, 16, 268-281.

Adger, W.N., Agrawal, S., Mirza, M.M.Q., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R., Smit, B. and Takahashi, K. 2007. Assessment of adaptation practices, options, constraints and capacity. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, (eds.), Cambridge University Press, Cambridge, UK, 717-743. [online]
http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch17.html

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J., and Wreford, A. 2009. Are there social limits to adaptation to climate change? *Climatic Change*, 93, 335–354.

Anderies, J.M., Walker, B.H. and Kinzig, A.P. 2006. Fifteen weddings and a funeral: case studies and resilience-based management. *Ecology and Society*, 11, article 21. [online]
http://www.ecologyandsociety.org/vol11/iss1/art21/

Anderson R., Crabtree B.F., Steele, D.J., and McDaniel, R.R. 2005. Case Study Research: the View From Complexity Science. *Qualitative health research*. 15(5):669-685.

Andrade Pérez, A., Fernández, B.H. and Gatti, R.C. (eds). 2010. Building Resilience to Climate Change: Ecosystem-based adaptation and lessons from the field. International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland

Andresen, S. and Agrawal, S. 2002. Leaders, pushers and laggards in the making of the climate regime. *Global Environmental Change*,12, 41–51.

Armitage, D. 2008. Governance and the commons in a multi-level world. *International Journal of the Commons*, 2(1): 7-32.

Armitage, D. and Plummer, R. 2010. Integrating perspectives on adaptive capacity and environmental governance, chapter 1, in *Adaptive Capacity and Environmental Governance*, Armitage, D. and R. Plummer (eds.), 1-19; Springer, Berlin.

Arora-Jonsson, S. 2011. Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change*. 21: 744–751.

Association of Climate Change Officers (ACCO). 2011. *Core Competencies for Climate Change Officers and Professionals* [online] http://www.accoonline.org/certification-competencies.html .

Association of Climate Change Officers (ACCO). 2016. *Women's Climate Collaborative*. [online] http://www.womensclimate.org/ .

Atlantic Climate Adaptation Solutions Association (ACASA, 2011). *Nova Scotia Atlantic Climate Adaptation Solutions Project NEWSLETTER*, volume 4, October [online] https://atlanticadaptation.ca/en/islandora/object/acasa%3A646 .

Atlantic Climate Adaptation Solutions Association (ACASA). 2016. *About ACASA* [online] http://atlanticadaptation.ca/acasa/ .

Atlantic Climate Adaptation Solutions Association (ACASA). 2011. *SALTWATER INTRUSION and CLIMATE CHANGE*, Prince Edward Island Department of Environment, Labour and Justice, Charlottetown [online] http://www.gov.pe.ca/photos/original/cle_WA1.pdf

Atlantic Coastal Action Program (ACAP). 2015. *Climate Change Adaptation Plan for the Marconi Trail*, [online] http://www.acapcb.ns.ca/#!Climate-Change-Adaptation-on-the-Marconi-Trail/c7ol/55534f6b0cf21fee1387cddc April

Attride-Stirling, J. 2001. Thematic networks: an analytic tool for qualitative research. *Qualitative Research*. 1(3): 385-405.

Averyt, K. 2010. Are We Successfully Adapting Science to Climate Change? *Bulletin of the American Meteorological Society (BAMS)*. June, 723-726.

Baird, J., Plummer, R. and Pickering, K. 2014. Priming the Governance System for Climate Change Adaptation: The Application of a Social-Ecological Inventory to Engage Actors in Niagara, Canada. *Ecology and Society*. 19(1): 3. [online] http://dx.doi.org/10.5751/ES-06152-190103

Barnes, J., Dove, M., Lahsen, M., Mathews, A., McElwee, P., McIntosh, R., Moore, F., O'Reilly, J., Orlove, B., Puri, R., Weiss, H., and Yager, K. 2013. Contribution of anthropology to the study of climate change. *Nature Climate Change*, 3, June, 541-544.

Barnett, J. and O'Neill, S. 2010. Maladaptation: Editorial. *Global Environmental Change*, 20, 211–213.

Bay of Fundy Environmental Partnership (BoFEP), 2016a. *One hundred years of monitoring in the St. Croix Estuary*, summary report.

Bay of Fundy Environmental Partnership (BoFEP), 2016b, BoFEP Chair Recognized with GOMC Award. [online] http://www.bofep.org/wpbofep/wp-content/uploads/2016/07/2016_summer.htm .

Bennis, W.G. and Nanus, B. 1985. *Leaders: The strategies for taking charge*, Harper & Row, New York.

Bennis, W.G. and Thomas, R.J. 2002. *Geeks & Geezers: How Era, Values and Defining Moments Shape Leaders.* Harvard Business School Press, Boston.

Berkes, F. and Ross, H. 2013. Community Resilience: Toward an Integrated Approach. *Society and Natural Resources*, 26, 5-20.

Bidwell, D., Dietz, T. and Scavia, D. 2013. Fostering knowledge networks for climate adaptation. *Nature Climate Change*. 3, July, 610-611.

Bizikova, L., Burch, S., Cohen, S. and Robinson, J. 2009. A participatory integrated assessment approach to local climate change responses: Linking sustainable development with climate change adaptation and mitigation, chapter x in *Climate Change, Ethics and Human Security*, K. O'Brien, St Clair, A. and Kristofferson, B. (eds.), Cambridge University Press, Cambridge.

Bizikova L., Neale, T. and Burton, I. 2008. *Canadian communities' guidebook for adaptation to climate change. Including an approach to generate mitigation co-benefits in the context of sustainable development*. First Edition. Environment Canada and University of British Columbia, Vancouver.

Black, S.A., Groombridge, J.J. and Jones, C.G. 2011. Leadership and conservation effectiveness: finding a better way to lead. *Conservation Letters*. 4: 329-339.

Blomme, R.J. 2012. How Managers Can Conduct Planned Change in Self-organising Systems: Actor-Network Theory as a Perspectiev to Manager's Actions. *International Journal of Business Administration*, 3:5, 9-22.

Bourgon, J. 2011. *A New Synthesis of Public Administration: Serving in the 21st Century*. McGill-Queens University Press, Montreal.

Boyle, G. 2010. Cities and climate change: leading to a low carbon London. Chapter 18 in Wilson G., P. Furniss & R. Kimbowa eds., *Environment, Development and Sustainability Perspectives and cases from around the world*. Oxford University Press, Oxford, 185-193.

Brass, D.J. and Burkhardt, M.E. 1993. Potential Power and Power Use: An Investigation of Structure and Behavior. *The Academy of Management Journal*, 36(3), 441-470.

Bray, Z. 2008. Ethnographic approaches, chapter 15 in della Porta, D. & Keating, M. (eds.) 2008. *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective*. Cambridge University Press, Cambridge, UK, 296-315.

Bronen, R. and Chapin III, F.S. 2013. Adaptive governance and institutional strategies for climate-induced community relocations in Alaska. *Proceedings of the National Academy of Sciences (PNAS)*, 110(23), 9320–9325.

Brown, S., 2015a. *"We have the best life there ever was": Linking sense of place and adaptive capacity in Nova Scotia's coastal communities*. Masters thesis, Environment and Resource Studies, University of Waterloo.

Brown, S. 2015b. Personal communication via Skype, April 1[st] .

Burch, S. 2010. Transforming barriers into enablers of action on climate change: Insights from three municipal case studies in British Columbia, Canada. *Global Environmental Change*. 20: 287–297.

Burch, S., Andrachuk, M., Carey, D., Frantzeskaki, N., Schroeder, H., Mischkowski, N., and Loorbach, D. 2017. Governing and accelerating transformative entrepreneurship: exploring the potential for small business innovation on urban sustainability transitions . *Current Opinion in Environmental Sustainability* , 22:26–32.

Burch, S., Shaw, A., Dale, A., and Robinson, J. 2014. Triggering transformative change: a development path approach to climate change response in communities. *Climate Policy.* 14:4. 467-487.

Burn, S. 1991. Social Psychology and the Stimulation of Recycling Behaviors: The Block Leader Approach. *Journal of Applied Social Psychology*. 21:8. 611-629.

Burton, I. 2008. Moving Forward on Adaptation. Chapter 10, in *From Impacts to Adaptation: Canada in a Changing Climate 2007*. D. Lemmen, F.J. Warren, J. Lacroix and E. Bush (eds.) Government of Canada. Ottawa.

Burton, I., Bizikova, L. Dickinson, T. and Howard, Y. 2007. Integrating adaptation into policy: upscaling evidence from local to global. *Climate Policy*.7:4, 371-76.

Burton, I. and van Aalst, M. 2004. *Look Before You Leap: A Risk Management Approach for Incorporating Climate change into World Bank Operations*. The World Bank, Environment Department Papers, Climate Change Series, Paper 100.

C40 Cities. 2017. *C40 Blog, Women4Climate*. [on-line]. http://www.c40.org/blog_posts/women-4-climate

C-Change. 2016. International University Community Research Alliance (ICURA). Canada-Caribbean Coastal Climate Adaptation Strategies. [on-line]
http://www.coastalchange.ca/index.php/the-project/description

Canadian Climate Change Leadership Network (CCCLN). 2016. [on line] www.cccln.ca

Cape Breton Regional Municipality (CBRM), 2014. *Municipal Climate Change Action Plan (MCCAP) For the Cape Breton Regional Municipality: Final Report*, CBCL Limited, April.

Carter, T.R., Jones, R.N., Lu, X., Bhadwal, S., Conde, C., Mearns, L.O., O'Neill, B.C., Rounsevell, M.D.A. and Zurek, M.B. 2007. New Assessment Methods and the Characterisation of Future Conditions. In M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*., Cambridge University Press, Cambridge, UK, 133-171.

Carvajal-Escobar, Y., Quintero-Angel, M. and Garcia-Vargas, M. 2008. Women's role in adapting to climate change and variability. *Advances in Geosciences*, European Geosciences, Union, 2008, 14, 277-280.

Cash, D. W., Adger, W.N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L. and Young, O. 2006. Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and Society* 11(2): 8. [online] URL: http://www.ecologyandsociety.org/vol11/iss2/art8/

Cash, D.W. and Moser, S. 2000. Linking global and local scales: designing dynamic assessment and management processes. *Global Environmental Change*. 10, 109-120.

Chambwera, M., G. Heal, C. Dubeux, S. Hallegatte, L. Leclerc, A. Markandya, B.A. McCarl, R. Mechler, and J.E. Neumann, 2014: Economics of adaptation. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach,M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 945-977.

Charles, J. 2015. Personal communication. April 17[th] .

Christensen, K.S. 1985. Coping with Uncertainty in Planning. *Journal of the American Planning Association*, 51(1), 63-73. [online] http://dx.doi.org/10.1080/01944368508976801

Chynoweth, A., May, B., Fenech, A., MacLellan, J.I., Comer, N. and MacIver, D. 2011. Tools for integrating climate change and community disaster management in Canada. *Practical Solutions for a Warming World: American Meteorological Society Conference on Climate Adaptation*. July. [online] http://ams.confex.com/ams/19Applied/webprogram/Paper190059.html

City of Charlottetown, 2010. *Integrated Community Sustainability Plan, City of Charlottetown, PEI*. Stantec Consulting Ltd., February.

City of Charlottetown, 2012. Comprehensive Waterfron Master Plan, FINAL REPORT, Ekistics Planning and Design, December, [online] http://city.charlottetown.pe.ca/pdfs/Charlottetown-Waterfront-Final-2012_12_19.pdf

City of St. Catharines. 2011. *Tending the Garden City: The City of St. Catharines Sustainability Strategy*, August.

City of Windsor, 2012. *Climate Change Adaptation Plan*. Ontario, Canada, September.

Cohen, S., Neilsen, D., Smith, S., Neale, T., Taylor, B., Barton, M., Merritts, W., Alila, Y., Shepherd, P., McNeill, R., Tansey, J., Carmichael, J., and Langsdale, S. 2006. Learning With Local Help: Expanding the Dialogue on Climate Change and Water Management in the Okanagan Region, British Columbia, Canada. *Climatic Change*. 75. 331-358.

Cohen S.J. and Wandell, M. 2010. *Climate Change in the 21st Century*, McGill-Queens University Press, Montreal.

Collinson, D. 2006. Rethinking followership: A post-structuralist analysis of follower identities. *The Leadership Quarterly*. 17, 179– 189.

Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2010. *Adaptation science: Opportunities and responses to climate change impacts*. Climate Adaptation Flagship, June.

Conger, J.A. 2010. Leadership Development Interventions: Ensuring a Return on the Investment. In N. Nohria and R. Khurana (eds). *Handbook of Leadership Theory and Practice: A Harvard Business School Centennial Colloquim*. Harvard Business Press, Boston. 709-738.

Cook, C.N., Mascia, M.B., Schwartz, M.W., Possingham, H.P. and Fuller, R.A. 2013. Achieving Conservation Science that Bridges the Knowledge-Action Boundary. *Conservation Biology*. xx. 1-10.

Coughlin, L., Wingard, E. and Hollihan, K. (eds). 2005. *Enlightened Power: How Women Are Transforming the Practice of Leadership*, Jossey-Bass, San Francisco.

Crawford-Boettcher, E. 2009. *Bridging Science and Policy for Community Climate Change Adaptation: Is Climate Science "Useable" for Local Practitioners?* Report, Adaptation and Impacts Research Division, Environment Canada, April.

Crona, B. and Bodin, Ö. 2010. Power Asymmetries in Small-scale Fisheries: a Barrier to Governance Transformability? *Ecology and Society,*15(4), 32. [online] http://www.ecologyandsociety.org/vol15/iss4/art32/

Crutchfield, L. and MacLeod Grant, H. 2010. Shared Leadership, chapter 9 in Perry, J.L. (ed). *The Jossey-Bass Reader on Nonprofit and Public Leadership*. Jossey-Bass, San Francisco, 124-149.

Cunslo-Willox, A. 2015. Personal conversation via Skype. March 31st .

Cutter, S.L, Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E. and Webb, J. 2008. A place-based model for understanding community resilience to natural disasters. *Global Environmental Change,* 18, 598–606.

Day, D.V., Gronn, P. and Salas, E. 2006 Leadership in team-based organizations: On the threshold of a new era. *The Leadership Quarterly*. 17: 211-216.

della Porta, D. and Keating, M. (eds). 2008a. *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective*. Cambridge University Press, Cambridge, UK.

della Porta, D. and Keating, M. 2008b. Comparing approaches, methodologies and methods, Some concluding remarks, chapter 16 in della Porta, D. and Keating, M. (eds). *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective*. Cambridge University Press, Cambridge, UK, 316-322.

della Porta, D. 2008. Comparative analysis: case-oriented versus variable-oriented research, chapter 11 in della Porta, D. and Keating, M. (eds). *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective*. Cambridge University Press, Cambridge, UK, 198-222.

Dengler, M. 2007. Spaces of power for action: Governance of the Everglades Restudy process (1992-2000). *Political Geography*, 26, 423-454.

Denton, F., T.J. Wilbanks, A.C. Abeysinghe, I. Burton, Q. Gao, M.C. Lemos, T. Masui, K.L. O'Brien, and K. Warner, 2014: Climate-resilient pathways: adaptation, mitigation, and sustainable development. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.).Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1101-1131.

Deppisch, S. and Hasibovic, S. 2011. Social-ecological resilience thinking as a bridging concept in transdisciplinary research on climate-change adaptation. *Natural Hazards*, [online] DOI 10.1007/s11069-011-9821-9, May 17.

Dessai, S. and Hulme, M. 2003. *Does climate policy need probabilities?* Tyndall Centre for Climate Change Research, Working Paper 34, University of East Anglia, Norwich.

Dexter, J.R. 2012. *Atlantic Climate Adaptation Solutions Knowledge Transfer Strategy*. Horizons Community Development Associates Inc., report for the Atlantic Canada Climate Adaptation Solutions Association, March.

Dhanasai, C. and Parkhe, A. 2006. Orchestrating Innovation Networks. *The Academy of Management Review*, 31(3): 659-669.

Dickinson, T. 2007. *The Compendium of Adaptation Models for Climate Change*, first edition, Adaptation and Impacts Research Division, Environment Canada, Toronto.

Drucker, P.F. 1954. *The Practice of Management*. Harper & Row Publishers, New York.

Drucker, P.F. 1985. *Innovation and Entrepreneurship: Practice and Principles*. Harper Collins, New York.

Ebi, K.L., Lim, B. and Aguilar, Y. 2005. Scoping and Designing an Adaptation Project, Chapter 1 in B. Lim and E. Spanger-Siegfried, eds. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. Cambridge University Press, Cambridge, 33-46.

Eckman, E. 2006. Co-principals: Characteristics of Dual LeadershipTeams. *Leadership and Policy in Schools*, 5(2): 89-107.

Einarsen, S., Asland, M.S. and Skogstad, A. 2007. Destructive leadership behaviour: A definition and conceptual model. *The Leadership Quarterly*. 18 (3): 207-216.

Eisenack, K., Moser, S.C., Hoffmann, E., Klein, R.J.T., Oberlack, C., Pechan, A., Rotter, M., and Termeer, C.J.A.M. 2014. Explaining and overcoming barriers to climate change adaptation. *Nature Climate Change*. 4: October. 867-872.

Ely, R.L. and Rhode, D.L., 2010. Women and Leadership: Defining the Challenges. In N. Nohira and R. Khurana (eds.) *Handbook of Leadership Theory and Practice: A Harvard Business School Centennial Colloquium*. Harvard Business Press, Boston 377-410.

Environics Research Group (Environics), 2010. *National Climate Change Adaptation Benchmark Survey*: *Final Report*. prepared for Natural Resources Canada, contract: 23483-090364 001CY, April

Environment Canada, 2010. *Evaluation of the Clean Air Adaptation Theme*. Audit and Evaluation Branch, Gatineau.

Ernston, H., Barthel, S., Andersson, E. and Bogstrom, S.T. 2010. Scale-crossing brokers and network governance of urban ecosystem services: the case of Stockholm. *Ecology and Society*. 15(4):28.

Evans, L.S., Hicks, C.C., Cohen, P.J., Case, P., Prideaux, M. and Mills, D.J. 2015. Understanding leadership in the environmental sciences. *Ecology and Society* 20(1): 50. [online] http://dx.doi.org/10.5751/ES-07268-200150

Eyzaguirre, J. and Warren, F.J. 2014. Adaptation: Linking Research and Practice, chapter 9 in *Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation*, F.J. Warren & D.S. Lemmen, (eds). Government of Canada, Ottawa. 253-286.

Fenech, A. 2015. Personal communication. April 24[th] .

Flyvbjerg, B. 2006. Five Misunderstandings About Case-Study Research. *Qualitative Inquiry*. 12:2, 219-245.

Folke, C., Colding, J. and Berkes, F. 2003. Synthesis: building resilience and adaptive capacity in social-ecological systems. In F. Berkes, J. Colding, and C. Folke (eds.). *Navigating Social-Ecological Systems:building resilience for complexity and change*, Cambridge University Press, London, 352-387.

Gachon, P. 2005. *A first evaluation of the strength and weaknesses of statistical downscaling methods for simulating extremes over various regions of eastern Canada*. Working Paper, Environment Canada, Downsview.

Gafarova, S., May, B. and R. Plummer. 2010. *Adaptive Collaborative Risk Management and Climate Change in the Niagara Region: A Participatory Integrated Assessment Approach for Sustainable Solutions and Transformative Change*. Science Plan. Adaptation and Impacts Research Section – Environment Canada. Toronto.

Galaz, V., Moberg, F., Olsson, E.K., Paglia, E. and Parker, C. 2011. Institutional and political leadership dimensions of cascading ecological crises. *Public Administration,* 89, 361-380.

Gaventa, J. 2003. *Towards Participatory Local Governance: Assessing the Transformative Possibilities*. paper prepared for Conference on Participation: From Tyranny to Transformation, Manchester, 27-28 February

Gebelein, S.H., Nelson-Neuhaus, K.J., Skube, C.J., Lee, D.G., Seevens, L.A., Hellervik, L.W., and Davis, B.L. 2010. *Successful Manager's Handbook: Develop Yourself, Coach Others*. 8th edition, PDI Ninth House Global Leadership Solutions, Roswell, US.

Gibbert, M., Ruigrok, W., and Wicki, B. 2008. Research Notes and Commentaries: What Passes as a Rigorous Case Study? *Strategic Management Journal*, 29: 1465–1474.

Giddens, A. 1984. *The Constitution of Society*. Polity Press. Cambridge, UK. available as an e-book from www.polity.co.uk   accessed [29 October 2014].

Giddens, A. 2011. *The Politics of Climate Change*, second edition. Polity Press. Cambridge, UK. available as an e-book from www.polity.co.uk [30 September 2016].

Government of Canada, 2010. *Fifth National Communication on Climate Change*. Actions to Meet Commitments Under the United Nations Framework Convention on Climate Change, submitted to the UNFCCC Secretariat.

Government of Canada, 2011. *Federal Adaptation Policy Framework*. Environment Canada, Gatineau, Quebec.

Government of Canada, 2012. *Land use planning tools for local adaptation to climate change*. Ottawa. [online] http://publications.gc.ca/collections/collection_2013/rncan-nrcan/M4-106-2012-eng.pdf

Government of Canada, 2014. *Sixth National Communication on Climate Change*. Actions to Meet Commitments Under the United Nations Framework Convention on Climate Change, submitted to the UNFCCC Secretariat.

Government of Canada. 2016. *Estimate of the Average Annual Cost for Disaster Financial Assistance Arrangements due to Weather Events*. Office of the Parliamentary Budget Officer, Ottawa.

Glynn, M.A. and De Jordy, R. 2010. Leadership Through an Organization Behavior Lens. In N. Nohria and R. Khurana (eds.) *Handbook of Leadership Theory and Practice: A Harvard Business School Centennial Colloquim*, Harvard Business Press, Boston, 119-157.

Graen, G.B. 2013. The "Missing Link" in Managerial Network Dynamics, chapter 20 in Rumsey, M.G., ed. *The Oxford Handbook of Leadership*. Oxford University Press, Oxford. 359-375.

Gray, B. 2008. Enhancing Transdisciplinary Research Through Collaborative Leadership. *Proceedings of the American Journal of Preventative Medicine*. 35(S2), S124-S132.

Gronn, P. 1999. Substituting for Leadership: The Neglected Role of the Leadership Couple. *The Leadership Quarterly*. 10(1): 41-62.

Gronn, P. 2002. Distributed leadership as a unit of analysis. *The Leadership Quarterly*. 13, 423–451.

Groves, K.S. 2007. Integrating leadership development and succession planning best practices. *Journal of Management Development*. 26(3) 2007, 239-260.

Guiterrez, N.L., Hilborn, R. and Defeo, O. 2011. Leadership, social capital and incentives promote successful fisheries. *Nature*. [online] Doi:10.1038/nature09689

Gulf of Maine Council (GOMC), 2015. *Gulf of Maine Council 2015 Awards,* Visionary Award Winners, Stan Choptiany, June.

Gupta, J., Termeer, C., Klostermann, J., Meijerink, S.,van den Brink, M., Jong, P., Nooteboom, S. and Bergsma, E. 2010. The Adaptive Capacity Wheel: a method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science and Policy.* 13, 459-471.

Hajer, M. 2003. Policy without polity? Policy analysis and the institutional void. *Policy Sciences*. 36, 175-195.

Halifax Regional Municipality (HRM), 2013. *Halifax Regional Municipality Urban Forest Master Plan*, July.

Hallegatte, S., 2009. Strategies to adapt to an uncertain climate change. *Global Environmental Change*. 19, 240-247.

Hanna, K., Dale, A., Filion, P., Khan, Z., Ling, C., Rahaman, K. and Seasons, M. 2013. *Planning for adaptation in an uncertainty setting: Local government action in Canada*. AESOP-ACSP Joint Congress, Dublin, Ireland, July. [online] http://www.localadaptation.ca/ , accessed December 4.

Health Canada, 2008. *Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity*, J. Seguin (ed.), Government of Canada, Ottawa.

Health Canada, 2011. *Extreme Heat Events Guidelines: Technical Guide for Health Care Workers*. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Government of Canada, Ottawa.

Heenan, D.A. and Bennis, W. 1999. *Co-Leaders: The Power of Great Partnerships*. John Wiley & Sons, New York.

Heifetz, R.A. 1994. *Leadership Without Easy Answers*. Harvard University Press, Cambridge.

Heifetz, R.A., Grashow, A. and Linsky, M. 2009. *The Practice of Adaptive Leadership: Tools and Tactics for Changing Your Organization and the World*. Cambridge Leadership Associates, Harvard Business School Publishing, Boston, Massachusetts.

Heifetz, R.A. and Linsky, M. 2002. *Leadership on the Line: Staying Alive Through the Dangers of Leading*. Harvard Business School Publishing, Boston, Massachusetts.

Henein, A. and Morissette, F. 2007. *Made in Canada Leadership: Wisdom from the Nation's Best and Brightest on Leadership Practice and Development*. John Wiley and Sons Canada, Mississauga.

Henstra, D. 2015. *The Multilevel Governance of Climate Change: Analyzing Canada's Adaptation Policy Regime*. Paper prepared for the Annual Meeting of the Canadian Political Science Association Session K6 - New Forms of Governance in Public Policy Development, University of Ottawa, Ottawa, Ontario.

Héritier, A. 2008. Causal Explanation, chapter 4 in D. della Porta & M. Keating (eds.). *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective*. Cambridge University Press, Cambridge, UK 61-79.

Hewat, C. and B. Banda. 2010. Community-led sustainable development: the champion approach. Chapter 23 in Wilson G., P. Furniss and R. Kimbowa eds., *Environment, Development and Sustainability Perspectives and cases from around the world*. Oxford University Press, Oxford, 232-239.

Hinkel, J. and Bisaro, A. 2016. Methodological choices in solution-oriented adaptation research: a diagnostic framework. *Regional Environmental Change*. 16: 7-20.

Homer-Dixon, T. 2007. The Upside of Down: Catastrophe, Creativity nd the Renewal of Civilization. Vintage Canada, Toronto.

Homer-Dixon, T. 2000. *The Ingenuity Gap*. Alfred A. Knopf, New York. [online] http://www.ingenuitygap.com/

Hooghe, L. and Marks, G. 2001. Types of Multi-Level Governance. *European Integration online Papers (EIoP)*. 5(11). http://eiop.or.at/eiop/texte/2001-011a.htm

Hoppe, R. 2011. *The Governance of Problems: Puzzling, Power and Participation*. The Policy Press, Bristol, UK.

House, R.J. and Aditya, R.N. 1997. The Social Scientific Study of Leadership: Quo Vadis? *Journal of Management*, 23(3), 409-473.

Huitema, D., Jordan, A., Massey, E., Rayner, T., van Asselt, H., Haug, C., Hildingsson, R., Monni, S. and Stripple, J. 2011. The evaluation of climate policy: theory and emerging practice in Europe. *Policy Science,* 44, 179-198.

Huitema, D. and Meijerink, S. 2010. Realizing water transitions. the role of policy entrepreneurs in water policy change. *Ecology and Society,* 15(26). [online] http://www.ecologyandsociety.org/vol15/iss2/art26/

Imperial, M.T., Ospina, S., Johnston, E., O'Leary, R., Thomsen, J., Williams, P. and Johnson, S. 2016. Understanding leadership in a world of shared problems: advancing network governance in large landscape conservation. *Front Ecol Environ.* 14(3). 126–134.

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden & C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK.

Intergovernmental Pane on Climate Change (IPCC), 2014: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core WritingTeam, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130.

Jagers, S.C. and Stripple, J. 2003. Climate Governance Beyond the State. *Global Governance.* 9(3), 385-399.

Jenkins, H. 2009. A 'business opportunity' model of corporate social responsibility for small- and medium-sized enterprises. *Business Ethics: A European Review*, 18(1): 21-36.

Kates, R.W. 2011. What kind of a science is sustainability science? *PNAS.* 108:49 19449–19450.

Kates, R.W., W.C. Clark, R. Corell, J.M. Hall, C.C. Jaeger, I. Lowe, J.J. McCarthy, H.J. Schellnhuber, B. Bolin, N.M. Dickson, S. Faucheux, G.C. Gallopin, A. Grubler, B. Huntley, J. Jaeger, N.S. Jodha, R.E. Kasperson, A. Mabogunje, P. Matson, H. Mooney, B. Moore III, T. O'Riordan, and U. Svedin, 2001. Sustainability Science. *Science*. 292, April, 641-2.

Keeley, L., Walters, H., Pikkel, R., and Quinn, B. 2013. *Ten types of innovation: The discipline of building breakthroughs*. John Wiley & Sons.

Kellerman, Barbara. 2012. *The end of leadership*. Harper Business, New York.

Keskitalo, E.C.H. (ed). 2010a. *Developing Adaptation Policy and Practice in Europe: Multi-Level Governance of Climate Change*. Springer, Berlin.

Keskitalo, E.C.H., 2010b. Concluson: The Development of Adaptive Capacity and Adaptation Measures in European Countries. In Keskitalo, E.C.H. (ed.) *Developing Adaptation Policy and Practice in Europe: Multi-Level Governance of Climate Change*. Springer, Berlin.

Key Informant 001 (KI001), 2015. Recorded interview, Halifax, Nova Scotia, June 12

Key Informant 002 (KI002), 2015. Recorded interview, Saint Andrews, New Brunswick, June 11

Key Informant 004 (KI004), 2015. Recorded interview, Tatamagouche, Nova Scotia, June 2nd

Key Informant 005 (KI005), 2015. Recorded interview, Tatamagouche, Nova Scotia, June 2nd

Key Informant 006 (KI006), 2015. Recorded interview, Sydney, Nova Scotia, June 5th

Key Informant 007 (KI007), 2015. Recorded interview, Bonshaw, Prince Edward Island, June 5th

Key Informant 008 (KI008), 2014. Recorded interview, Cheticamp, Nova Scotia, August 4th

Key Informant 009 (KI009), 2015. Recorded interview, Fredricton, New Brunswick, June 10th

Key Informant 010 (KI010), 2015. Recorded interview, Charlottetown, Prince Edward Island, May 26th

Key Informant 011 (KI011), 2015. Recorded interview, Charlottetown, Prince Edward Island, May 28th

Key Informant 012 (KI012), 2015. Analytic memo, Cousins Shore, Prince Edward Island, June 8th

Key Informant 014 (KI014), 2015. Recorded interview, Halifax, Nova Scotia, June 3rd

Key Informant 015 (KI015), 2015. Recorded interview, Charlottetown, Prince Edward Island, June 1st

Key Informant 016 (KI016), 2015. Recorded interview, Halifax, Nova Scotia, June 3rd

Key Informant 017 (KI017), 2015. Analytic memo, Halifax, Nova Scotia, June 4th

Key Informant 018 (KI018), 2015. Recorded interview, Breadalbane, Prince Edward Island, May 30th

Key Informant 021(KI021), 2015. Recorded interview, Charlottetown, Prince Edward Island, June 8th

Key Informant 022 (KI022), 2015. Recorded interview, Charlottetown, Prince Edward Island, May 27th

Key Informant 023 (KI023), 2015. Recorded interview, Charlottetown, Prince Edward Island, May 27th

Key Informant 024 (KI024), 2015. Recorded interview, Bonshaw, Prince Edward Island, June 1st

Key Informant 025 (KI025), 2015. Recorded interview, Halifax, Nova Scotia, June 4th

Key Informant 026 (KI026), 2015. Recorded interview, Charlottetown, Prince Edward Island, June 8th

Key Informant 027 (KI027), 2016. Recorded interview, Waterloo, Ontario, January 12th

Key Informant 028 (KI028), 2016. Recorded interview, Charlottetown, Prince Edward Island, February 16th

Key Informant 029 (KI029), 2016. Recorded interview, Charlottetown, Prince Edward Island, February 16th

Key Informant 031 (KI031), 2016. Recorded interview, Charlottetown, Prince Edward Island, February 17th

Key Informant 032 (KI032), 2016. Telephone conversation with analytic memo, Waterloo, Ontario, February 29th

Key Informant 037 (KI037), 2015. Recorded interview, Waterloo, Ontario, May 27th

Klein, J.T. 2008. Evaluation of Interdisciplinary and Transdisciplinary Research: A Literature Review. *Proceedings of the American Journal of Preventative Medicine*, 35(S2), S117-S123.

Klein, R.J.T., Huq, S., Denton, F., Downing, T.E., Richels, R.G., Robinson, J.B. and Toth, F.L. 2007. Inter-relationships between adaptation and mitigation. In M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*,., Cambridge University Press, Cambridge, UK, 745-777.

Klein, R.J.T., Nicholls, R.J. and Thomalla, F. 2003. Resilience to natural hazards: How useful is this concept? *Environmental Hazards*. 5, 35-45.

Kløcker Larsen, R., Swartling, Å. G., Powell, N., May, B., Plummer, R., Simonsson, L. and Osbeck, M. 2012. A framework for facilitating dialogue between policy planners and local climate change adaptation professionals: Cases from Sweden, Canada and Indonesia. *Environmental Science and Policy.* 23: 12-23.

Korpi, W. 1985. Power Resources Approach vs. Action and Conflict: On Causal and Intentional Explanations in the Study of Power. *Sociological Theory*, 3(2), 31-45, Autumn.

Kotter, J. P. 2005. Leading Change: Why Transformation Efforts Fail, *Harvard Business Review*, Reprint 95204, March-April.

Kouzes, J. M. and Posner, B. 2007. *The Leadership Challenge (Fourth edition)*. John Wiley and Sons, San Francisco.

Kunreuther, F. 2010. The Changing of the Guard: What Generational Differences Tell Us About Social-Change Organizations, chapter 27 in Perry, J.L., ed. *The Jossey-Bass Reader on Nonprofit and Public Leadership*. Jossey-Bass, San Francisco, 522-531.

Lemmen, D.S., Warren, R., and Lacroix, J. 2008. Synthesis in D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush (eds). *From Impacts to Adaptation: Canada in a Changing Climate 2007*. Government of Canada, Ottawa, 1-20.

Lemprière, T.C., Bernier, P.Y., Carroll, A.L., Flannigan, M.D., Gilsenan, R.P., McKenney, D.W., Hogg, E.H., Pedlar, J.H., and Blain, D. 2008. *The importance of forest sector adaptation to climate change*, Information Report NOR-X-416E, Canadian Forest Service, Natural Resources Canada, Ottawa.

Levin, K., Cashore, B., Berstein, S. and Auld, G. 2012. Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. *Policy Sciences*. 45: 123–152.

Lim, B. and Spanger-Siegfried, E. (eds). 2005. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. United Nations Development Programme. Cambridge: Cambridge University Press.

Lortsch, J. 2010. A Contingency Theory of Leadership. In N. Nohria and R. Khurana (eds). *Handbook of Leadership Theory and Practice: A Harvard Business School Centennial Colloquim, Harvard Business Press*, Boston, pp. 411-429.

Lövebrand, E., Stripple, J. and Wiman, B. 2009. Earth System Governmentality: Reflections on science in the Anthropocene. *Global Environmental Change*, 19, 7-13.

Luttrell, C., Bird, K., Byren, S., Carter, J., and Chakravarti, D. 2007. *The Power Cube Explained*. Empowerment Note 3. [on-line] www.poverty-wellbeing.net

Lynch, A.H., Tryhorn, L. and Abramson, R. 2008. Working at the Boundary: Facilitating Interdisciplinarity in Climate Change Adaptation Research. *Bulletin of the American Meteorological Society (BAMS)*. February.

Macfarlane, B. 2017. The paradox of collaboration: a moral continuum. *Higher Education Research and Development*. 36:3, 472-485.

MacMillan, M. 2015. *History's People: Personalities and the Past*. Massey Lectures, Canadian Broadcasting Corporation (CBC), Toronto, Anansi Press, Toronto.

Mair, P. 2008. Concepts and concept formation, chapter 10 in D. della Porta & M. Keating (eds). *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective*. Cambridge University Press, Cambridge, UK , 177-197.

Marion, R. 2013. Organizational Leadership and Complexity Mechanisms. chapter 11 in Rumsey, M.G. (ed). *The Oxford Handbook of Leadership*. 184-202 Oxford University Press, Oxford.

Marshall, M.N. 1996a. The key informant technique. *Family Practice*. 13(1): 92-97.

Marshall, M.N. 1996b. Sampling for qualitative research. *Family Practice*. 13(6): 522-525.

May, B. 2013. *Power, Contextual Intelligence and Leadership: Research Approaches for Understanding Participatory Community Climate Change Adaptation*. Environmental Sustainability Research Centre, Brock University. Working Paper Series. ESRC-2013-002 [online] https://dr.library.brocku.ca/handle/10464/5120

May, B. 2015. From Informant to Actor to Leader: Social-Ecological Inventories as a Catalyst for Leadership Development In Participatory Community Climate Change Adaptation. In K. O'Brien and E. Selboe (eds). *The Adaptive Challenge of Climate Change*, Cambridge University Press, Cambridge.

May, B. and Plummer, R. 2011. Accommodating the challenges of climate change adaptation and governance in conventional risk management: adaptive collaborative risk management (ACRM). *Ecology and Society.* 16(1), 47. [online] http://www.ecologyandsociety.org/vol16/iss1/art47/

Mayo, A.J. and Nohria, N. 2005. Zeitgeist Leadership. *Harvard Business Review*. October, 45-60.

McCright, A.M. 2010. The effects of gender on climate change knowledge and concern in the American public. *Population and Environment*. 32(1):66–87.

McEntire, D.A. 2004. Development, Disasters and Vulnerability: A Discussion of Divergent Theories and the Need for their Integration. *Disaster Prevention and Management*, 13(3), 193-198.

McGill University (McGill), 2008. Canada's water and our changing climate [on line] https://www.mcgill.ca/channels/news/canadas-water-and-our-changing-climate-100248 .

McKenzie-Mohr, D. 2011. *Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing.* New Society Publishers. Gabriola Island, B.C.

Meijerink, S. and Stiller, S. 2013. What kind of leadership do we need for climate adaptation? A framework for analyzing leadership functions and tasks in climate change adaptation. *Environment and Planning C: Government and Policy*, 31, 240-256.

Mercer Clarke, C. 2015. Personal conversation. April 14th .

Metro News, Halifax (Metro). 2013. Maritime lobster fishermen united in staying out of water over low prices. [online] http://www.metronews.ca/news/halifax/2013/05/12/maritime-lobster-fishermen-united-in-staying-out-of-water-over-low-prices.html .

Milly, P.C., Betancourt, D.J., Falkenmark, M., Lettenmaier, D. and Stouffer, R.J. 2008. Stationarity is dead: whither water management. *Science*, 319(5863), 573-574.

Mimura, N., Pulwarty, R.S., Duc, D.M., Elshinnawy, I., Redsteer, M.H., Huang, H.Q., Nkem, J.N., and Sanchez Rodriguez, R.A. 2014: Adaptation planning and implementation. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 869-898.

Mintzberg, H. 2013. *Simply Managing: What Managers Do – And Can Do Better*. Berrett-Koehler Publishers Inc. San Francisco.

Mintzberg, H. 2015. *Rebalancing Society*. Berrett-Koehler Publishers Inc., Oakland.

Morrow, P.C. and McElroy, J.C. 1987. Work Commitment and Job Satisfaction over Three Career Stages. *Journal of Vocational Behavior*, 30: 330-346.

Mortsch, L.D. 2015. Personal communication. April 23[rd] .

Moser, S.C. and Ekstrom, J.A. 2010. A framework to identify barriers to climate change adaptation. *Proceedings of the National Academy of Sciences (PNAS) Early Edition*. [online] www.pnas.org/cgi/doi/10.1073/pnas.1007887107

Moss, R.H., Meehl, G.A., Lemos, M.C., Smith, J.B., Arnold, J.R., Arnott, J.C., Behar, D., Brasseur, G.P., Broomell,S.B., Busalacchi, A.J., Dessai, S., Ebi, K.L., Edmonds, J.A., Furlow, J., Goddard, L., Hartmann, C.A., Hurrell, J.W., Katzenberger, J.W., Liverman, D.M., Mote, P.W., Moser, S.C., Kumar, A., Pulwarty, R.S., Sellyer, E.A., Turner III, F.S., Washington, W.M. and Wilbanks, T.J. 2013. Hell and High Water: Practice-Relevant Adaptation Science. *Science*, 342, 696-698, November.

Munang, R., Thiaw, I., Alverson, K., Mumba, M., Liu, J. and Rivington, M. 2013. Climate change and Ecosystem-based Adaptation: a new pragmatic approach to buffering climate change impacts. *Current Opinion in Environmental Sustainability*, 5: 1-5.

Murphy, J., Rhodes, M.L., Meek, J.W. and Denyer, D. 2017. Managing the Entanglement: Complexity Leadership in Public Sector Systems. *Public Administration Review*, 77(5), 692–704.

National Round Table on the Environment and Economy (NTREE), 2012. *Facing the Elements: Building Business Resilience in a Changing Climate (Case Studies)*. Climate Prosperity, Report 5, Ottawa, Canada.

Natural Resources Canada (NRCan). 2016. Climate Impacts and Adaptation Program. [on line] http://www.nrcan.gc.ca/environment/impacts-adaptation/regional-initiatives/10631)

Nelson, D.R., Adger, W.N. and Brown, K. 2007. Adaptation to Environmental Change: Contributions of a Resilience Framework. *Annual Review of Environment and Resources*, 32, 395–419.

New Brunswick, 2011. *Environmental Trust Fund Act*. Chapter 151. Queen's Printer for New Brunswick, May.

New Brunswick, 2016. *Environmental Trust Fund Awards List: 2016-2017* [on-line] http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/ETFAwards.pdf

Newfoundland and Labrador, 2016. *Office of Climate Chang, Department of Environment and Climate Change* [online]. http://www.ecc.gov.nl.ca/climate_change/

Nhamo, G. 2009. Co-Leadership in Climate Change: An Agenda to 2013 and Beyond. *Politikon*, 36(3): 463–480.

Nielsen, J.O. and D'haen, S.A.L. 2013. Asking about climate change: Reflections on methodology in qualitative climate change research published in Global Environmental Change since 2000. *Global Environmental Change*. [online]. http://dx.doi.org/10.1016/j.gloenvcha.2013.10.006

Nova Scotia, 2011. *Municipal Climate Change Action Plan Guidebook. Canada-Nova Scotia Agreement on the Transfer of Federal Gas Tax Funds*. www.nsinfrastructure.ca .

Nova Scotia, 2015. *Nova Scotia Adapts*, excerpt from Nova Scotia Adaptation Work Plan presentation, May.

Nye, J.S., Jr. 2010. Power and Leadership. In N. Nohira and R. Khurana (eds.) *Handbook of Leadership Theory and Practice: A Harvard Business School Centennial Colloquium*, Harvard Business Press, Boston, 305-332.

O'Brien, K., Eriksen, S., Schjolden, A. and Nygaard, L. 2004. *What's in a word? Conflicting interpretations of vulnerability in climate change research*. Center for International Climate and Environmental Research (CICERO), Working Paper 2004:04.

O'Brien, K. and Selboe, E. (eds). 2015a. *The Adaptive Challenge of Climate Change*. Cambridge University Press, Cambridge.

O'Brien, K. and Selboe, E. 2015b. *Social Transformation: The Real Adaptive Challenge*. Chapter 17 in O'Brien, K. and E. Selboe (eds). 2015b. *The Adaptive Challenge of Climate Change*. Cambridge University Press, Cambridge, 311-324.

O'Toole, J., Galbraith, J. and Lawler, E.E. III. 2002. *When Two (or More) Heads are Better Than One: The Promises and Pitfalls of Shared Leadership*. CEO Publication, G 02-8 (417), Center for Effective Organizations, Marshall School of Business, University of Southern California, March.

Olsson, P., Gunderson, L.H., Carpenter, S.R., Ryan, P., Lebel, L., Folke, C. and Holling, C.S. 2006. Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society,* 11(1), 18. [online] URL:http://www.ecologyandsociety.org/vol11/iss1/art18/

Ontario, 2009. *Adapting to Climate Change in Ontario: Towards the Design and Implementation of a Strategy and Action Plan*, Expert Panel on Climate Change Adaptation report to the Minister of the Environment, November.

Organization for Economic Co-operation and Development (OECD), 2015. *Innovating the Public Sector: from Ideas to Impact*. Building Organisational Capacity for Public Sector Innovation, background paper, conference, 12-13 November 2014, OECD Conference Centre, Paris.

Ostrom, E. 2007. A Diagnostic Approach for Going Beyond Panaceas. *Proceedings of the National Academy of Sciences* (PNAS)104(39), 15181-7.

Ostrom, E and Ostrom, V. 2014. The Quest for Meaning in Public Choice, chapter 3, in *Choice, Rules and Collective Action: The Ostroms on the Study of Institutions and Governance*. F. Sabetti and P.D. Aligica, (eds). ECPR Press, Colchester, UK. 61-93.

Oxford English Dictionary (Oxford), 2016. *Oxford Dictionaries* [online] https://en.oxforddictionaries.com/definition/fluidity

Oxford English Dictionary (Oxford), 2017. *Oxford Dictionaries* [online] https://en.oxforddictionaries.com/definition/archetype

Paddock, L. 2011. *Beyond Deterrence: Compliance and Enforcement in the Context of Sustainable Development*. Proceedings, Ninth International Conference on Environmental Compliance and Enforcement, International Network for Environmental Compliance and Enforcement (INECE), 589-615.

Parks Canada Agency (PCA), 2016. *Canadian Register of Historic Places*, [online] http://www.historicplaces.ca/en/pages/more-plus/contact.aspx , Gatineau, Quebec.

Parry, K.W. and Bryman, A. 2006. Leadership in Organizations. In S., Clegg, C. Hardy, T.B. Lawrence and W.R. Nord (eds.) *The SAGE Handbook of organization studies, second edition*. SAGE Publications, London, 447-468.

Participant Observation 001 (P001). 2015. CLIVE demonstration, Cascumpec Bay Watershed Association Inc. annual meeting, with KI007, May 26[th] .

Participant Observation 002 (P002). 2015. Media interview. CBC Radio, Maritime Connections, Halifax, Nova Scotia, Municipal Climate Change Adaptation Program, with KI001. March 22[nd] .

Participant Observation 003 (P003). 2015. Video interview, Colchester-Cumberland Wind Field Inc. with KI004 and K005. https://www.youtube.com/watch?v=Fq-AXDqSgRM uploaded October 4th, 2011, viewed May 28th.

Participant Observation 004 (P004). 2015. Conference, Electric Mobility Canada EV2015VÉ, Halifax, Nova Scotia, with KI004 and KI005. May 25th.

Participant Observation 005 (P005). 2015. Conference, session: *Climate Change, Land Use, and Planning on Prince Edward Island*, Climate Change in Culture, Charlottetown, Prince Edward Island, with KI021, KI023 and KI026. May 29th.

Participant Observation 006 (P006). 2015. Conference, *Local Ecological Knowledge*, Climate Change in Culture, Charlottetown, Prince Edward Island, with KI010. May 28th.

Participant Observation 007 (P007). 2015. Conference, *Plenary Address: A Walking Tour of Prince Edward Island's Eroding Shoreline*, Climate Change in Culture, Greenwich, Prince Edward Island, with KI007, May 30th .

Participant Observation 008 (P008). 2016. Facilitated meeting, Climate Lab, University of Prince Edward Island, Charlottetown, Prince Edward Island, with KI028 and KI029, February 16th .

Partnership for Canada-Caribbean Community Climate Change Adaptation (ParCA). 2016. [on-line] http://parca.uwaterloo.ca/ .

Pelling, M., High, C., Dearing, J. and Smith, D. 2008. Shadow spaces for social learning: a relational understanding of adaptive capacity to climate change within organisations. *Environment and Planning A*, 40(4), 867–884.

Perez, R.T. and Yohe, G. 2005. Continuing the Adaptation Process, chapter 9 in Lim, B. and Spanger-Siegfried (eds.). *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. United Nations Development Programme. Cambridge: Cambridge University Press, 205-223.

Perry, J.L. (ed). 2010. *The Jossey-Bass Reader on Nonprofit and Public Leadership*. Jossey-Bass, San Francisco.

Pfeffer, J. 2000. The Ambiguity of Leadership. in E.D. Duryea (ed). *ASHE Reader on Organization and Governance in Higher Education*, *fifth edition*, Prentice Hall, New Jersey.

Pfeffer, J. 2016. *Getting beyond the BS of leadership literature*. McKinsey Quarterly, January.

Pfeffer, J. and Sutton, R.I. 2006. *Hard Facts, Dangerous Half-Truths, and Total Nonsense: Profiting from Evidence-Based Management*. Harvard Business School Press, Boston, Massachusetts.

Pickering, K., Pickering, G.J., Inglis, D., Shaw, T., and Plummer, R. 2012. *Innovation and adaptation in the Ontario grape and wine industry: An integrated, transdisciplinary response to climate change* Environmental Sustainability Research Centre, Brock University, Working Paper Series. ESRC-2012-002 [online] https://brocku.ca/environmental-sustainability-research-centre/esrc-publications/working-paper-series

Pickering, K., Plummer, R. and May, B. 2011. Niagara Climate Change Project: A collaborative participatory approach to climate change adaptation. *Practical Solutions for a Warming World: American Meteorological Society Conference on Climate Adaptation*. July [online] http://ams.confex.com/ams/19Applied/webprogram/Paper190532.html

Pielke,R.A., Jr. 2007. *The Honest Broker: Making Sense of Science in Policy and Politics*, Cambridge University Press, Cambridge.

Pitcher, P. 1995. *Artists, Craftsmen and Technocrats: The Dreams, Realities and Illusions of Leadership*. Stoddart, Toronto.

Podolny, J.M., Khurana, R. and Besharov, M.L. 2010. Revisiting the Meaning of Leadership. In N. Nohira and R. Khurana (eds). *Handbook of Leadership Theory and Practice: A Harvard Business School Centennial Colloquium*. Harvard Business Press, Boston, 65-106.

Prince Edward Island (PEI), 2013. Provincial Land Use Policies Consultation Document, April [online] http://www.gov.pe.ca/photos/original/consultation.pdf

Prince Edward Island Waterhsed Alliance (PEIWA), 2016. Prince Edward Island Watershed Alliance, [online] http://peiwatershedalliance.org/web/

Public Infrastructure Engineering Vulnerability Committee (PIEVC). 2008. *Adapting to Climate Change: Canada's First National Engineering Vulnerability Assessment of Public Infrastructure*, Engineers Canada, April.

Rhode, D.L. 2017. *Women and Leadership*. Oxford University Press, New York.

Ribot, J. 2011. Vulnerability before adaptation: Toward transformative climate action. *Global Environmental Change*. 4, 1160-1162.

Rogers, K.H., Luton, R., Biggs, H., Biggs, R.(O)., Blignaut, S., Choles, A.G., Palmer, C.G., and Tangwe, P. 2013. Fostering Complexity Thinking in Action Research for Change in Social-Ecological Systems. *Ecology and Society* 18(2): 31 [online] http://www.ecologyandsociety.org/vol18/iss2/art31/

Rumsey, M.G. (ed). 2013a. *The Oxford Handbook of Leadership*. Oxford University Press, Oxford.

Rumsey, M.G., 2013b. The Elusive Science of Leadership, chapter 26 in M.G. Rumsey (ed). *The Oxford Handbook of Leadership*. Oxford University Press, Oxford, 455-466.

Ryan, C.M. 2001. Leadership in collaborative policy-making: An analysis of agency roles in regulatory negotiations. *Policy Sciences,* 34, 221-245.

Sachs, W.M. and Meditz, M.L. 1979. A Concept of Active Adaptation. *Human Relations*. 32(12), 1081-1093.

St. Louis, D. and Killorn, D. 2014. Charlotte County Climate Change Adaptation Action Plan 2016. Eastern Charlotte Waterways Inc.

Saldaña, J. 2013. *The Coding Manual for Qualitative Researchers.* second edition. SAGE Publications. London. e-book.

Savoie, D.J. 2010. *POWER: Where Is It?* McGill-Queen's University Press, Montreal.

Savoie, D. J. 2013. *Whatever Happened to the Music Teacher? How Government Decides and Why*. McGill-Queens University Press, Montreal.

Schroeder, H. (ed). 2005. *Science Plan: Institutional Dimensions of Global Environmental Change*. International Human Dimensions Program on Global Environmental Change, Report 16, Bonn.

Schultz, L., Folke, C. and Olsson, P. 2007. Enhancing ecosystem management through social-ecological inventories. Lessons learned from Kristianstads Vattenrike Biosphere Reserve. *Environmental Conservation*. 34: 140-152.

Schultz, L, Plummer, R. and Purdy, S. 2011. *Applying a Social-Ecological Inventory: A workbook for finding the key actors and engaging them*. [online] http://www.stockholmresilience.org/download/18.1f74f76413071d337c380004085/RA+workbook+final.pdf

Schumpeter, J.A. 1942. *Capitalism, Socialism and Democracy*, Harper and Brothers, New York.

Seijts, G., Crossan, M, and Gandz, 2008. The Cross-Enterprise Leader, Ivey Business Journal, July/August. [on-line] http://iveybusinessjournal.com/publication/the-cross-enterprise-leader/

Senge, P. 1990. *The Fifth Discipline: The Art and Practice of Learning Organizations*. Doubleday, New York.

Shobe, W.M. and Burtaw, D. 2012. Rethinking Environmental Federalism in a Warming World. *Climate Change Economics.* 3(4), 1-33.

Shuffler, M.L., Burke, C.S., Kramer, W.S. and Salas, E. 2013. Leading Teams: Past, Present, and Future Perspectives, chapter 9 in Rumsey, M.G. (ed). *The Oxford Handbook of Leadership*. Oxford University Press, Oxford, 144-166.

Silvertown, J. 2009. A new dawn for citizen science. *Trends in ecology and evolution.* 24(9), 467-471.

Site Visit 001 (V001). 2015. Cousin's Shore, Prince Edward Island, with KI012. June 8[th] .

Site Visit 002 (V002). 2015. Harbor redevelopment, Saint Andrews, New Brunswick, with KI002. June 11[th] .

Site Visit 003 (V003). 2015. Shoreline erosion and recent development, Victoria-by-the-Sea, Prince Edward Island, June 2[nd] .

Smit., B., Burton, I., Klein, R.J.T. and Wandel, J. 2000. An anatomy of adaptation to climate change and variability. *Climatic Change*. 45(1), 223-251.

Smit, B. and Wandel, J. 2006. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16, 282-292.

Stacey, R. 2012. *Tools and Techniques of Leadership abd Management: Meeting the challenge of complexity*. Routeledge, London.

Steen, S.L., Noe, R.A., Hollenbeck, J.R., Gerhart, B., and Wright, P.M. (eds). 2009. *Human Resource Management, Second Canadian Edition*. McGraw-Hill Ryerson, Toronto.

Steenberg, W.N., Duinker, P.N. and Charles, J.D. 2013. The neighbourhood approach to urban forest management: The case of Halifax, Canada. *Landscape and Urban Planning*. 117.135-144.

Stevenson, K. 2005. Trafficking in Trust: The Art and Science of Human Knowledge Networks, Chapter 15 in Coughlin, L., E. Wingard and K. Hollihan (eds). *Enlightened Power: How Women Are Transforming the Practice of Leadership*, Jossey-Bass, San Francisco, 243-264.

Stiller S. and Meijerink, S. 2016. Leadership within regional climate change adaptation networks: the case of climate adaptation officers in Northern Hesse, Germany. *Regional Environmental Change*, 16: 1543-1555.

Task Force on Land Use Planning (TFLUP), 2009. *New Foundations: Report of the Commission on Land and Local Governance*, Province of Prince Edward Island, December.

Termeer, C., Dewulf, A., van Rijswick, H., van Buuren, A., Huitema, D., Meijerink, S. & Wiering, M. 2011. The regional governance of climate adaptation: a framework for developing legitimate, effective, and resilient governance arrangements. *Climate Law*. 2(2), 159-179.

Thompson, A.M., Salawitch, R.J., Hoff, R.M., Logan, J.A. and Einaudi, F. 2012. Environment Canada Cuts Threaten the Future of Science and International Agreements. *EOS*, 93(7), 69-70.
Tomkins, E.L. and Adger, W.N. 2004. Does adaptive management of natural resources enhance resilience to climate change? *Ecology and Society*, 9(2),10. [online] URL:http://www.ecologyandsociety.org/vol9/iss2/art10 .

Torry, W.I. 1983. Anthropological Perspectives on Climate Change. In R.S. Chen, E. Boulding and S.H. Schneider (eds). *Social Science Research and Climate Change: An Interdisciplinary Appraisal,*. D. Reidel Publishing, Dordecht, 208-227.

Uhl-Bien, M., Marion, R. and McElvey, B. 2007. Complexity Leadership Theory: Shifting leadership from the industrial age to the knowledge era. *The Leadership Quarterly.* 18(4), 298-318.

United Kingdom, The Stationary Office (UKTSO). 2011. *Managing Successful Programmes*. Fourth edition, Norwich, UK. www.best-management-practice.com .

United Nations Framework Convention on Climate Change (UNFCCC), 2016. *Private Sector Initiative – database of actions on adaptation* [online] http://unfccc.int/adaptation/workstreams/nairobi_work_programme/items/6547.php .

University of Prince Edward Island (UPEI), 2015. *Climate Change in Culture*. conference schedule, Charlottetown, May 28th -31st

University of Prince Edward Island (UPEI), 2016a. ACASA Coastal Infrastructure Project Contribution Agreement binder, AP291, February.

University of Prince Edward Island (UPEI), 2016b. ACASA Large Economic Study Project Contribution Agreement binder, AP204, February.

University of Prince Edward Island (UPEI), 2016c. Coastal Impacts Visualization Environment (CLIVE) [on line] http://www.upei.ca/communications/news/2014/06/road-clive-pei%E2%80%99s-coastal-erosion-visualization-tool

Unwin, T. 1994. *The Place of Geography*. Longman Group UK Limited, Essex, reprint edition.

van Aalst, M.K., Cannon, T. and Burton, I. 2008. Community level adaptation to climate change: The potential role of participatory community risk assessment. *Global Environmental Change*, 18, 165-79.

van Wart, M. 2010. Public-Sector Leadership Theory: An Assessment, Chapter 6 in Perry, J.L., ed. *The Jossey-Bass Reader on Nonprofit and Public Leadership*. Jossey-Bass, San Francisco, 73-107.

Vancura, P. and Leichenko, R. 2015. Emerging Equity and Justice Concerns for Climate Change Adaptation: A Case Study of New York State, chapter 6 in O'Brien, K. and E. Selboe, eds. *The Adaptive Challenge of Climate Change*. Cambridge University Press, Cambridge, 98-117.

Vass, T. 2013. *What is the significance of "community" wind energy? The influence of local project initiation, participation, and investment on local perceptions of small-scale wind energy projects in Nova Scotia*. Honours thesis, Environmental Science, Dalhousie University, March.

Vasseur, L. 2010. Championing Climate Change Adaptation at the Community Level by Using an Ecosystem Approach An Example from Greater Sudbury in Ontario, Canada. In Á.A. Pérez, , B.H. Fernández and R.C. Gatti (eds.). *Building Resilience to Climate Change: Ecosystem-based adaptation and lessons from the field*. International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland, 151-159.

Vasseur, L. 2011. Moving from Research into Action on Issues of Climate Change for a Canadian Community: Integration of Sciences into Decision Making. *The International Journal of Climate Change: Impacts and Response*, 2(4), 115-126.

Vasseur, L. and Catto, N. 2008. Atlantic Canada, chapter 4, in Lemmen, D.S., F.J. Warren, and J. Lacroix (eds). *From Impacts to Adaptation: Canada in a Changing Climate, 2007*. Government of Canada, Ottawa. 119-170.

Vasseur, L., Thornbush, M. and Plante, S. 2015. Gender-Based Experiences and Perceptions after the 2010 Winter Storms in Atlantic Canada. *International Journal of Environmental Research and Public Health*. 12, 12518-12529.

Vatn, A. 2009. An institutional analysis of methods of environmental appraisal. *Ecological Economics,* 68, 2207-2215.

Vayda, A.P. 1983. Progressive Contextualization: Methods for Research in Human Ecology. *Human Ecology*. XI(3), 265-281.

Vignola, R., Leclerc, G., Morales, M., and Gonzalez, J. 2017. Leadership for moving the climate change adaptation agenda from planning to action. *Current Opinion in Environmental Sustainability*, 26: 84-89.

Vlok, A. 2012. A leadership competency profile for innovation leaders in a science-based research and innovation organization in South Africa. *Procedia - Social and Behavioral Sciences.* 41, 209 – 226.

Vogel, C., Moser, S.C. Kasperson, R.E. and Dabelko, G.D. 2007. Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships. *Global Environmental Change,*17, 349–364.

Walmsley, R. D. 2014. *The Contribution of the RAC Atlantic Climate Adaptation Solutions Project towards Building Adaptive Capacity in Nova Scotia*, report to ACASA.

Warren, F.J. and Lemmen, D.S. (eds). 2014. *Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation*; Government of Canada, Ottawa, 286p.

Weber, E.P. and Khademian, A.M. 2008. Wicked Problems, Knowledge Challenges, and Collaborative Capacity Builders in Network Settings. *Public Adminsitration Review*, March-April, 344-349.

Weick, K.E. 1989. Theory Construction as Disciplined Imagination. *The Academy of Management Review*, 14:4, 516-531.

Welsh, M. 2013. Resilience and responsibility: governing uncertainty in a complex world. *The Geographical Journal*, 1-12.

Westley, F. and Mintzberg, H. 1989. Visionary Leadership and Strategic Management. *Strategic Management Journal*,10, 17-32.

Westley F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., Thompson, J., Nilsson, M., Lambin, E., Sendzimir, J., Banerjee, B., Galaz, V. and van der Leeuw, S. 2011. Tipping Toward Sustainability: Emerging Pathways of Transformation. *AMBIO: A Journal of the Human Environment*. 40(7), 762-780.

Westley, F., Patton, M.Q. and Zimmerman, B. 2007. *Getting to Maybe: How the World Is Changed*. Vintage Canada, Toronto.

Wheaton, E.E. and MacIver, D.C. 1999. A Framework and Key Questions for Adapting to Climate Variability and Change. *Mitigation and Adaptation Strategies for Global Change*, 4, 215-225.

Wilbanks, T.J. 2003. Integrating climate change and sustainable development in a place-based context. *Climate Policy*. 3(S1), S147-S154.

Wilbanks, T.J. 2007. Scale and sustainability. *Climate Policy*. 7(4), 278-287.

Wilson, C. and McDaniels, T. 2007. Structured decision-making to link climate change and sustainable development. *Climate Policy*, 4, 353-370.

Woods, P.A., Bennett, N., Harvey, J.A., and Wise, C. 2004. Variabilities and Dualities in Distributed Leadership: Findings of a Systematic Review. *Educational Management Administration & Leadership*, 32: 439-457.

Yin, R.K. 2012. *Applications of Case Study Research*. 3[rd] edition, SAGE Publications Inc., Thousand Oaks, California, e-book version.

Yohe, G.W., R.D. Lasco, Q.K. Ahmad, N.W. Arnell, S.J. Cohen, C. Hope, A.C. Janetos and R.T. Perez. 2007. Perspectives on climate change and sustainability Chapter 20 in: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.), Cambridge University Press, Cambridge, UK, 811-841.

Zaccaro, S.J., LaPort, K., and Jose, I. 2013. The Attributes of Successful Leaders: A Performance Requirements Approach, chapter 1 in M.G. Rumsey (ed). *The Oxford Handbook of Leadership*. Oxford University Press, Oxford, 11-36.

APPENDICES

Appendix 1 - Key Questions - Climate Change Adaptation Leadership

Key Questions	Key References
Lead adaptation to what ends?	Vision creation, meaning making, sense giving (Cash et al., 2006; Podolny et al. 2010; Blomme, 2012) Creation of Adaptive Capacity (Gupta et al. 2010; Armitage & Plummer 2010) Ecosystem Based Adaptation (IUCN, 2010; Munang et al., 2013) Strategic decision-making (Hallegate 2009) Integration of adaptation, mitigation, sustainability and disaster risk reduction (Wilbanks., 2003; McEntire, 2004; Bizikova et al. 2008) Vulnerability reduction (Ribot 2011) Bridging Knowledge and Action (Cook et al., 2013)
Who or what leads adaptation?	Informants, actors and agents (Schultz et al. 2007; Schultz et al. 2011; May, 2015) Champions (Jenkins, 2009; Vasseur, 2010; Lemmen & Warren, 2014) Extension agents (Cohen & Waddell, 2009; Hewat & Banda, 2010) Climate Adaptation Officers (Stiller & Meijerink, 2016) Block leaders (Burn, 1991; McKenzie-Mohr, 2011) Citizen Scientists (Silvertown, 2009) Super-agents (Dengler 2007) Scale-crossing brokers (Ernstson et al. 2010; Galaz et al. 2011) Boundary workers (Lynch et al. 2008) Politicians, Opinion leaders (Boyle, 2010; Crona & Bodin 2010) Individuals, Teams and Organizations (Day et al., 2006; Kouzes & Posner 2007) Innovation networks (Dhanasai & Parkhe, 2006) Co/Dual leaders (Nhamo, 2009; Gronn, 1999; Heenan & Bennis, 1999; O'Toole et al., 2002)

Key Questions	Key References
How does adaptation leadership occur?	Innovation and entrepreneurialism (Huitema & Meijerink 2010; Vlok, 2012; Keeley et al., 2013; OECD, 2015; Burch et al., 2017)

Creativity (Homer-Dixon, 2006)

Knowledge Power Spaces (Science, Policy, Local) (Dengler 2007)

Adaptive Collaborative Risk Management (May & Plummer 2011)

Contextual intelligence/Enlightened power (Coughlin et al., 2005; Nye 2010; Savoie, 2010; May, 2013)

Cross-Enterprise intelligence (Seijts et al. 2008)

Managing (Mintzberg, 2013)

Following (Collins 2006; Kellerman, 2012)

Participatory integrated assessments (Bizikova et al. 2009)

Placed-based approaches (Wilbanks, 2003; Wilbanks, 2007)

Communityship (Mintzberg, 2015)

Collaboration and knowledge brokering (Kløcker Larsen et al. 2012; Macfarlane, 2017)

Structured decision-making (Wilson & McDaniels 2007)

Learning and sharing of best practices (Cohen et al. 2006)

Partnerships/Alliances (Heifetz, 1994) |
| What constitutes effective adaptation leadership? | Value creation/Performance (Cash et al., 2006; Kouzes & Posner 2007; Black et al., 2011)

Passion (Kouzes & Posner, 2007)

Removing barriers (Moser & Ekstrom 2010; Eisenack et al., 2014)

Complexity Leadership Theory and Complexity Thinking (Woods et al., 2004; Uhl-Bien et al. 2007; Bourgon, 2011; Blomme, 2012; Stacey, 2012; Rogers et al., 2013; Vignola et al., 2017; Murphy et al., 2017)

Collaborative Leadership (Gray, 2008)

Policy, Connectivity, Complexity and Sustainability leadership (Meijerink & Stiller 2013)

Connecting Leadership (Termeer et al., 2011)

Succession planning (Groves, 2007; Gebelein et al., 2010; Conger, 2010, UKTSO, 2011)

Apprenticeship, Mentoring and Talent Management (Henein & Morissette, 2007; Steen et al., 2009; Gebelein et al., 2010; Rhode, 2017)

Leading by example (Burton, 2008)

Measurement, Indicators, Analytics (Gachon, 2005; Perez & Yohe, 2005) |

Appendix 2 – Embedded Cases in the Atlantic Region of Canada

This Appendix summarizes the rationale for selection of each of the seven (7) cases examined in detail, as part of the embedded regional case study approach. The cases are first presented in Figure 4 and Table 6. The embedded cases are derived from the twenty-two (22) climate change adaptation entry points discussed by key informants as part of the interview process, as listed in Appendix 6.

Figure 4 Ref.	Embedded Case	Description	Rationale
1	Cape Breton Regional Municipality (RM) Marconi Trail Climate Change Adaptation Plan	Project to identify climate change adaptation options in support of the Cape Breton RM Climate Change Adaptation Plan, conducted by the Cape Breton hub of the Ecology Action Centre (ACAP, 2015; CBRM, 2014)	This project was conceived in order to complement the development of the municipal Cape Breton RM Climate Action Plan. Municipal funding under provincial and federal legislation is contingent on municipalities in Nova Scotia having approved Plans. From a multi-level governance perspective, this case involved the engagement of a local non-profit (ACAP) in facilitating and brokering aspects of stakeholder engagement and local climate change adaptation priority setting.
2	Atlantic Climate Adaptation Solutions Association (ACASA)	Federally-funded Canadian project to collaboratively develop climate change adaptation solutions in the Atlantic Region of Canada (ACASA, 2016; NRCan, 2016)	This embedded case is representative of one aspect of the Canadian federal government's approach to climate change adaptation – the provision of seed money to local consortia of provincial governments, academia and other organizations to catalyze action of climate change adaptation. ACASA is an example of an innovation network, requiring a high degree of multi-level governance interaction and coordination to manage complexity.
3	Halifax Regional Municipality (RM) Urban Forest Master Plan	Multi-year plan developed between the Halifax RM and Dalhousie University to incorporate neighbourhood-level analysis and implementation plan for the urban forest (HRM, 2013; Steenberg et al., 2013)	This case is an example of a specific strategic alliance: a bi-lateral, collaborative municipal-academic partnership whose goal is to embed a long term, sustainably-funded approach to resilience of the urban forest environment. Consideration of climate change is an integral part of the long term planning context.

Figure 4 Ref.	Embedded Case	Description	Rationale
4	Colchester-Cumberland Wind Field Inc. (CCWFI)	For-profit community wind energy enterprise operating in Tatamagouche, Nova Scotia (Vass, 2013)	CCWFI is a local business which is demonstrating leadership in the promotion and adoption of community wind energy in the Province of Nova Scotia. It is the first of its kind in the Atlantic Region of Canada and an example of the early adoption approach to innovation. Co-principals were faced with the challenges of being the first to interact with potential investors, the local community, and government agencies to turn their vision into reality. The case was chosen under the assumption that such innovators can provide transferable lessons for climate change leadership.
5	City of Charlottetown Integrated Sustainability Plan	Plan developed by the City of Charlottetown to integrate sustainability principles within its existing Official Plan to guide decision making and development (City of Charlottetown, 2010)	This case is an example of the challenges faced in development of a broad-based, integrated community sustainability plan that incorporates climate change adaptation priorities. It highlights the key role that municipalities play in climate change adaptation, which includes meeting provincial and federal requirements and garnering community buy-in for climate change adaptation. It is also an important example for examination of how leadership exhibits fluidity over the long term.
6	Prince Edward Island (PEI) Task Force on Land Use Planning (TFLUP)	Provincial, quasi-judicial inquiry to examine land use practices on PEI and guide future strategic statements of provincial interest (TFLUP, 2009)	This embedded case examines the role that arms-length institutional arrangements can have in leveraging action on climate change adaptation. It is also useful in providing perspective on how team-based and organization leadership styles can influence actions in less formalized areas of social influence.
7	Town of Saint Andrews Integrated Planning Approach	Municipality-wide initiative to incorporate future climate change considerations into water and emergency plans (St. Louis & Killorn, 2014)	This case is useful in examining the role of charismatic leadership in developing approaches to climate change adaptation at municipal levels of governance. It also provides perspective on how issues of leadership transition are managed.

Appendix 3 – List of Key Informants Interviewed

Confid ID #	Leadership Position	Location	Type	Completed
001	Project Coordinator	Halifax, NS	NGO	6/12/2015
002	Mayor	Saint Andrews, NB	Mun	6/11/2015
004	Co-Principal	Tatagamouche, NS	Bus	6/2/2015
005	Co-Principal	Tatamagouche, NS	Bus	6/2/2015
006	Project Coordinator	Sydney, NS	NGO	6/5/2015
007	Director	Charlottetown	Uni/InterProv	6/7/2015
008	President	Cheticamp, NS	NGO	done (SB)
009	Manager	Fredericton, NB	Prov	6/10/2015
010	Director	Charlottetown, PEI	MC	5/26/2015
011	Public Safety Officer	Charlottetown, PEI	Prov	5/28/2015
012	Watershed Coordinator	Cousin's Shore, PEI (*analytic memo*)	NGO	6/8/2015
014	Senior Policy Advisor	Halifax, NS	Prov	6/3/2015
015	Adaptation Specialist	Charlottetown, PEI	Prov	6/1/2015
016	Professor	Halifax, NS	Uni/Mun	6/3/2015
017	Private Consultant	Halifax, NS (*analytic memo*)	Cslt	6/4/2015
018	Chairperson	Breadalbane, PEI	NGO	5/30/2015
019	Climate Scientist	Downsview, ON	Fed/Intl	5/14/2015
021	Private Consultant	Charlottetown, PEI	Mun	6/8/2015
022	Sustainability Officer	Charlottetown, PEI	Mun	5/27/2015
023	Land Use Planner	Charlottetown, PEI	Prov	5/27/2015
024	Watershed Coordinator	Bonshaw, PEI	NGO	6/1/2015
025	Senior Policy Analyst	Halifax, NS	Prov	6/4/2015
026	Manager	Charlottetown, PEI	Prov	6/8/2015
027	Senior Policy Advisor	Waterloo, ON	Fed	1/12/2016
028	Program Manager	Charlottetown, PEI	Uni/InterProv	2/16/2016
029	Project Manager	Charlottetown, PEI	Uni/InterProv	2/16/2016
031	Manager	Charlottetown, PEI	Mun	2/17/2016
032	Program Manager	Waterloo, ON (*telecon*)	Fed	1/29/2016
037	Climate Scientist	Waterloo, ON	Fed/Intl	5/7/2015
N =			**29**	

Appendix 4 – Interview Protocol

Meta-Concept	Research Question	Reference
Preamble	This purpose of this interview is to gain insights about climate change adaptation in [*community*]. Specifically we would like to know how leadership has influenced the process. The information gained from this interview will assist in testing the study's conceptual model of climate change adaptation leadership. It will also permit insights about your perception of the process. The interview is expected to take approx. 1 ½ hours. We can take a break at any time, if you wish. For the purpose of University of Waterloo's research ethics policy, I would like to ask you for your informed consent to proceed. Here is a standard consent form for you to read and sign [*provide consent form*]. Please be advised that you can withdraw your consent at any time, by informing me. We will conclude the interview on your request. The interview will be recorded on a digital recorder. I will also take notes to jog my memory. Once completed, it will be transcribed, and you will have an opportunity to review it and make any modifications you wish.	
Background (Introduction)	• *KI Identification Number* • *Gender* • *Date of Interview* • *Location of Interview* • *Time Start* Tell me a little about yourself. You current position, background, education? Tell me about the role you played in the climate change adaptation initiative?	Dengler, 2007
PART I Lead adaptation to what ends?	1) What was the overall focus of the process? (PROMPT: *adaptation, mitigation, sustainability, vulnerability reduction, resilience, adaptive capacity*) 2) Was there any specific circumstance or event that prompted this approach? 3) How did it fit in with other organizational goals, plans and priorities? 4) Were there any participants who initially dismissed the problem?	Podolny et al., 2010; Gupta et al., 2010; Plummer & Armitage, 2010; Berkes & Ross, 2013; Ribot, 2011 Hallegatte, 2009; Bizikova et al., 2008 Moser & Ekstrom, 2010
PART II Who or what leads adaptation?	5) Who was leading the process? What entity/organization had ultimate responsibility? 6) Were there other external organizations or entities that influenced activities?	Moser & Ekstrom, 2010 Moser & Ekstrom,

		2010
(at what level and scale?)	7) How were people chosen to participate?	Schultz et al., 2011; Baird et al., 2014
	8) Did either you or any other individual stand out that was able to bridge science with policy or local knowledge? How did this happen?	Dengler, 2007; Keskitalo, 2010b; Lynch et al., 2008
	9) Were you or any other participant able to bridge different levels of government or jurisdictions to make progress on adaptation?	Galaz et al,., 2010; Ernston et al., 2010
	10) Were there any particular individuals within the community that were able to promote your initiative and influence others to join?	Crona & Bodin, 2010
	11) Do you think that the success of your initiative was due more to specific individuals, any teams you created as part of the process, or the sponsor organization?	Kouzes & Posner, 2007; Collinson, 2006
PART III How does adaptation leadership occur?	12) Were there any innovative solutions that were developed during the process? Things that no one has done before? Were there any innovators or entrepreneurs within the group?	Huitema & Meijerink, 2010; Keeley et al., 2013
	13) Would you say that in generating knowledge, science, policy/government or local considerations were more important? Did this change over time? Was collaboration an important part of this process?	Dengler, 2007; Nye, 2010; Klocker Larsen et al., 2012
	14) Would you say the challenges you faced were more related to technical problem solving or behavioural change? Which best describes the skills that were needed to be successful? (*creating vision or direction, technical decision-making or being able to translate the vision into action*)	Heifetz, 1998; Heifetz et al., 2009; Pitcher, 1995
	15) Did you follow a structured approach to help with your decision making? Did you use any tools to help understand the problem?	Bizikova et al., 2009; May & Plummer, 2011; Wilson & McDaniels, 2007; Moser & Ekstrom, 2010
	16) Do you think that the network you developed helped in addressing the issue in question? Was the network built from the ground up or did it "just happen"? Was there any one person that contributed to its development?	Tomkins & Adger, 2004; Olsen et al., 2006; Blomme, 2012
	17) Were you able to learn from past experiences and incorporate them into your initiative?	
	18) Were there any barriers that needed to be overcome? (PROMPT: *understanding, planning & decision making, managing*)	Cohen et al., 2006; Pelling et al., 2008 Moser & Ekstrom, 2010

PART IV	19) What do you feel has been the most valuable contribution of this process? What specific actions have resulted from this?	Kouzes & Posner, 2007
What constitutes effective adaptation leadership?	20) Is there anyone that played a key managerial role in your process? How did you manage the process of collaboration? Did you set up any tasks that helped to manage interactions? (PROMPT: *tasks, planning, agendas, project management – administrative leadership, human capital for implementation*) (*processual tasks*)	Uhl-Bien, et al., 2007; Gray, 2008; Meijerink & Stiller, 2013; Moser & Ekstrom, 2010
	21) Was there anyone from the political area that championed the cause and provided legitimacy to the process?	Meijerink & Stiller, 2013
	22) In the collaborative process that you undertook how did you decide what to focus on and what was important? (*cognitive tasks*)	Gray, 2008
	23) During your process, where there any "surprises" in your deliberations? Anything that was unexpected as a result of the interaction of different points of view and perspectives? Anything that made you change direction? Who was involved? (*adaptive leadership*)	Uhl-Bien et al., 2007; Meijerink & Stiller, 2013
	24) In relation to the above question, who was involved and how did they help in taking this new information, disseminate it and help create specific action? How did you coordinate and exchange information? (*structural tasks?*) Was it effective? (*enabling leadership, dissemination leadership*)	Uhl-Bien et al., 2007; Gray, 2008; Meijerink & Stiller, 2013; Moser & Ekstrom, 2010
		Barnett & O'Neill, 2010
	25) Has the process been able to help you avoid any potential serious problems for the community that you thought at first were good ideas?	Few et al., 2007
	26) Do you think the process was/has been inclusive? Is/are there any groups or individuals that in hindsight you would have involved in the process? Do you think it would have changed the result?	Moser & Ekstrom, 2010
	27) How much negotiation or mediation skill was there among participants? Were they adequately trained?	Moser & Ekstrom, 2010
	28) Were leaders willing to revisit past decisions?	Moser & Ekstrom, 2010
	29) Did the process incorporate an evaluation component to learn from the experience? Who was accountable for conducting it?	Gebelein et al., 2010; UKTSO, 2011
	30) Do you have a process in place to identify and retain future leaders? Is there a development process to provide adequate training and/or mentoring?	
Closing (Conclusion)	• *Time Finish* Is there anything else you would like to add that is relevant to how to role of leadership was important for the process? Is there anyone else that you think we should talk to?	emergent based on response snowball sampling

	Are there any important sources of information that you think might help us understand the process further (e.g. meeting minutes, white papers, newspaper articles, program evaluation exercises)? would you be available for a follow-up interview, either in person or over the phone? Thank you very much for your time today in contributing to this research.	approach secondary data

Appendix 5 – Coding Structure

CODE	CATEGORY	THEME
Adaptation Entry Points	• adaptation • adaptive capacity • resilience • vulnerability reduction • maladaptation avoidance • mainstreaming • sustainability • climate risk management and disaster risk reduction	Classification of the specific adaptation entry point
Tasks	• processual • cognitive • structural • networking	Classification of specific collaborative tasks required for leadership success
Level	• international • binational • national/federal • First Nation • provincial/territorial • regional • local • household • non-government organization • private/business	Classification of specific levels multi-level involvement of interest
Tools	• GIS/visualization • focus groups • workshops • risk management • economic analysis • plans • engineering • vulnerability assessment • external contracting/consulting	Classification of specific tools used for leadership involvement Initial list only (see APPENDIX 6 for all Tools coded)
Skills	• vision or direction • technical decision-making • action/results • collaboration • flexibility • learning	Classification of specific skills required to facilitate leadership Initial list only (see Appendix 7 for all Skills coded)
Most Valuable Contribution	• technical • structural • processual • collaborative	Classification of the most important contribution of leadership intervention discussed

Barriers/ Challenges	• understanding • planning/decision-making • managing	Classification of specific barriers that had to be overcome Initial list only (See Appendices 8 and 9 for all Barriers (coded)
Spaces of Power	• science • policy • local • multiple combinations	Classification of specific spaces of power for action required
Leadership 1	• individual • team • organization • multiple combinations	Classification of area of leadership theory important for success
Leadership 2	• maximal • participative • shared • distributed • supportive • minimal	Classification of specific types of leadership style from Mintzberg's continuum
Leadership 3	• political • administrative • enabling • adaptive • connective • dissemination	Classification of specific types of leadership from Complexity Leadership Theory
Effectiveness	• Y/N • formal • informal • anecdotal • embeddedness • not present • too early/premature	Classification of effectiveness of leadership adaptation intervention

Appendix 6– Specific Adaptation Entry Points Discussed by Key Informants

Type	Initiative
Adaptation Planning	Atlantic Climate Adaptation Solutions Association – Overall Program Cape Breton RM Marconi Trail Climate Change Adaptation Plan International Joint Commission Integrated Climate Impacts Assessment Prince Edward Island Coastal Impacts of Sea Level Rise
Adaptive Capacity	Atlantic Climate Adaptation Solutions Association – Decision Support Tool Nova Scotia Adaptation Work Plan
Resilience	Halifax RM Urban Forest Master Plan
Vulnerability Reduction	Lennox Island FN Vulnerability Assessment
Maladaptation Avoidance	Atlantic Climate Adaptation Solutions Association – Adaptation Costing
Mainstreaming	City of Charlottetown Setback and Elevation By-Law City of Charlottetown Waterfront Development Review Global Environment Facility Coastal Afforestation Project Nova Scotia Coastal Ecosystem and Community Protection Prince Edward Island Task Force on Land Use Planning Prince Edward Island Watershed Protection Plan (Coles Brook) Prince Edward Island Watershed Protection Plan (Kensington) St. Croix Estuary Monitoring Project
Sustainability	City of Charlottetown Integrated Sustainability Plan Colchester-Cumberland Community Wind Field Inc. Gulf Nova Scotia Fishermen's Coalition
Climate Risk Management and Disaster Risk Reduction	Coastal Cities at Risk Research Project Town of Saint Andrews, New Brunswick Integrated Planning Approach

Appendix 7 – Array of Key Informant Multi-Level Governance Experience

MLG Area of Experience									
KI	A	M	P	F	I	FN	NGO	B	C
001		X	X					X		
002		X	X		X				
004		X	X	X				X	
005		X	X	X				X	
006		X	X				X		
007	X		X	X	X				X
008		X	X	X			X	X	
009	X	X	X	X					
010			X	X		X		X	
011	X		X						X
012		X	X				X	X	
014		X	X	X					
015		X	X	X					
016	X	X	X	X	X				X
017	X	X	X						
018		X	X	X	X		X		
019	X	X	X		X				X
021	X	X	X						X
022		X							
023		X	X						X
024		X	X				X		
025		X	X				X		
026		X	X	X					
027	X		X	X			X	X	
028	X		X	X					
029	X		X	X					
031		X							
032				X					
037	X	X	X	X	X	X			X
	11	22	26	16	6	2	8	6	7
	A	M	P	F	I	FN	NGO	B	C

	LEGEND
KI	Key informant
A	Academic
M	Municipal
P	Provincial
F	Federal
I	International
FN	First Nation
NGO	Non-governmental organization
B	Business
C	Consulting

Appendix 8– List of Tools Identified by Key Informants

Tools (Technical Training)	Frequency
Project Management	10
GIS	7
Public Meetings/Consultation/Focus Groups	7
Legislation (e.g. MCCAPs, zoning, setbacks)	6
Conference/Workshop	5
LIDAR	4
Meetings	4
Monitoring Programs	4
Scenarios/Models	4
Walkabouts, Charettes	4
Citizen Science	3
Contribution Agreements (MOUs)	3
Mapping Exercises (e.g. Participatory, Hazard)	3
Stakeholder Engagement	3
Visualization	3
Vulnerability Assessments	3
Activity Reports (Templates)	2
Climate Science & Social Science	2
Climate Station Data	2
Conference Calls	2
Consulting	2
Filesharing	2
GPS applications	2
Infrastructure Assessments	2
Mainstreaming	2
Regulatory Approvals (Read the Instructions)	2
Research	2
Risk Assessment/Management/Communication	2
Social Resilience/Adaptive Capacity	2
Story telling (e.g. iconic events)	2
Sustainability	2
Watershed Restoration	2
Adaptation Plans/Strategies	1
Adaptation Platfrom	1
Adaptation Workplan	1
Asset Management	1
Business Planning	1
CLIVE	1
Collecting Anecdotal Evidence	1
Community-based Adaptation	1
Decision Support Tools	1

Development Processes	1
Different Funding Sources	1
Drones	1
EAC toolkit	1
Education	1
Emergency Preparedness Planning	1
Engineering and Technical Services	1
FCM	1
Formal Commissions	1
IBC MRAT	1
Indicators Development	1
Informal Networking	1
Integrated Assessments	1
Livelihood Assessment	1
Living Shorelines	1
On-line Surveys	1
Partner Identification	1
Policy Development	1
POLIS	1
Presentations	1
Proposal Development	1
Relationship Building	1
Reports/Studies	1
Social Marketing	1
Social Media	1
Steering Committee	1
Survey Instruments	1
Talking Circles	1
Traditional Science	1
Values Mapping	1
	144

Appendix 9 – List of Skills identified by Key Informants

Skills (Experiential, Behavioural)	Frequency
Collaboration	11
Bridge Scientist/Product (End User Focus)/Practical Results	9
Facilitation	8
Networking/Relationships	8
Contextual Intelligence	6
Communcation (up and out)	5
Negotiation	5
Stakeholder Engagement/Consultation	5
Trust-Building/Credibility/Follow-through on Commitments	5
Multidisciplinary Perspectives	4
Perseverance/Persistence/Determination/Patience	4
Share Stories/Story telling	4
Dealing with Consultants/Consultant Mindset	3
Dialogue-Deliberation	3
Mediation	3
Self-Education/Reflection/Learn by Experience	3
Accountability/Reporting	2
Balancing Interests	2
Evidence-Based Decision-making (Knowledge Transfer)	2
Information Translation/Knowledge Dissemination	2
Public Education/Awareness	2
Strategic Thinking	2
Analytic Ability	1
Bridging Levels	1
Creativity	1
Cross-Departmental Perspectives	1
Ingenuity	1
Innovation	1
Multi-tasking	1
Passion/Drive/Ambition	1
Push the Envelope (Risk Taking)	1
Puzzling	1
Transparency	1
	109

Appendix 10 – Leadership Barriers to Adaptation (Moser and Ekstrom, 2010)

Barrier Area	Diagnostic Question	Descriptor
Understanding	*Not included in diagnostic questions*	Knowledge
	Do leaders, norms, or institutions dismiss the issue as a problem?	Receptivity
	How much negotiation or mediation skill is there among participants?	Negotiation
Planning and Decision-Making	Who is leading the process?	Leaders
	Do leaders have formal authority and/or the necessary skill and ability to facilitate the process?	Authority & Skill
	Do leaders and others involved have the ability and willingness to develop a set of criteria to judge options?	Develop Criteria
	What entity/organization has responsibility, authority, and lead control over the process?	*Not identified in interviews*
	Which organizations/entities influence process?	Other Influencers
	Is there a well-connected and knowledgeable leader to identify and gather the necessary resources to adequately support an option assessment?	*Not identified in interviews*
	Are other participants in the process adequately trained?	Training
	How do institutional mission, policy agendas, historical legacies, procedural rules, social and professional norms, or even customarily consulted information sources shape the assessment?	Institutional
	Is there a leader that can facilitate the selection process and help mediate among different interests and agendas?	Mediate Selection
	Is there a well-connected and knowledgeable leader to identify and gather the necessary resources to adequately support an option assessment?	Resources

Managing the Problem	Does the actor have the (perceived) adaptive capacity or any cognitive biases for or against implementing the option?	Adaptive Capacity Cognitive Biases
	Does the human capital exist to implement the strategy?	*Not identified in interviews*
	Do necessary collaborations and lines of communication exist to accomplish an efficient and effective implementation?	Collaboration Communication
	Is anyone willing, charged or accountable to conduct an evaluation?	Evaluation
	Are leaders, decision-makers, and other stakeholders willing to learn from an evaluation exercise?	*Not identified in interviews*
	Are leaders willing to revisit past decisions?	*Not identified in interviews*
	Not identified in diagnostic questions	Sustained Funding

Appendix 11 – Results – Leadership Barriers to Adaptation

Description	Type	U/P/M
Bureaucrats dismiss CC	Receptivity	U
CC fatigue	Receptivity	U
Community perceptions	Receptivity	U
Denial	Receptivity	U
Skepticism	Receptivity	U
Skepticism	Receptivity	U
Uncertainty	Receptivity	U
Availability of information	Knowledge	U
CC as threat multiplier	Knowledge	U
Expressing uncertainty	Knowledge	U
Getting research to decision makers	Knowledge	U
Immediate need for info from researchers	Knowledge	U
Issue framing	Knowledge	U
Lack of knowledge	Knowledge	U
Lack of understanding - politicians	Knowledge	U
Maintaining currency on science	Knowledge	U
Science to direct policy	Knowledge	U
Sustainability thinking	Knowledge	U
Framing adaptation	Knowledge	U
Coordination	Authority & Skill	P
Governance	Authority & Skill	P
Legal MOU accountability	Authority & Skill	P
Non-confrontational engagement	Authority & Skill	P
Political will	Authority & Skill	P
Provincial reluctance to enforce	Authority & Skill	P
Regulatory	Authority & Skill	P
Relationship building	Authority & Skill	P
Reporting/Accountability	Authority & Skill	P
Tax disincentives	Authority & Skill	P
Sustained commitment - in kind partners	Collaboration	P
Destruction of leadership	Destruction	P
Ensuring accountability	Develop Criteria	P
Lack of real-time monitoring data	Develop Criteria	P
Other priorities	Develop Criteria	P
Reliable costing data	Develop Criteria	P
Technical	Develop Criteria	P
Tool selection (regulatory/non)	Develop Criteria	P
Administrative burden	Institutional	P
Administrative burden	Institutional	P
Bureaucratic levels	Institutional	P
Corporate memory	Institutional	P

Differing challenges (Prov)	Institutional	P
Existing govt channels don't work	Institutional	P
Five year renewal process	Institutional	P
Incentives to participate	Institutional	P
Institutional rules	Institutional	P
Intergovernmental structures	Institutional	P
Lack of national strategy	Institutional	P
Loss of institutional memory	Institutional	P
Organizational difference (budget cycle)	Institutional	P
Organizational changes	Institutional	P
Organizational structures inhibit	Institutional	P
Policy turnover	Institutional	P
Political turnover and retraining	Institutional	P
Shifting priorities	Institutional	P
Shifting priorities	Institutional	P
Silos	Institutional	P
Silos	Institutional	P
Staff attrition/turnover	Institutional	P
Staff turnover	Institutional	P
Stale legislation	Institutional	P
Technical vs. Behavioural Biases	Institutional	P
Updating old legislation	Institutional	P
Vertical linkages	Institutional	P
Government leadership (P/F)	Leaders	P
Government leadership (P/F)	Leaders	P
Lack of high level leadership	Leaders	P
Political vacuum	Leaders	P
Role models	Leaders	P
ACASA frustration (info to action)	Mediate Selection	P
Behavioural change	Mediate Selection	P
Common direction/focus	Mediate Selection	P
Coordinated stakeholder engagement	Mediate Selection	P
Coordination	Mediate Selection	P
Directing Academic PIs	Mediate Selection	P
Identifying policy levers	Mediate Selection	P
Implementation	Mediate Selection	P
Maintaining collective focus	Mediate Selection	P
Maintaining relevance	Mediate Selection	P
Moving from science to stakeholders	Mediate Selection	P
Right sizing	Mediate Selection	P
Shared coordination	Mediate Selection	P
Disconnect with engineering profs	Other Influencers	P
Disconnect with landowners	Other Influencers	P
Disconnect with realtors	Other Influencers	P
Engaging the right people	Other Influencers	P

Engineering conservatism	Other Influencers	P
Engineering engagement	Other Influencers	P
Landowners/developers not engaged	Other Influencers	P
Reaching outside government	Other Influencers	P
Small pocket of local opposition	Other Influencers	P
$$	Resources	P
Admin procedures to access $$	Resources	P
Budget tracking/$$ allocation rules	Resources	P
Coordination of $$ flow	Resources	P
Federal cost-cutting	Resources	P
Functional hurdles (contracting, allocation)	Resources	P
Funding	Resources	P
Funding for implementation	Resources	P
Sustained funding	Resources	P
Time delays	Resources	P
Common tools	Training	P
Grass roots change	Training	P
Identifying required skill sets	Training	P
Community capacity	Adaptive Capacity	M
Municipalities - little capacity	Adaptive Capacity	M
Small municipalities with low capacity	Adaptive Capacity	M
Behavioural change	Cognitive Biases	M
Frustration	Cognitive Biases	M
Resistance to change	Cognitive Biases	M
Networks as constraining	Collaboration	M
Communication	Communication	M
Communication	Communication	M
Internal/external communication	Communication	M
Knowledge transfer	Communication	M
Resources for evaluation	Sustained Financing	M
$$ for implementation	Sustained Financing	M
Financial	Sustained Financing	M

Appendix 12 – Sources Used to Assign Predominant Leadership Style

KI	Style	Source: Interview	Other	Document	Observation	Confirmation Re-interview
001	Distributed/ Supportive	(KI001, 2015)	(Fenech, 2015)		(P002, 2015)	
002	Participative	(KI002, 2015)	(KI009, 2015)	(GOMC, 2015)	(V002, 2015)	
004	Shared	(KI004, 2015)	(KI005, 2015)		(P004, 2015)	
005	Shared	(KI005, 2015)	(KI004, 2015)		(P004, 2015)	
006	Supportive	(KI006, 2015)	(Cunslo-Willox, 2015)	(ACAP, 2015)		
007	Shared	(KI007, 2015)	(KI028, 2016) (KI029, 2016)		(P001, 2015)	(KI007, 2016)
008	Participative	(KI008, 2015)	(Brown, 2015b)	(Metro, 2013)		
009	Distributed	(KI009, 2015)	(KI002, 2015) (Fenech, 2015)			
010	Distributed	(KI010, 2015)	(KI028, 2016) (Fenech, 2015)		(P006, 2015)	
011	Distributed	(KI011, 2015)	(Fenech, 2015)			
012	Supportive	(KI012, 2015)		(PEIWA, 2016)	(V001, 2015)	
014	Distributed	(KI014, 2015)	(KI025, 2015) (Fenech, 2015)			
015	Supportive	(KI015, 2015)	(Fenech, 2015)	(UPEI, 2016a) (UPEI, 2016b)		
016	Shared	(KI016, 2015)		(HRM, 2013)		
017	Supportive	(KI017, 2015)	(Charles, 2015)	(ACASA, 2011)		
018	Shared	(KI018, 2015)		(BoFEP, 2016b)		(KI018, 2016)
019	Supportive	(KI019, 2015)				
021	Distributed/ Supportive	(KI021, 2015)	(Mercer Clarke, 2015)		(P005, 2015)	
022	Distributed	(KI022, 2015)	(KI031, 2016)	(21Inc., 2016)		
023	Distributed	(KI023, 2015)		(TFLUP, 2009)	(P005, 2015)	
024	Distributed/ Supportive	(KI024, 2015)	(Fenech, 2015)	(PEIWA, 2016)		
025	Distributed	(KI025, 2015)	(KI014, 2015) (Fenech, 2015)			
026	Distributed	(KI026, 2015)	(KI011, 2015)		(P005, 2015)	
027	Distributed/ Supportive	(KI027, 2016)	(Mortsch, 2015)			
028	Shared	(KI028, 2016)	(KI010, 2015)		(P008, 2016)	
029	Distributed/ Supportive	(KI029, 2016)	(KI015, 2015)	(UPEI, 2016a) (UPEI, 2016b)	(P008, 2016)	
031	Distributed	(KI031, 2016)	(KI022, 2015)	(City of Charlottetown, 2010)		(KI031, 2016)
032	Distributed/ Supportive	(KI032, 2016)	(Mortsch, 2015)	(Government of Canada, 2012)		
037	Distributed/ Supportive	(KI037, 2015)		(McGill, 2008)		

Appendix 13 – Results – Complexity Leadership Functions

CLT Functions							
KI		Career	P-A	E	A	C	D
001	F	E		x	x	x	
002	M	L/P	x	x	x	x	
004	M	L	x			x	x
005	M	L	x				x
006	F	E			x	x	
007	M	L	x	x	x	x	x
008	M	L	x		x	x	
009	M	M	x			x	x
010	M	L	x	x	x	x	x
011	M	M				x	x
012	M	L		x		x	x
014	M	M	x			x	x
015	M	E				x	x
016	M	L	x	x		x	x
017	M	M	x			x	
018	F	L/P		x	x	x	
019	M	M	x			x	
021	F	E	x		x		x
022	F	E	x	x		x	x
023	F	M	x		x	x	
024	F	E		x	x		
025	F	E	x	x	x	x	x
026	F	M	x	x		x	x
027	F	L	x	x		x	x
028	M	L/P	x		x	x	
029	F	E	x			x	x
031	F	L	x	x	x	x	
032	F	L	x	x		x	x
037	F	L	x			x	

Appendix 14 – Archetype and Leadership Application

How might a climate change adaptation leadership archetype be applied? Eyzaguirre and Warren (2014) suggest four phases in the institutional climate change adaptation process (highlighted below). The following table suggests a roadmap on how findings from section 6.5 might be applied in a hypothetical climate change adaptation organization.

PHASE	STEP	Archetype Activities
AWARENESS	1. Awareness of climate change 2. Awareness of need to adapt	• Contextualize adaptation to particular adaptive challenges • Become an *extension agent* • Embrace *shared leadership* through working with *champions* • Assume a *mobilizer* role
PREPARATION	3. Mobilizing resources 4. Building capacity to adapt	• Apply flexible cognitive framing in the selection of adaptation entry points • Assess individual, organizational and network leadership capabilities • Capitalize on multi-level governance experience • Embrace *shared leadership* • Assume an *instigator* role • Collaborate, where appropriate
ADAPTATION	5. Implementing targeted adaptation actions	• Understand the interrelationship of leadership, followership and context for adaptation innovation • Embrace *shared leadership* • Assume an *instigator* role • Actively identify barriers and develop means to overcome them • Develop contextual intelligence to apply formal power and informal influence • Understand the process of innovation
MOVING TOWARDS ADAPTIVE MANAGEMENT	6. Measuring and evaluation progress 7. Learning, sharing knowledge with others and adjusting	• Develop robust evaluation frameworks and measure results • Embrace *shared leadership* • Develop technical and behavioural competencies for collaborative leadership • Understand the complex inter-relationship of leadership styles and functions • Forge strategic alliances • Seek out mentorship opportunities • Become an apprentice as part of a reflective climate change adaptation practice