Absorptive capacity for responding to environmental change: an assessment of three public-sector agencies

By

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Submitted in fulfilment of the requirements for the degree Masters of Technology in Nature Conservation, to be awarded at the Nelson Mandela Metropolitan University

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2015

ABSTRACT

In a time of global environmental instability, public-sector organisations that manage and protect natural resources, which are needed for human wellbeing, play an increasingly important role. These organisations frequently have to weigh up the costs and benefits of managing natural resources and their services for the public good. Management of social-ecological systems is commonly characterised by uncertainty, disagreement and trade-offs. In South Africa, these challenges are compounded by the fact that mandated organisations are often inadequately resourced in terms of finances, skilled staff and infrastructure.

In order to maintain the resilience and robustness of social-ecological systems, public-sector organisations need to cultivate a set of dynamic capabilities, with strong emphasis on learning from their experiences and adapting their management strategies, to innovate and improve their performances. Absorptive capacity (AC) has been described as the ability of an organisation to recognise the value of new external information, acquire it and assimilate it within the organisation, transforming it by applying it with existing knowledge and exploiting the new knowledge for benefit. Organisations with good AC are able to recognise rapidly changing environments and address them by renewing and building on their levels of skill, knowledge and capability to deal with change.

This construct has been extensively researched in industries related to business and technology, where its development has been found to stimulate innovative capabilities. There has, however, been little research into its relevance for public-sector organisations or organisations with environmental mandates. This study used methodological triangulation to assess the perceptions of employees on the current state of AC in three public-sector organisations with environmental mandates. This was done to gain insight into their capacity to absorb information and apply their new knowledge in decision-making, in a manner that navigates through environmental change.

The key findings of this research suggest that knowledge transformation and exploitation are enhanced by in-house research capabilities and cross-functional interface between internal departments. These findings also suggest that the

acquisition of knowledge is not only determined by the in-house research capacity but also depends on the resources available to these departments in terms of time, finances and skilled staff. There was minimal evidence of knowledge exploitation; however, obstacles that were highlighted as hindering this process included individual responsibility and motivation, as well as general organisation capacities, such as communication hierarchies, funding, time and organisational silos. This research found that the well-studied concept of AC can be used as an institutional mechanism to assess and promote adaptive capacity in public-sector organisations with environmental mandates to navigate and innovate through the Anthropocene.

Key words: Absorptive capacity, adaptive capacity, environmental change, public-sector organisations

DECLARATION OF ORIGINALITY

I, Samantha Jo Mc Culloch, student number 212241257, hereby declare that the *dissertation* for *Students Masters of Technology in Nature Conservation* is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification. I have read and understand the information on plagiarism as outlined in the NMMU regulations.

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DEDICATION

I would like to dedicate my Master's thesis to my beloved father who passed away in 2010. He was a man who inspired humility, faith and dedication. He was my role model and best friend, without whom I would never be where I am today. When I was weak, he gave me strength, when I was lost, he gave me direction. Most of all, he showed me love that was beyond shame and weakness. He was a true leader, a dedicated husband and a loving father.

Dad, thank you so much for believing in me and making me believe in myself. You worked tirelessly your whole life to make sure your family had everything you never had. I know you look down on us now and are comforted by the legacy you left behind. I know you are proud of me and, finally, I can say that I am proud to be myself.

ACKNOWLEDGEMENTS

I would like to express my deep appreciation and gratitude to my supervisors Prof Christo Fabricius and Prof Dirk Roux for their patience, guidance and mentorship in this Master's journey. I could not have asked for better supervision in what has to have been the bumpiest and greatest learning journey of my life. They inspired and challenged me to reach my intellectual potential, far beyond what I thought I was capable. I am truly fortunate to have had the opportunity to work with such inspiring scientists.

I would also like to thank Chloe Guerbois and Jeanette Pauw for their patience and kind attitudes in assisting me statistically. In the same vein, I would like to thank my fellow students of the SRU. Having that support and communication structure in place has helped me through many frustrating times.

To my participants from Eden District Municipality, CapeNature and the Garden Route National Park, thank you so very much for co-operating and participating in this study. It was a privilege to have your doors opened up to me so that I may catch a glimpse of the hard work and dedication that occur daily for the benefit of our social-ecological environment.

To my funders; National Research Foundation (NRF), Sustainability Research Unit (SRU), the Water Research Commission (WRC) and Nelson Mandela Metropolitan University (NMMU), I am eternally grateful for your extended support for this study.

Lastly, I could not have done this without the encouragement of my family and my partner, Andrew Jackson. Collectively, they have offered me stability in a very turbulent time.

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DEFINITION OF KEY CONCEPTS

The following are definitions of key concepts that were used during this study.

Absorptive capacity (AC) is a set of routines and processes found within organisations that give the organisation the ability to acquire, assimilate, transform and exploit new information in a manner that produces dynamic capabilities (Zahra and George, 2002). These researchers further suggest that AC exists as two subcomponents, i.e., potential and realised capacity. Potential AC is comprised of the dimensions knowledge acquisition and assimilation; realised AC is comprised of the dimensions knowledge transformation and exploitation.

Adaptive capacity is the ability of a system or organisation to cope with change without losing opportunities for future development. Systems that have high adaptive capacity are resilient to abrupt and disorganising environmental change, as they can absorb the disturbance without losing major functioning capacity (Folke *et al.*, 2002; Walker *et al.*, 2004; Fazey *et al.*, 2007)

Anthropocene is described as the current geological epoch where human activity has had a profound effect on the global environment (Lewis and Maslin, 2015). These human-induced changes include a magnitude and variety of changes in atmospheric composition and land transformations. The impacts of these changes are likely to be observed in the geological stratigraphic record for millions of years. Lewis and Maslin (2015) give evidence and propose two possible dates for the beginning of the Anthropocene: 1610 and 1964.

The date 1610 ‘Orbis spike’ marks the time when the Old (European) and New World (Americas) human populations meet, when two hemispheres were connected through global trade routes. This resulted not only in a mixing of biota, but also a period of mass human decline (50 million deaths in the Americas due to disease, famine, war and slavery), leading to a CO_2 dip following agricultural abandonment (Lewis and Maslin, 2015).

The date 1964 ‘Bomb spike’ marks the time during a great acceleration of human activity. This includes a major expansion of the human population, development of persistent organic pollutants, inorganic compounds and the testing of nuclear bombs, where peak global C was recorded (Lewis and Maslin, 2015).

Architectural innovations occur when the components (knowledge or parts) of a product or project are linked together in a new way, leaving the fundamental output unchanged (Van den Bosch *et al.*, 1999).

Capabilities are high level routines within the organisation that allow it to achieve various actions, functions and outputs (Winter, 2003).

Climate change is a phenomenon that occurs within the biosphere, which brings long-term shifts in average weather conditions; this is attributed to natural variability as well as human activity (Alley *et al.*, 2007).

Dynamic capabilities are the routines and processes that are geared towards strategically navigating the organisation through periods of change; i.e., they allow the organisation to evolve and develop. Dynamic capabilities stimulate the organisation to create and implement knowledge necessary to build on other organisational capabilities (Winter, 2003; Zahra and George, 2002)

Environmental change in the context of this research not only refers to the effects of climate change, but also includes changes in social, economic and political systems that can themselves undergo abrupt and disorganising change. This has impacts on the functioning of SES at local and global scales, e.g., the global economic recession of 2008 and national election cycles.

Incremental innovations happen when minor changes are made to a product, service or strategy. By doing this, the organisation exploits the potential of a previous project, making it more efficient (Henderson and Clark, 1990).

Information refers to organised data, that has relevance and purpose or that has been interpreted to create meaning (Davenport and Prusak, 1998). The creation of information requires human participation in the act of purposeful organisation of raw data. Information is explicit and can be transferred with ease to others (Roux *et al.*, 2006; Davenport and Prusak, 1998).

Knowledge acquisition refers to an organisation's capacity to identify and acquire externally produced information that is relevant to its operations (Zahra and George, 2002)**.**

Knowledge assimilation refers to the routines and processes that allow the organisation to examine, process, interpret and understand the information acquired from external sources, i.e., converting information into knowledge (Zahra and George, 2002).

Knowledge exploitation refers to the application of new knowledge that enables the organisation to refine and extend existing capabilities or create new ones (Zahra and George, 2002). The outcome of knowledge exploitation allows an organisation to create new technologies, ideas or practice that expands the organisation's competencies for the benefit of their mandate.

Knowledge is defined as a mix of contextual information, experience, intuition and values that provide an outline for evaluating and incorporating new information and experiences (Davenport and Prusak, 1998). The capacity to act effectively stems from knowledge (Roux *et al.*, 2006). Two types of knowledge are identified; i.e., tacit and explicit knowledge. Tacit knowledge is personal and is deeply rooted in an individual's experience, emotions, values and ideals (Roux *et al.*, 2006). This makes tacit knowledge difficult to transfer to others, as it is subjective. To transfer knowledge, we need to make it explicit, by putting it into words or numbers, such as within a report, i.e., by creating information. This explicit knowledge represents content, but as knowledge is contextual, there is often more knowledge within us than we can communicate effectively through words or text (Roux *et al.*, 2006).

Knowledge transformation refers to the organisation's capability to develop and refine the routines that facilitate the combining of existing knowledge with newly acquired and assimilated knowledge. A part of this may also involve deleting expired knowledge or interpretation of existing knowledge in a new manner (Zahra and George, 2002)**.**

Radical innovations occur when a whole new set of design principles are used, completely reforming the components of the project to produce an entirely new project (Henderson and Clark, 1990).

Resilience is described as the ability of a system to absorb disruption and change by reorganising capabilities, so as to still retain the same essential functions, feedback and structures (Walker *et al.*, 2004).

Robustness is described as the ability of a social system to prevent ecological systems on which they rely from moving into a regime that cannot support the human population, or causes long-term suffering to human well-being (Anderies *et al*., 2004).

Social-ecological systems (SES) thinking has been outlined in resilience literature, as it is now understood that it is fundamentally important to understand that people are embedded in ecological systems at local and global scales. Human beings interact and shape the ecological environments around them due to their complex dependence on ecological systems for well-being (Berkes and Folke, 1998).

Transformative capacity is the ability to create a fundamentally new system when social, economic and ecological structures make the existing system unsustainable (Westley *et al.*, 2011).

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LIST OF ABBREVIATIONS

AC – Absorptive Capacity

CN – CapeNature

EDM – Eden District Municipality

GRNP – Garden Route National Park

IDP – Integrated Development Plan

NEM: PAA – National Environmental Management: Protected Area Act (Act No. 57 of 2003)

NMMU – Nelson Mandela Metropolitan University

NRF – National Research Foundation

QEM – Quarterly Ecological Meetings

REST – Regional Ecological Support Team

SALGA – South African Local Government Association

SAM – Strategic Adaptive Management

SANParks – South African National Parks

SES – Social-ecological systems

SRU - Sustainability Research Unit

V-STEEP – Values - Social, Technological, Environmental and ecological, Economic and Political

WCNCB – Western Cape Nature Conservation Board

WRC - Water Research Commission

WfW – Working for Water

CHAPTER 1: INTRODUCTION

We are living at a time characterised by global environmental change that is unprecedented at all scales. A major driver of this change is human advancement, so much so that scientists are now referring to this era of human domination as the Anthropocene (Lewis and Maslin, 2015). Modifications to natural resources affect the services that are provided by the Earths' ecosystems, which in turn are directly linked to human well-being (Biggs *et al.*, 2004). The institutions that are in place to determine how society governs ecosystems are therefore fundamental to navigate through the negative impacts of unwanted environmental change (Cundill *et al.*, 2011). Key to navigating through environmental change is the ability of these organisations to learn and use readily available knowledge (Roux *et al.*, 2008). How organisations manage their learning becomes particularly pertinent in a time when information is readily available and produced at an alarming pace, to the point where information-overload is a stark reality.

Historically, there has been a lack of understanding of the dynamic and complex coupling of social and ecological systems. This often led to a disconnection in the management of these systems at local and global scales, causing extensive environmental change and societal challenges (Biggs *et al.*, 2010). Given the links and feedback between ecological and social systems, this has led to the belief that ecosystems are better understood and managed as coupled social-ecological systems (SES). SES are by their very nature complex and natural resource management by public-sector organisations is therefore commonly characterised by strategic trade-offs (Anderies *et al.*, 2004). In South Africa, this is compounded by the fact that these organisations are often under-resourced in terms of finance, skilled staff and infrastructure (Roux *et al.*, 2008).

Science and innovation can play an important role in facilitating a positive transition in the way public-sector organisations manage SES (Olsson and Galaz, 2012). Strategies published in scientific literature outline theoretical and practical examples of navigating through environmental change. The uptake and implementation of these, however, have mostly been unsuccessful within local environmental institutions (Olsson and Galaz, 2012). This phenomenon has been recorded in many branches of applied science and is not unique to environmental conservation alone (Pfeffer and

Sutton, 1999). It has been suggested that the uptake and implementation of environmental change strategies are highly dependent on the ability of mandated public-sector organisations and the individuals in their employ to absorb and use externally produced information (Murray *et al.*, 2011).

The absorption of knowledge is an accumulative process. The deeper an individual's prior knowledge on a topic, the easier it is to absorb new complementary information on that topic (Cohen and Levinthal, 1990). This capability has been referred to as absorptive capacity (AC) in organisational research and is defined as *'the ability of an organisation to recognise the value of new external information, acquire it, assimilate it, transform and exploit it'* (Zahra and George, 2002). By absorbing and combining new information with existing knowledge, organisations are able to adapt and innovate faster than if they had to produce the knowledge on their own. By fostering this capability, these institutions would then be able to take action and innovate with the best and most up-to-date knowledge.

AC is essentially a capability developed within organisations by a set of routines and processes. This gives them the ability to recognise changing environments rapidly and address them by renewing and building on their component knowledge (Murray *et al.*, 2011). AC is not only determined by organisational learning, but also by realising the potential of the absorbed knowledge. This is achieved through experimentation with the new information by transforming practices and using them as an opportunity to further learn, adapt and innovate (Zahra and George, 2002).

Innovation is a term synonymous with new technology; however, this also applies to new ideas, practices and strategies (Westley *et al.*, 2011). Olsson and Galaz (2012) argues that societies need innovations that will better enhance the fit between governance and ecosystems, taking into consideration all aspects of social, economic and ecological situations. Studies have shown (Lane and Lubatkin, 1998) that AC not only influences organisations' capacity for innovation, but also intra-organisational knowledge transfer, inter-organisational learning and overall performance. This capability can foster adaptiveness in decision-making, preparing organisations for future possibilities and the potentially unknown.

AC has been extensively researched in organisational science (Lane *et al.*, 2006). It has, however, only been theoretically implied as a desirable capability for

environmentally mandated public-sector originations (Roux *et al.*, 2008; Murray *et al.*, 2011). Perhaps by understanding the different components that feedback into the AC of public-sector organisations, their strength and weaknesses can be highlighted and in turn provide a guideline for future development. This study adapted a multidimensional tool, developed for industrial organisations (Flatten *et al.*, 2011), to explore the current state of AC and the feedback to decision-making in three environmentally mandated public-sector organisations.

Research Statement

The purpose of this research was to gain an understanding about the current state of AC and its feedback to decision-making in three public-sector organisations with environmental mandates. With the use of a multidimensional survey instrument and contextual narrative research, the researcher was able to explore the perceptions of employees about the routines and processes that determine AC and assess their strengths and weaknesses that feedback into decision-making in response to environmental change.

Research Aims

This study aims to explore the perceptions of employees about the routines and processes that determine the AC of three public-sector organisations with environmental mandates in the Southern Cape, with a view to better understanding their capacity for adopting new external information for decision-making in order to respond to environmental change.

Research Questions

1. What is the feedback between the processes and routines that determine AC and decision-making to deal with environmental challenges for public-sector organisations that have environmental mandates?

2. Is the multidimensional measure of AC adapted from Flatten *et al.* (2011) a reliable and useful instrument to assess AC of public-sector organisation with environmental mandates?

The Significance of this Research

AC is a well-researched concept in business science and commercial organisational research; however, it has only been theoretically implied as a desirable capability for

public sector organisations with environmental mandates. This research will explore the AC of three public-sector organisations in order to better understand their capacity to use external knowledge to make decisions that enable adaptation in response to environmental change.

Outline of Dissertation

Chapter 1: Introduction

This chapter will be used to set the scene for the research study. It will outline some of the major environmental challenges faced in today's SES, as well as some of the challenges faced by organisations mandated to manage these systems. This chapter will then argue the need for these organisations to have the capacity to be aware and up-to-date on newly produced knowledge in order to be innovative and adapt through environmental change.

Chapter 2: Conceptual background

In this chapter, I have highlighted some of the major challenges faced by public-sector organisations, with environmental mandates, in a time characterised by complex social and ecological uncertainty and environmental change. I argue that developing AC within public-sector organisations is essential to developing the depth and breadth of knowledge needed to allow adaptation to, predicted and unpredicted environmental change.

Chapter 3: Study domain

In this chapter, a contextual background of the selected organisations will be given. The organisation's vision, mission and management strategies will be outlined, including the dominated legislation that mandates them.

Chapter 4: Methodology, research design and methods

This chapter will be presented in four sections. Section one will explain the methodology that was followed; this includes the paradigm that the researcher subscribes to and the knowledge philosophy that was followed. The second section will describe the research design. This will include information about the sampling and data analysis strategy used, as well as outlining the parameters and assumptions that

constrained this study. The third section will describe the methods used during data collection and analysis. Lastly the ethical considerations of this study will be discussed.

Chapter 5: Results

This chapter will display the results that were obtained with the mixed-method analysis, according to the research questions of the study.

1. What is the feedback between the processes and routines that determine AC and decision-making to deal with environmental challenges for public-sector organisations with environmental mandates?
2. Is the multidimensional measure of AC adapted from Flatten *et al.* (2011) a reliable conventional instrument to assess AC of public-sector organisation with environmental mandates?

Chapter 6: Discussion

This chapter will discuss the results of the study highlighting the employee's perceptions of strength and weakness of certain processes and routines that enable or restrict AC. This will then be related to the feedback between AC and adaptive decision-making towards environmental change. Lastly, the researcher will discuss the validity of this study for public-sector organisation with environmental mandates.

Chapter 7: Conclusion

This chapter will bring together all the explorative results of the study and make propositions based on the findings. This will then be translated in terms of relevance to theory and management. The researcher will then highlight the strengths and weaknesses of the study and make recommendations based on these findings for future research.

CHAPTER 2: CONCEPTUAL BACKGROUND

In this chapter, I have highlighted some of the major challenges faced by public-sector organisations with environmental mandates, in a time characterised by complex social-ecological feedback and environmental change. I argue that developing AC within public-sector organisations is essential for creating the depth and breadth of knowledge needed for adapting to both predicted and unpredicted environmental change.

Natural Resource management and environmental change

The past lack of understanding about the dynamic and complex relationship between social and ecological systems led to a compartmentalized approach in the management of these systems at local, national and global scales (Olsson and Galaz, 2012). This separation has caused extensive environmental change and societal challenges (Biggs *et al.*, 2010). Ultimately, this has led to the loss of vital ecosystem services that are beneficial, if not essential, for human well-being (Biggs *et al.*, 2010).

The management of SES is commonly characterised by an imperfect knowledge base (Murray *et al.*, 2011). Adding to this the environmental public-sector organisations, which are mandated to care for these systems, are often under-resourced in terms of finances, skilled staff and infrastructure (Roux *et al.*, 2008). Environmentally mandated public-sector organisations (referred to in Figure 1 as public infrastructure providers by Anderies *et al.* (2004)) frequently have to weigh up the costs and benefits of distributing natural resources to the public in a manner that is equitable, efficient and sustainable (Funke *et al.*, 2008). Therefore natural resource management is commonly characterised by strategic trade-offs.

Anderies *et al.* (2004) highlighted the role of the public-sector organisations in maintaining the robustness of SES. They state that a '*SES is robust if it prevents the ecological system upon which it relies from moving into a new domain of attraction that cannot support a human population, or that will induce a transition that causes long-term human suffering*' (Anderies *et al.*, 2004. pg. 7). Figure 1 is an adaptation of a conceptual model for SES developed by Anderies *et al.* (2004). It shows the interactions and feedback between natural resources, resources users, public-sector organisations and public infrastructure, and the influence of external drivers that affect environmental change.

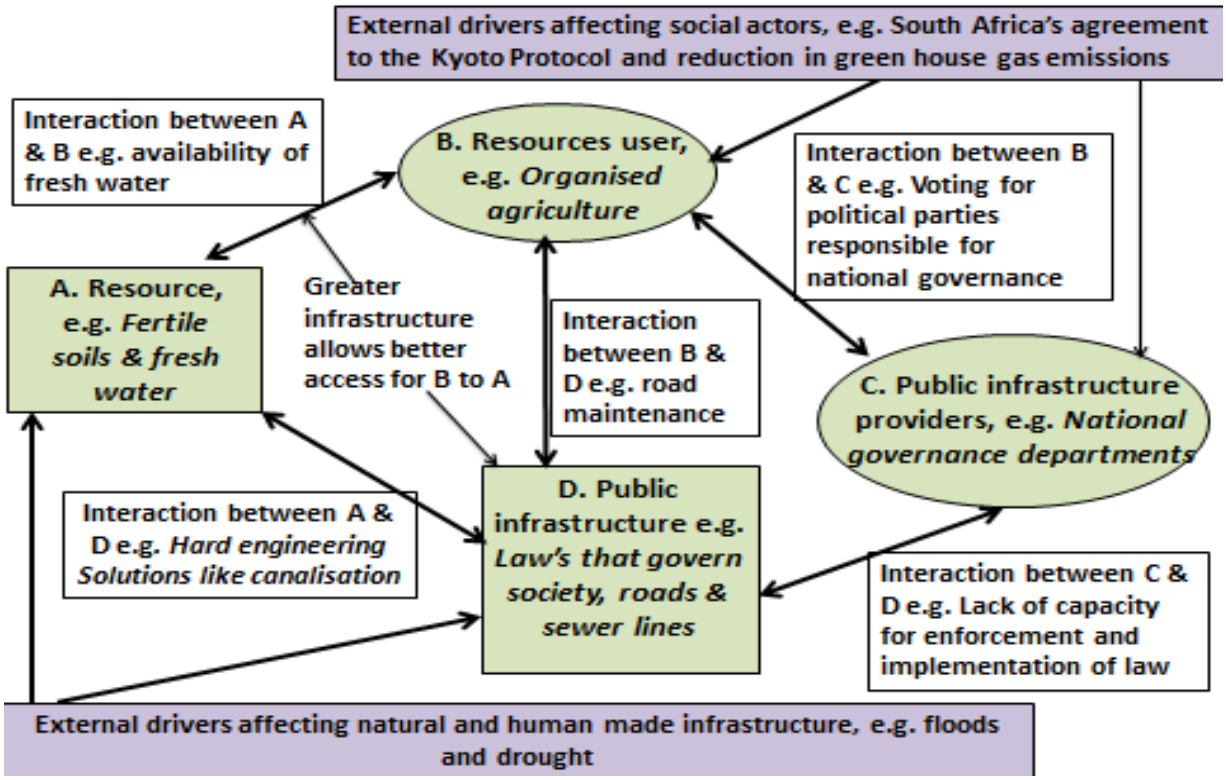

Figure 1: Diagram adapted from Anderies *et al.* (2004) showing the main components and the many forms of feedback between them that need to be considered in the management of SES. The green Boxes A, B, C and D depict the basic components of a SES as natural resources, resource users, public infrastructure providers and public infrastructure respectively. The white boxes depict the interactions between the components of the SES and external drivers of environmental change. The purple boxes show examples of external drivers of environmental change that affect the SES and its management.

The framework highlights the links and vulnerability posed by external drivers that can cause environmental change to the components of a SES. These environmental changes can be gradual, and at other times it can be abrupt and turbulent (Folke *et al.*, 2005). Anderies *et al.* (2004) states that public-sector organisations are key to maintain the robustness of these SES. Robustness and resilience are similar concepts; however, robustness emphasises the cost-benefit trade-offs associated with the management of these systems to cope with uncertainty. In order to do this, public-sector organisations need to recognise that SES are complex adaptive systems and cultivate a set of capabilities with strong emphasis on continued learning and adapting their practices to promote experimentation, monitoring and reflection (Biggs *et al.*, 2015).

To promote robustness, public-sector organisations need to cultivate internal adaptive capacity. Adaptive capacity refers to management that promotes reflexive learning and

the ability to foster and experiment with innovative solutions (Armitage, 2005). Key to this is promoting the ability to learn from past experiences and forecast potential unpredictable scenarios and plan accordingly (Fabricius *et al.*, 2007), while at the same time making peace with the unknown. AC has been suggested as a capability that can nurture adaptive capacity and learning within public-sector organisations (Murray *et al.*, 2011). AC enables organisational learning and has been described as critical to innovative capabilities (Cohen and Levinthal, 1990). Garvin (1993) defined a learning organisation as one that '*is skilled at creating, acquiring and transferring knowledge, and modifying its behaviour to reflect new knowledge and insight*s'. Managing for AC reflects organisational learning, experimentation and innovation and is characterised by efficient feedback loops and organisational transformation when necessary (Murray *et al.*, 2011).

Absorptive capacity and organisational learning

The term AC was first described by Cohen and Levinthal (1989) in *The Economic Journal*. They described it as '*the firm's ability to identify, assimilate and exploit knowledge from the environment'* (Cohen and Levinthal, 1989). AC has since then been thoroughly researched and reconceptualised in the business sciences, as a set of processes and routines by which a firm values, acquires, assimilates, transforms and exploits external knowledge to produce innovations and gain competitive advantage (Zahra and George, 2002).

In their reconceptualization of AC, Zahra and George (2002) made the distinction between potential AC and realized AC. Potential AC relates to the receptiveness of an organisation to the acquisition and assimilation of external knowledge. Realized AC relates to the capabilities that allow transformation and exploitation of external knowledge, essentially incorporating new knowledge to benefit the organisations performance (Zahra and George, 2002). Some organisations may have good potential AC, but this does not necessarily translate to good realized AC. Organisations that are able to realise the potential of the AC through good routines and processes of knowledge transformation and exploitation are more likely to have dynamic capabilities. Dynamic capabilities give organisations the capacity to recognise rapidly changing environments and address them by renewing and building on their levels of skill, knowledge and capability to deal with change (Mowery *et al.*, 1996).

Van den Bosch *et al.* (1999) also made the distinction of managing the determinants of AC between stable and turbulent knowledge environments. They noted that in stable environments it is best to manage for efficiency in order to exploit existing competencies. However, in changing or turbulent knowledge environments, they state it is best to manage for knowledge flexibility and scope in order to explore pathways of adaptation. Due to the uncertainty that is present in the management of SES (Allen *et al.*, 2011), and the rapid production of knowledge around such management (Roux *et al.*, 2008), it is suggested to view the knowledge environment as being turbulent rather than stable. Fazey *et al.* (2007) note that it is important to learn flexibly in a variety of contexts to promote SES resilience. It is therefore suggested that these organisations manage for knowledge flexibility and scope, in order to adapt their knowledge components and make decisions that reflect the most up-to-date information.

Component knowledge is the knowledge that resides within an organisation and consists of tacit and explicit knowledge (Boisot, 1999). Change in component knowledge is linked to single-, double- and triple-loop learning processes. Single-loop learning promotes incremental change and involves detection and correction of minor errors that relate to day-to-day activities (Smith and Sadker-Smith, 2005).The act of incremental changing increases the efficiency of an organisation and should be a continuous process (Roux *et al.*, 2008). Double-loop learning promotes architectural change and occurs when the underlying assumptions of component knowledge are questioned and revisions are made to reform strategies within a framework (Smith and Sadker-Smith, 2005). Triple-loop learning promotes radical change and involves questioning and reformation the governing values behind the framework (Roux *et al.*, 2008). Double- and triple-loop learning are more demanding; however, organisations that embark on these two processes show signs of flexibility (Fazey *et al.*, 2007). In turn, this makes them more adaptable and robust to unpredictable change.

Adverse environmental changes are often abrupt and disorganising. Catastrophes occur when major natural disturbances impact on a SES that lacks the adaptive capacity to cope with the event (Folke *et al.*, 2005). This creates challenges to existing governance structures and may erode the resilience of the SES and shift them into an undesired state (Folke *et al.*, 2002). Resilience is the ability of an ecological system to absorb disturbance while maintaining its major character and functioning (Gunderson

and Holling, 2002). This, in turn, is dependent on the robustness of the institutions that manage these systems (Anderies *et al.*, 2004).

If a SES is not resilient and robust, it is likely to be affected by progressively smaller events that may lead to catastrophes. Institutions and ecological systems with high adaptive capacity are robust and resilient, and are able to re-organise after a disturbance, limiting impacts to the crucial functioning of ecological services that impact human well-being (Folke *et al.*, 2002). Adaptive capacity in ecological systems is related to the overall diversity of the system, be it in genetics or varieties of landscapes (Berkes *et al.*, 2003). The adaptive capacity of a social system is related to the presence of institutions and networks that learn, store knowledge and experience and use this to adapt and re-organize in changing environments (Berkes *et al.*, 2003). Public-sector organisations that are mandated to navigate through environmental change need to develop their adaptive capacity in order to promote the robustness and resilience of SES (Fazey *et al.*, 2007).

Learning and AC can be considered as mutually reinforcing activities. This is because AC is acquired and enhanced by learning. The more one learns the easier and faster the learning becomes, increasing the depth or breadth of knowledge and therefore increasing their AC (Roux *et al.*, 2008). Knowledge breadth and depth enable organisations scope and flexibility to fulfil complex mandates requiring solutions to unpredictable and unwanted environmental change (Roux *et al.*, 2008). Knowledge breadth or scope is influenced by a diversity of disciplinary backgrounds, such as sciences and engineering, as well as whether disciplines are applied, empirical or normative (Max-Neef, 2005). Knowledge breadth is also a function of forms of knowledge, be it practical, scientific or indigenous knowledge (van Kerkhoff and Lebel, 2006). The potential of harnessing the breadth of knowledge is based on individual and organisational capacity to form relationships and networks to share information. Knowledge depth is found within individuals who are able to relate and apply what they know to a deeper theoretical understanding. This requires a deep foundation of factual knowledge and an aptitude for retrieving and applying the knowledge in new situations and in novel ways, i.e. promoting knowledge flexibility (Bransford *et al.*, 2003). It is rare to have individuals that are skilled with breadth and depth of knowledge, as both take considerable time and effort to gain. It is therefore recommended that organisations invest in internal and external learning networks, as well as in time for

deep thinking for individuals to reflect on and apply double- and triple-loop learning practices, to transform knowledge for adaptive decision-making (Roux *et al.*, 2008).

It has been found that organisations with good depth and breadth of knowledge have greater AC, and as such their ability to adapt and innovate in turbulent environments is greatly improved (Van den Bosch *et al.*, 1999). It has also been found that environmental organisations with good adaptive capacity are more resilient and robust to unpredictable environmental change (Olsson *et al.*, 2006). It is then assumed that AC could be an essential element and an institutional prerequisite for adaptive capacity to navigate through environmental change.

Other determinants that enhance AC

Cohen and Levinthal (1990) argued that AC is largely a function of prior related knowledge and that this, in turn, is related to in-house capacity for research and development (R&D). However the development of this concept has come to recognise that AC does not hinge on a single determinant, but rather is a set of routines and processes within organisations that enable AC (Zahra and George, 2002). These can be assigned into three broad groups:

1) Prior related knowledge and in-house research capacity

Prior related knowledge is necessary, as organisations need specific competencies to understand the ideas of others to effectively exploit them (Grünfeld, 2003). It has been argued that AC is an accumulative and path-dependant process, because experience in a field facilitates the interpretation and use of similar new knowledge (Cohen and Levinthal, 1989). The level of prior knowledge accessible to an organisation is therefore dependent on the level and diversity of skills and expertise available to the organisation through its employees (Schmidt, 2005). By having a diversity of skilled individuals with the competency to acquire and understand external information therefore increases the organisation's AC.

One way of developing in-house capacity for prior knowledge is R&D. Organisations' capacity for R&D not only generates new information and innovations, but also enhances the ability to identify, assimilate and exploit existing knowledge (Cohen and Levinthal, 1989). These organisations are also able to recognise complementary knowledge development and therefore adopt and exploit external research (Cohen and Levinthal, 1994). Schmidt (2005) found that intensity of R&D did not significantly

influence AC as previously thought; however, he identified that continuous R&D engagement did. Roux *et al.* (2015) states that active stakeholder engagement from conservation agencies is important, as it increases the relevance of their research, while encouraging peer-reviewed outputs can increase the reliability of the resulting information.

Organisational learning is often encased in standard operating procedures (Nystrom and Starbuck, 1984). These procedures aid in organisational stability and efficiency; however, they can also result in a disproportionate reliance on prior knowledge, leading to complacency and inertia (Roux *et al.*, 2008). Public-sector organisations that are mandated to deal with rare environmental catastrophes may need the skill to identify when prior knowledge is out-of-date, which means that they may need to unlearn old knowledge (Nystrom and Starbuck, 1984). Unlearning is not simply the process of forgetting something, but rather overwriting that information. This can be inhibited or enabled by prior knowledge, depending on how strong the emotional ownership is or how established the mind-sets are (Becker, 2005). To reduce the likelihood of outdated knowledge becoming entrenched, it is good to engage with learning networks on a constant basis and to value the contributions of deep-thinking individuals (Roux *et al.*, 2008).

2) Organization structure and knowledge transfer practices

Van den Bosch *et al.* (1999) argued that the way an organisation manages and uses its prior knowledge cannot be separated from the structure of the organisation. This is highly dependent on the manner in which the organisation stimulates knowledge transfer across departments and individuals (Schmidt, 2005). Van den Bosch *et al.* (1999) argued that knowledge-sharing in organisations can be stimulated through formal routines and processes that they have described as combinative capabilities. Combinative capabilities are divided into three categories; these are: systems capabilities, coordination capabilities and socialization capabilities. These capabilities can define the effect, be it positive, neutral of negative, of knowledge absorption within and between organisations.

System capabilities reflect the degree to which communication, instructions, procedures and rules are formalised within an organisation. They outline the way in which behaviours in an organisation are programmed in advance of their

implementation (Galbraith, 1973). The main advantage of systems capabilities is that they provide an organisational memory for handling routine situations; therefore, allowing employees to react quickly, eliminating the need for further communication (Van den Bosch *et al.*, 1999). This capability allows organisations to be more efficient in handling routine matters.

Coordination capabilities enhance lateral ways of communication and coordination with newly absorbed knowledge. They encourage relationships between employees and departments as well as with other organisations (Van den Bosch *et al.*, 1999). Methods that improve coordination capabilities are job rotation, formation of interdisciplinary task teams, mutual participation in decision-making and liaison mechanisms (Van den Bosch *et al.*, 1999).The presence of 'knowledge broker' can play a vital role in inter-departmental and intra-organisational liaising. Knowledge brokers are those individuals whose role it is to screen the environment for knowledge and transform it into something that can be understood by other employees. They provide an interface either between different departments or they can span the boundary between organisations and other stakeholders (Schmidt, 2005).

Good knowledge brokers can also play instrumental roles in preventing and breaking down silos. The 'silo effect' is a mentality that is present in many organisations, where certain individuals, divisions or departments resist sharing valuable information either within the same organisation or between organisations (Stone, 2004). Silos are formed when a group of employees become more loyal to their group or department, than to their employer (Stone, 2004). Silos are often antagonised through organisational structuring into functional departments and are entrenched with strong organisational shared language and culture (Murray *et al.*, 2011).

Socialization capabilities refer to the ability of an organisation to produce shared ideology and sense making (Gruman *et al.*, 2006). This capability results from organisational culture and consists of shared norms and behaviours that stimulate group cohesion (Stirzaker *et al.*, 2011). Norms fortify behaviours against undesirable change (Ehrlich and Levin, 2005). This capability enables social integration that goes far beyond that of co-ordination and systems capabilities (Van den Bosch *et al.*, 1999). This is good for efficiency of integrating absorbed knowledge; however, it limits the flexibility of knowledge absorption when a shared language develops to such a stage

that organisations become self-referential, resulting in a ‘not-invented-here’ syndrome (Murray *et al.*, 2011). Another problem that has been noted with strong socialization capabilities is when departments are loosely coupled and a strong culture develops within departments or sub-departments (Van den Bosch *et al.*, 1999). This strong identity can lead to a silo mentality that inhibits the sharing of newly absorbed knowledge with other departments or sub-departments (Stone, 2004).

3) Motivation and good leadership

There is a need for key individuals that can provide good leadership to navigate through the complexities of SES. Good leadership provides vision, motivation and trust (Fabricius *et al.*, 2007) and can help transform the management toward a culture that values learning (Folke *et al.*, 2005). Motivation is often required to facilitate the absorption of knowledge from external sources (Murray *et al.*, 2011). Self-motivation is also an important driver of knowledge absorption; however, learning potential is often realised in the presence of others (Roux *et al.*, 2008). Given the nature of challenges associated with the management of natural resource in complex SES, it is important for public-sector organisations to learn how to participate in extended group learning that transcends disciplines (Roux *et al.*, 2008). Good leadership is therefore required to create a safe space that encourages informal and formal group learning, resolves conflict, encourage communication and patient reflective learning in deep thinking individuals (Olsson *et al.*, 2006; Cilliers, 2006). These conditions enhance the adaptive capacity of these organisations, preparing them for more proactive responses towards unpredictable environmental change.

CHAPTER 3: STUDY DOMAIN

The study focused on three public-sector organisations with environmental mandates that operate in the Southern Cape region, within the Western Cape Province of South Africa. The three organisations were Eden District Municipality (EDM), CapeNature (CN) – Gouritz cluster and South African National Parks - Garden Route National Park (GRNP) (See Figure 2). These are the main three public-sector organisations with environmental mandates in this area. The organisations are primarily mandated under the Constitution of South Africa (Act 108 of 1996) (RSA, 1996) and each belong to a different sphere of South Africa's formal government system; national, provincial and local. Under the Constitution of the Republic of South Africa these public-sector organisation are mandated to work cooperatively (The Republic of South Africa, 1996).

Eden District Municipality

Municipalities are considered the sphere of government closest to the scale at which environmental management activities and decision-making take place (Sitas *et al.*, 2014). There are three different municipal types in South Africa, metropolitan municipalities, local municipalities and district municipalities. EDM is a district or category C-municipality which encompasses a number of smaller local B-municipalities; Kannaland, Hessequa, Mossel Bay, George, Oudtshoorn, Bitou and Knysna. The total area incorporated into this boundary is around 123 045 Km^2, with a projected population of around 787 490 (EDM, 2015).

EDM is charged with a range of roles and responsibilities under the Municipal Systems Act No. 32 of 2000 (RSA, 2001). Their main functions are regulatory and service provision which are laid out by the Municipal Structures Act of 1998 (RSA, 2000) (See Appendix 1) and are strategically guided by their Integrated Development Plan (IDP). The IDP is the product of a planning process that is stipulated in the Municipal Systems Act (No. 32 of 2000) (RSA, 2001), through which municipalities must prepare a strategic developmental plan to guide their activities for a five-year period (EDM, 2012). The IDP is informed by key strategic policy directives, including the Millennium Development Goals and National key performance areas (See Appendix 2).

EDM's vision is "*Eden a future empowered through excellence*", the elements of this vision are (EDM, 2014);

- "*EDEN: Represents the entire jurisdiction of the district, including the seven B-municipalities, which are Hessequa, Mossel Bay, George, Knysna, Bitou, Oudtshoorn and Kannaland*
- *FUTURE: Changed environment, well-being of citizens, growth & development*
- *EMPOWERED: Training & development, education, economic growth, job creation, self-reliance, enabling environment, mentorship, working together, facilitate*
- *EXCELLENCE: Service delivery, customer care, innovation, political stability, integrated planning*"

EDM Mission statement is as follows (EDM, 2014);

- "*Providing strategic leadership and coordination to B-municipalities in the district within our resources available;*
- *Executing integrated development planning in collaboration with sector departments and service organisations; and*
- *Upholding the principles of good governance in pursuit of excellence as a regional leader in local government.*"

To fill this mission statement, EDM follows seven strategic objectives; these include (EDM, 2014):

- "*Promote sustainable environmental management and public safety*
- *Creating healthy and socially stable communities*
- *Build a capacitated workforce and communities*
- *Conduct regional bulk infrastructure planning, implement projects, roads maintenance and public transport; manage and develop council's assets*
- *Ensure financial viability of the EDM*
- *Promote good governance*
- *Growing the district economy*"

For the department of EDM, this study focused on their community services department and relevant sub-departments (Municipal Health Management, Disaster risk Management, Waste Management and Regional Development and Planning) as these were the departments that are responsible for environmental management in various forms at EDM (EDM, 2012). Core functions are development planning, water

quality monitoring, environmental pollution control, disposal of the dead, electricity delivery, sanitation and sewage, storm-water and disaster management (Sitas *et al.*, 2014).

In terms of natural resource management, EDM only has one environmental officer employed directly in the Community services - Municipal health management department (EDM, 2014). This environmental management 'unit' is obligated by the Western Cape Government and South African Local Government Association (SALGA) to include biodiversity management, climate change mitigation and adaptation, coastal management and environmental compliance (EDM, 2014). For the year 2014/15, Environmental protection was allocated R 2 436 379.20 a total of 0.8 % of the total budget allocated for that period, of which R 756 769.86 and R 1 679 609.35 was allocated to environmental management and air quality, respectively (EDM, 2015). There was no formal research culture within this organisation. The key challenges in this department were lack of skilled staff capacity and lack of finance capacity (EDM, 2015).

CapeNature

CN is the provincial conservation authority for the Western Cape and is the executive branch of the Western Cape Nature Conservation Board (WCNCB), which was established in terms of the Western Cape Nature Conservation Board Act, 1998 (Act No. 15 of 1998) (RSA, 1998).

CN Vision is "*A quality driven public entity conserving the unique natural heritage resources of the Western Cape for the benefit of all*".

CN mission is "*To establish biodiversity conservation as the foundation of a sustainable economy in the Western Cape, thereby creating benefits and opportunities for all*".

CN has four strategic goals which are:

- *"Securing priority biodiversity and ecosystem services through integrated biodiversity management enabling appropriate climate change response*
- *Contributing to the reconstruction and development of social capital.*
- *Promoting socio-economic development through the conservation economy*
- *Ensuring an efficient and effective institution."*

These strategic goals are guided by seven strategic objectives that are further broken up into measureable objectives (See Appendix 3).

The key challenges faced by the organisation are capacity in terms of finance and skilled staff. The organisation has undergone a budget reduction of R 13 million since 2013, and as such, they have been unable to fill vacant job posts to the value of R 6.6 million (CapeNature, 2015). To cope with the budget cuts and their consequences, the organisation has undergone a streamlining process and has reviewed their management models to build efficiency for the medium to long term (CapeNature, 2015).

There are 26 Nature Reserves under CN care, in eight areas: Cape Metro, Breedeberg, North West, Boland, Overberg, Langeberg, Karoo and Garden Route. During the commencement of this study, these areas were clustered in two's; however, in 2014, it was decided to group these further into three regions of management in order to aid management efficiency, (CapeNature, 2012). Sixty percent of the mountain catchment areas in the Western Cape fall within CN protected areas (CapeNature, 2015). Therefore, they are one of the key role players in protecting and maintaining the ecosystem services that promote human well-being in the Western Cape. Beyond the formalized conservation areas, CN is also responsible for Environmental Stewardship Programmes, Corridor and Biosphere Initiatives, World Heritage Sites, Research and Specimen Permitting in formally protected Nature Reserves and private land within the province, and land use management.

To help achieve their objectives, CN has put together Regional Ecological Support Teams (REST). The purpose of REST is to standardize and coordinate the collection and curation of biodiversity related data that can be used to inform planning and decision-making within the organisation (Palmer *et al.*, n.d.). The REST teams are to serve as a bridging mechanism between scientific services and field staff in order to promote dissemination of accurate, relevant and reliable data. These teams are compiled out of the cluster Regional Ecologist, two Ecological Co-ordinators and a GIS Technician that work closely together to acquire and disseminate biodiversity data that is relevant to decision-making and conservation implementation. These REST teams then report to the two area managers (within relevant cluster), the knowledge manager and biodiversity manager. The research culture of this organisation is therefore based

around improving conservation operations and biodiversity management within their protected areas.

The objectives of REST are (Palmer *et al.*, n.d.):

- *"To support biodiversity planning and review*
- *To support effective data management*
- *To provide ecological decision support*
- *To create and maintain an scientifically sound biodiversity monitoring and evaluation system*
- *To facilitate staff development*
- *To promote biodiversity coordination and networking"*

This study focused on the Gouritz cluster of CapeNature's management mandate. This included the Garden Route and Cape Karoo areas. The Garden Route area is comprised of four formally protected nature reserves; Robberg, Keurbooms, Goukamma and Outeniqua. The Cape Karoo area is comprised of three formally protected nature reserves: Gamkaberg, Swartberg and Kammanassie. Sub-departments that were included in this study were: scientific services, nature reserve conservation management, conservation services, biosphere co-ordinator, project management teams and community conservation services, as these were all the sub-departments involved in environmental management.

Garden Route National Park

South African National Parks (SANParks) is the leading national conservation authority for all national parks in South Africa. SANParks is a national public entity that is primary mandated under the National Environmental Management: Protected Areas Act No. 57 of 2003 (NEM: PAA) (SANParks, 2006). SANParks is responsible for 19 National protected areas, including Garden Route National Park (GRNP).

SANParks vision is: *'A sustainable National Parks System connecting society'*

SANParks mission is: *'To develop, expand manage and promote a system of sustainable national parks that represent biodiversity and heritage assets, through innovation and best practice for the just and equitable benefit of current and future generations.'*

SANParks development and management of protected areas is guided by the concept of setting a desired state. This is a long term (30–50 yrs.) visioning process that is transformed into a set of manageable objectives through a broad set of desired outcomes (SANParks, 2012). The desired state is based on a collectively developed vision, involving all interested stakeholders. Here, desired future social, economic, ecological, technological, political and institutional perspectives are taken into account and aligned with corporate values and vital attributes of the Parks. This, together with the thresholds of potential concern and the zonation plan, make up what is termed the desired state (SANParks, 2006).

There are two main challenges in managing towards this desired state. Firstly, SES is not static and is therefore inherently full of complexity. Secondly, as a public entity with a vision of connecting society, it is necessary to respect and try to incorporate a diverse and often divergent set of values and exceptions (Roux and Foxcroft, 2011). Therefore, park management and scientists have ascribed to a strategic adaptive management (SAM) approach, which acknowledges that there are inherent uncertainties and that many influencing factors are outside of management jurisdiction (Kingsford and Biggs, 2012). Therefore, management and applied science interventions are designed to be measurable, to inform future decisions, and enhance adaptation (SANParks, 2006).

SANParks advocates that it is important to set the context for the area of management from the beginning stages of creating a management plan. This must not only encompass the spatial and temporal scales of management responsibility, but also take into account the multiple social values of stakeholder's in order to avoid conflict at latter stages (Knight *et al.*, 2006). Here, they follow a V-STEEP framework. V-STEEP is an acronym for values – social, technological, environmental and ecological, economic and political (Kingsford and Biggs, 2012). These key values are outlined and are essential for effective planning and management.

This study focused on the GRNP, which is a cluster of protected areas managed as a single entity by SANParks, between George in the Western Cape and Kareedouw in the Eastern Cape (SANParks, 2012). Knysna National Park was proclaimed in 2009 as the GRNP. In 2011, the Tsitsikamma National Park and Wilderness National Palk were consolidated into the GRNP. GRNP is uniquely situated within high to lowly

populated areas, with communities represented by two district municipalities (Eden DM and Cacadu DM) and four municipal areas (George Municipality, Knysna Municipality, Bitou Municipality and Goukamma Municipality). Combined, these three parks conserve an area of 157 000 ha.

The GRNP's management plan is set out in the SANParks coordinated policy framework, to which all national parks are aligned. In accordance with NEM: PAA, their management plan is open to regular public review to ensure that it reflects the organisation's mandate, societal values and new scientific knowledge. The conservation principles that govern GRNP are:

- *"Biodiversity forms an important basis of the ecosystem services that sustain the benefits that humans derive from conservation.*
- *The Web of Life is seen as a fundamental notion, evoked in all thought processes.*
- *People are seen as part of ecosystems, although the ways in which they interact with ecosystems may vary widely in different parks and circumstances.*
- *Thoughtful experimentation is seen as essential, to promote learning.*
- *Multiple ways of knowing and acquiring knowledge are acknowledged, appreciated and integrated.*
- *We aim to interpret the meaning of cultural, biodiversity and landscape assets through careful documented recognition of their significance, including their tangible and intangible value, and full natural and cultural context, by fostering productive involvement of all stakeholders and associated communities in the development and implementation of interpretative values.*
- *We measure our performance in all that we are mandated to do*."

SANParks acknowledges climate change and recognises that extensive changes may be required to adapt their conservation policies for future management (SANParks, 2006). They stipulate that a flexible approach may be necessary to manage their protected areas in the face of uncertainty and mitigate the effects of environmental change (SANParks, 2006). Due to this, they promote landscape linkages and connectivity between protected areas, to create biodiversity friendly landscapes.

SANParks promotes a culture of research within their organisation. Research within SANParks is governed by a strict set of professional norms and standards. These are:

universalism, scepticism, disinterestedness, communalism and honesty. Of the three organisations SANParks is the only organisation that has included social science research into their policy (SANParks, 2006)

Figure 2: Map depicting the management areas of the three participating organisations. Eden District Municipality's (EDM) boundary is outlined in dark blue. CapeNature (CN), Gouritz cluster is marked in solid green. The Garden Route National Park (GRNP) is marked in textured dark green and is found within the EDM boundary and to the east of the EDM boundary.

CHAPTER 4: METHODOLOGY, RESEARCH DESIGN AND METHODS

This chapter outlines and describes the methodology, research design and methods used for this study. These were used in the collection and analysis of data to explore and gain greater understanding of the AC within three public-sector organisations.

Methodology

Due to the explorative nature of this study, the paradigm that the researcher chose to work in was pragmatic (Teddlie and Tashakkori, 2009). It was important to gain insight into the research phenomena; therefore, the researcher used multiple means, rather than focusing on one experimental method (Creswell, 2003). There was no recognised global measurement that measured the four dimensions of AC at the commencement of this research (Flatten *et al.*, 2011; Vega-jurado *et al.*, 2008). The researcher therefore decided to adapt the multidimensional Flatten *et al.* (2011) survey instrument (See Appendix 4) that was validated to measure the four dimensions of AC in the commercial business sector. With the novel application of this construct, the researcher was unable to compare these results with previous research on AC in public-sector organisations. Previous research on AC based in organisational science was, however, used to inform the researcher's interpretations on the concept objectively.

A pragmatic approach allowed the researcher to commit to not only one knowledge philosophy. Instead, a pluralistic approach was used to draw on quantifiable and descriptive approaches for collecting and analysing data liberally (Creswell, 2003). The novel application of the AC concept to organisations with environmental mandates necessitated a pragmatic approach. This approach allows a researcher to acknowledge that there are post-positivist (empirical science) and socially constructed (participants views) assumptions. Post-positivist assumptions allow a researcher to use a measurement tool to understand the causes that influence outcomes of AC better (Teddlie and Tashakkori, 2009). Social constructivist assumptions acknowledge that people's experiences and views of the world influence the way they respond to the measurement tool (Teddlie and Tashakkori, 2009). By taking both assumptions into account, the researcher was able to explore and gain an understanding of the current state of AC of the three organisations better, using a mixed-method approach.

Research design

The researcher used a parallel mixed-methods research design. Teddlie and Tashakkori (2009) explain that this design allows a researcher to triangulate results from the separate quantitative and qualitative components of their data. This allowed the researcher to cross-validate, confirm or corroborate her findings within this study. Within this design, the researcher used a multiple purposeful sampling technique (Teddlie and Tashakkori, 2009; Durrheim and Painter, 2006). This included stratified purposeful sampling and snowball sampling.

Stratified purposeful sampling is when a researcher identifies specific sub-groups of a population and specific cases in that sub-group to be sampled (Teddlie and Tashakkori, 2009; Newing, 2010). This sampling method is used when a researcher wants to gain a wealth of information from a limited number of cases, therefore, making the sampling decision crucial (Teddlie and Tashakkori, 2009). Typically, with this method, the sample size is small, but a depth of information can be generated (Teddlie and Tashakkori, 2009). In the case of this study, the researcher used this method by selecting the upper managers of each organisation as the entry point for the survey. Upper level managers are considered as senior managers that are directly responsible for environmental management of specific protected and unprotected areas within the three case studies. Not only do these individuals have a wealth of knowledge about the on-goings in their organisations, but it was also crucial to gain their support in the study to increase the sample size. Snowball sampling was then used for the continuation of the study (Teddlie and Tashakkori, 2009). This was achieved by requesting the upper managers firstly to identify employees in their contact lists to distribute the survey. These employees where then asked to identify further employees to whom they thought the survey should be sent as well, and so on, creating a chain reaction through employee contact lists.

The researcher also used observation techniques, interviews with key informants and the organisation's annual reports and management plans to aid in informing her interpretations about the current state of AC within the selected organisations. The observations were used to gain insight into the information dissemination techniques and culture of the organisations. This was achieved by attending and observing meetings within the study period, as well as by observing a focus group, in the form of a dialogue around the topic of 'organisational silo's'.

Mixed-method approach explained

Mixed-method research most likely originates in 1959, when the authors Campbell and Fiske used a multi-method matrix to study the validity of psychological traits (Creswell, 2003; Jick, 1979). Through their encouragement, other researchers soon began approaches that associated field methods such as interviews and observations with the traditional use of surveys (Sieber, 1973). Mixed-method designs have gained popularity in recent years in the social sciences as it is believed that the combination of qualitative and quantitative data results in a better understanding of social research problems as it recognises that all methods have their limitations and that by mixing methods one could limit or neutralise the biases of singular methods (Ivankova *et al.*, 2006; Tashakkori and Teddlie, 2003; Creswell, 2003).

By taking a mixed-method approach, the researcher acknowledges that there are disadvantages and advantages to qualitative and quantitative measures. For example, quantitative data cannot explain why participants chose a specific rank and, therefore, there is potentially a loss of valuable insights (Teddlie and Tashakkori, 2009). The benefits, however, of using quantitative measures, such as a questionnaire, is that a relatively large sample group can be quickly accessed when compared to qualitative techniques. Such data are also seen as more objective, generalizable and representative, as statistical analysis can be used (Creswell, 2003; Teddlie and Tashakkori, 2009). Qualitative data, on the other hand, are more subjective and require a longer time to gather and analyse, which is considered a disadvantage. However, qualitative techniques allowed the researcher to gather insight into the participant's reasons for choosing a specific answer in the questionnaire and therefore allowed the researcher to gain a better understanding of their perceptions towards the research (Teddlie and Tashakkori, 2009).

By combining quantitative and qualitative techniques in a concurrent approach, the researcher was able to gain the benefit of the strengths of both techniques (Teddlie and Tashakkori, 2009; Tashakkori and Teddlie, 2003). This is referred to as a mixed-method concurrent triangulation strategy (Teddlie and Tashakkori, 2009). This selected approach allowed the researcher to attempt to cross-validate or corroborate findings within the study by integrating the results of the two methods during the interpretation phase.

Research assumptions

This research study is based on the assumptions that:

1. Using a mixed-method approach will provide the best understanding of the research problem (Teddlie and Tashakkori, 2009).
2. By approaching and gaining the buy-in of upper level management, the Internet-based survey will be distributed to managers and non-mangers within organisations.
3. Through this approach the research will get greater response rate than the 10–13% as predicted in the literature (Klassen and Jacobs, 2001; Flatten *et al.*, 2011).
4. The participants will follow the researcher's instructions for the survey.
5. By distributing the survey in English and Afrikaans, it will increase the reliability of the survey as these are two prominent languages spoken within the selected organisations.
6. By distributing the survey not only via the Internet, but also in pdf format, a greater reliability will be achieved, as it will allow employees without regular and reliable Internet access to participate.
7. By maintaining anonymity of the research participants, it will give them a safe environment to express their true perceptions.
8. Mixed-method research takes extra time due to the need for the researcher to collect and analyse both quantitative and qualitative data (Creswell, 2003).

Methods

The survey was created online via surveymonkey.com. It was composed of four explanatory variables, three ordinal and one interval (organisation, highest level of education, job category and number of years' experience with the organisation), and 15 Likert scale item questions based on the (Flatten *et al.*, 2011) survey (See Appendix 5). The 15 Likert scale questions were based on a five-point ranking system (strongly agree, agree, neither agree nor disagree, disagree and strongly disagree). Each of the 15 questions was related to a capacity that built on one of the four dimensions of AC (Flatten *et al.*, 2011). Question one to three related to information acquisition, question four to nine to information assimilation, ten to twelve to knowledge transformation and question thirteen to fifteen to knowledge exploitation. Each rank was assigned a score;

from five for strongly agree to one for strongly disagree. Under each of the 15 questions a comment section was left were the employees could volunteer explanations or examples to why they chose a specific ranking in the questionnaire.

The use of the multidimensional questionnaire allowed the participants to rank their perceptions of the state of AC in their organisation subjectively and then comment qualitatively to shed more light onto what informs their subjective experience. The quantitative data from the questionnaire allowed the researcher to be objective when analysing the results, whereas the analysis of content from the qualitative data can be considered subjective to the researcher's interpretations i.e., it is subjective to the researcher's depth of knowledge on AC and therefore her interpretations.

Data collection

The researcher purposively targeted top level managers from CapeNature, EDM and the Regional ecologist from Garden Route National Park. Individual meetings were held with each of these individuals to gain there buy-in and assistance in the distribution of the survey. The survey was initially distributed via an online link https://www.surveymonkey.com/s/Absorptivecapacity (link now inactive), to the above-mentioned individuals. These individuals, as per agreement, further distributed the survey to other employees within their respective organisations.

The survey was accompanied by a set of instructions that the participants were politely requested to follow. These were:

- Please use the preferred method of completion via the online survey link provided https://www.surveymonkey.com/s/Absorptivecapacity (link now inactive)
- Please copy the researcher in on the emails every time the survey is distributed to a new contact list
- Please print and hand out the PDF version to employees who do not have internet access
- Please inform the researcher so that arrangements can be made for collection
- Please answer all of the questions honestly and, if willing, elaborate in the comments box
- Please complete the survey within the given time-frame

- Please contact the researcher if there are any queries

All organisations were given approximately 1 month to complete the survey. At two-week intervals, the researcher sent an email reminder to all participants on her contact list.

Data analysis

All survey data were directly transferred from surveymokey.com into a Microsoft 2013 Excel spreadsheet. The programmes Statistica 12 (StatSoft Inc., 2013) and R 3.2.1 (R Development Core Team, 2011) were used for statistical analysis. ATLAS.ti 7 (Atlas.ti Scientific Software Development GmbH, 2013) qualitative data analysis software was used to do qualitative thematic content analysis.

Survey response

The researcher recorded the time it took for the organisations to participate from the date of initial agreement. Record was also made on the number of participants to whom the survey was originally sent, as well as the number of responses that were received. The researcher assessed the number of times the survey cascaded to a new contact list and the number of departments to which it was distributed. Biographical data, such as who participated in terms of education category (basic, graduate and post-graduate) and job category (operational support, operational management, science and research support, and strategic management and administration) was collected through the survey tool. Number of years' experience was a continuous interval variable; therefore, the overall and organisational average and the standard deviation per organisation was determined.

Absorptive capacity scores for three public-sector organisations

The sum of scores for each respondent per dimension and the total AC was calculated. This was achieved by adding the ranks selected for each question. Each respondent selected a rank ranging from strongly agree = 5, to strongly disagree = 1. For the dimensions acquisition, transformation and exploitation the highest possible sum of score was 15, as there were three questions in each of these sections. Assimilation involved six questions and therefore the highest possible sum of score for this dimension was 30. The highest possible total score for the AC survey was 75. All uncompleted surveys were removed at this point to avoid bias in the score results;

these results were then used to determine the mean percentage score, per dimension and for total AC for each organisation.

To understand the proportional contributions of the dimensions on each organisation's total AC score, a proportional index was created. The participant's scores for each dimension were divided by the total maximum dimension score. For example, if a participant ranked the three questions in acquisition as strongly agree, agree and agree, they would score 5 + 4 + 4 = 13/15 = 0.87.

By doing this, the researcher was able to give each dimension an equal proportion, as not all of the dimensions involved the same number of questions. These results were then added up to represent a total proportional score for AC for each respondent. Each dimensions' proportion, per participant, was divided by the total AC proportional score. This then gave the relative proportional contributions for each of the dimensions to the total absorptive score for each participant. All dimension proportions added together would equal one, thereby converting the ordinal data into ratio data. From these results, the researcher was able to determine the proportional contribution of each dimension to the total AC score of each organisation.

Content analysis

Qualitative analysis is the analysis of descriptive text and narrative information (Teddlie and Tashakkori, 2009). Each question in the survey was accompanied by a comment text box to allow the respondents to volunteer an explanation as to why they chose a specific rank. The researcher assessed the dominantly selected rankings and used a thematic content analysis to assess the reasons given as to why these dominant ranks were selected.

Thematic content analysis involves a process of repeatedly immersing yourself into the content of the data by reading through the text many times (Teddlie and Tashakkori, 2009). By doing this, the researcher was able to gain a good understanding of the themes found within the data. The next step was to create inducing themes. Induction is a method of inferring general guidelines that describe certain instances. This is a bottom-up approach that gives organising principles that underline the content of the text (Blanch et al., 2006). During the process of identifying themes, the researcher coded the text to highlight examples and opinions given, or evidence relevant to the overarching themes. For this study, those themes were

designated “enablers” and “restrictors” of AC within the selected organisations. These data were then used to corroborate, cross-validate and confirm findings from the qualitative analysis of the survey. All codes are number referenced to the original data set (e.g. GRNP 65:32). The First number represents the respondent and the sencond number references the sentence refered to within the respondeds survey.

Sustainability dialogue

“It's never enough just to tell people about some new insight. Rather, you have to get them to experience it in a way that evokes its power and possibility. Instead of pouring knowledge into people's heads, you need to help them grind a new set of eyeglasses so they can see the world in a new way.”
(John Seeley Brown, (The World Café, 2016))

In public-sector organisations the sharing of knowledge and communication of information is an important capability that adds to their AC. This is especially true when mandates are shared and collaboration is needed to collectively manage environmental change. A dialogue was coordinated for employees of the participating organisation to provide insight into what lies at the heart of the issue around organisational silos and how to navigate away from them.

In April of 2014, the researcher hosted a sustainability dialogue, at NMMU George campus. A sustainability dialogue is a method used by the Sustainability Research Unit (SRU) to facilitate constructive conversation with stakeholders around topics with sustainability implications. This method is based on the World Café (The World Café, 2016) method that was developed in 1995 by a group of business and academic leaders.

Here, stakeholders from the participating public-sector organisations, plus other organisations with environmental mandates, were invited to join a discussion around the topic of ‘Coming to grips with the silo effect’. The ‘silo effect’ was a topic identified as prevalent to knowledge sharing within the participating public-sector organisations through various workshops and engagements that the research attended during the early stages of her research. It is a mentality that is present in many organisations where certain individuals, divisions or departments resist sharing valuable information either within the same organisation or between organisations (Stone, 2004). This

mentality leads to a breakdown of trust between employees, affecting the company culture, reducing organisational efficiency and above all compromising organisational learning.

Sustainability dialogues are facilitated by neutral people (individuals outside of the public-sector domain) on neutral grounds (a space not formal linked to the operations of the public-sector organisations). They aim to build a deeper collective understanding around common concerns by collectively exploring problems and solutions. These solutions and problems are addressed by sharing knowledge and insights together, developing a new collective understanding and awareness. The main principles of these dialogues are for the participants to respect that everyone has different views. They should try to empathise with other thoughts and feelings around the issue. They must try to put all assumptions and prejudices on the table and treat others assumptions with respect and without judgment. Strategies used to encourage these principles are (Fabricius, 2014);

1. **"Dare to involve people with differing views.** Embrace diversity. It is tempting to include only those who think and feel the same about an issue. This invariably leads to back-patting, preaching to the converted and group thinking. Deliberately include people with different (*but not extremist*) viewpoints
2. **Start with empathy.** From the outset make sure people sense they are in a safe space where their issues are respected and where they are not judged. Express appreciation. Ensure that words of encouragement outnumber those of criticism in a 5:1 ratio
3. **Check for the three legs of dialogue:** equality; listening with empathy; and putting assumptions in the open
4. **Listen with attention.** Be fascinated by someone else's view, especially if it differs from one's own or that of the majority
5. **Take it easy.** Sustainability dialogues should not be rushed. After all, we've been on this unsustainable path for decades – what difference would a few hours, days or months make?
6. **Avoid interruption.** Give everyone a fair chance to air their views without fear of being cut short

7. **Strive to build trust** before looking for solutions. It is tempting to jump into solutions from the outset, but without common ground these will only partially supported and create further divisions. “I know exactly what is needed” is not dialogue but coercion
8. **Postpone decision making until the building blocks of trust, mutual understanding and common ground are in place**
9. **Focus on common interests – avoid focusing on divisions**
10. **Make liberal use of specific cases and examples**
11. **Check the reality of our information, rule-books and assumptions** – are the old rules and ‘ways of doing’ still applicable? Is the information that informs our views real, and accurate?
12. **Create a nice, neutral, ‘third place’,** which makes people feel special, and which encourages new thinking and where people can safely share their assumptions, fears, and baggage.**”**

The participants were seated in groups of four to five people around a table, with a table facilitator present. There was ample A0 paper with multiple coloured pens and plenty of good coffee. The participants were then facilitated though a three-point discussion. The first discussion was based on “What lies at the heart of the issue?” Here, the participant had to converse, write down and draw pictures based on the discussion topic for 20 minutes. Each table had a talking jar, a tool used to encourage respect of one another’s time to think and talk. Only the member with the jar was able to talk and air his/her views before passing it on to the next member of the group.

After 20 minutes, the groups would change tables and go over the previous group’s discussion for 5 minutes with the table facilitator. Afterwards, the group would move on to the next discussion topic. The second and last discussion followed the same process as the fist, mentioned above. Topic two dealt with the question “Is there a new way and what are the possibilities?” Topic three dealt with the questions “Was there a time when it worked differently and was more to your liking?”, and “What are the ingredients for breaking down silos?” After the three discussions and break had taken place, the participants gathered to summarise the day’s discussions and what was learned.

Evaluation of the survey instrument

As the multidimensional survey had to be adapted to fit public-sector environmental organisations, the researcher used factor analysis to asses if all the questionnaire items were reliable and to represent the correlations of interrelated variables (Tredoux *et al.*, 2006). By interpreting the correlations of the variables, the researcher was able to see how each item was related, to which dimensions the items were related and whether any of the items should be deleted (Tredoux *et al.*, 2006; Jolliffe, 2002).

Factor analysis involves three steps. This test outputs a set of Eigenvalues that are used to determine the total variance contribution of each factor. The general agreement is that only factors with Eigenvalues greater than 1 should be considered meaningful (Tredoux *et al.*, 2006). With the aid of the Eigenvalues, a matrix was generated, showing correlation coefficients (called factor loadings). In order to achieve a more interpretable structure, the factors were rotated with a Varimax rotation. Any items with a factor loading of less than 0.5 were considered as unrelated (Flatten *et al.*, 2011).

The researcher tested the reliability of the survey with the use of Cronbach's alpha reliability test (Oppenheim, 1992). This test measures the internal consistency of the survey in the form of correlation coefficients. This test therefore produces a scale that is expected to measure the questions as a single underlying continuum. If the dimensions of AC should show a strong relationship both with the continuum and with each other, by being highly correlated with one another, then the result would show high reliability and internal consistency for the questionnaire. In other words, it is likely to measure the variables as being homogenous and therefore have a low error-component (Oppenheim, 1992). Cronbach's alpha coefficient ranged from 0 to 1. Durrheim and Painter (2006) says that an acceptable internal consistency is dependent on what is being measured; however, the general rule of thumb for considering questionnaire-type scales reliable and internally consistent is an alpha value of 0.75 or above. This method of measuring internal consistency has been used in AC research by Flatten, *et al.* (2011) and Lane and Lubatkin (1998).

Ethical considerations

The South African Health Act (Act 61 of 2003) stipulates that an independent accredited research ethics committee must approve all research involving human

participants (Wessenaar, 2006). As such, this study was submitted to the human ethics committee at Nelson Mandela Metropolitan University in Port Elisabeth for approval before data collection could take place. The researcher received approval form the Faculty of Science Human Ethics Sub-Committee on 14 October 2013 and received an Ethics clearance reference number (Ref: H13-SCI-SRU-004) (See Appendix 6).

> "*The essential purpose of research ethics is to protect the welfare of the research participants*" (Wessenaar, 2006).

There are four widely accepted principles with regards to research ethics when dealing with people (Wessenaar, 2006; NCPHS, 1979). These are;

- Autonomy - all research participants must give voluntary informed consent and data received from them must be confidential,
- Non-maleficence - no harm must be caused to the research participants as a direct or indirect consequence of the research,
- Beneficence - the researcher and ethic committees must weigh the risk versus the benefits that the study might directly bring through the knowledge gained due to the study, and
- Justice - the researchers must treat the research participants with fairness and equity during all the stages of the research and that it is the researcher's responsibility to provide care and support for the participants should any harm or distress be caused by the study.

As part of the Ethics agreement, the researcher must keep two secure copies of the collected data. She must store these for a minimum of 5 years for verification and audit purposes, as per NMMU policy, and data must be referenced with numerical code as to not reveal the participants details. All ethical guidelines have been followed for this research, as per NMMU policy.

Participation as an indication of absorptive capacity

This story of AC starts from the moment that the upper level managers agreed to participate in the research. Table 1 indicates the time it took from initial agreement to participate to actual participation. EDM took 6 months, CN 2 weeks and GRNP 2 months to confirm their participation.

Table 1 shows that the survey reached seven employees from EDM, 31 from CN and 52 from GRNP. The number of times the survey cascaded from a distributer was once for EDM (See Figure 3), three times for CN (See Figures 4 and 5) and three times for GRNP (See Figure 6). The number of different departments reached by the survey was three for EDM, seven for CN and four for GRNP.

The employees that participated in the survey were from the education categories Graduate and Post-graduate for EDM and Basic (matric qualification), Graduate and Post-graduate from CN and GRNP. The employees that participated in the survey were from the job categories Operation support and, Strategic management and administration from EDM. For CN and GRNP, the job categories Operational management, Operational support, Science and research support and Strategic management and administration were included (See Table 1).

Table 1 also shows that the average number of years employed for the respondents from EDM was 9.19 years (SD ± 7.48). For CN the average number of years employed for respondents was 11.90 (SD ±9.89). For GRNP the average number of years employed for respondents was 12.50 (SD ± 8.43).

Table 1: Descriptive results from the multidimensional survey for EDM, CN and GRNP; Percentage of response [%] indicated in brackets.

Descriptive variables		**EDM**	**CN**	**GRNP**	**Total**
Time of participation from initial agreement		6 months	2 weeks	2 months	**NA**
Distributed N		7	31	52	90
Response rate N [%]		8 [114]	26 [84]	46 [89]	80
Cascading of distribution		1 (See Figure 3)	GR area 1 (See Figure 4) Karoo area 3 (See Figure 5)	3 (See Figure 6)	
Number of sub-departments distributed too		3	7	4	
Who participated	Education category	• Graduate [75] • Post-graduate [25]	• Basic [19] • Graduate [50] • Post-graduate [31]	• Basic [39] • Graduate [41] • Post-graduate [20]	
	Job category	• Operational support [62.5] • Strategic management and administration [37.5]	• Operational management [15.5] • Operational support [46] • Science and research support [23] • Strategic management and administration [15.5]	• Operational management [15] • Operational support [56.5] • Science and research support [22] • Strategic management and administration [6.5]	
Average number of years employed		9.19 (SD ±7.48)	11.90 (SD ±9.89)	12.50 (SD ± 8.43)	11.97

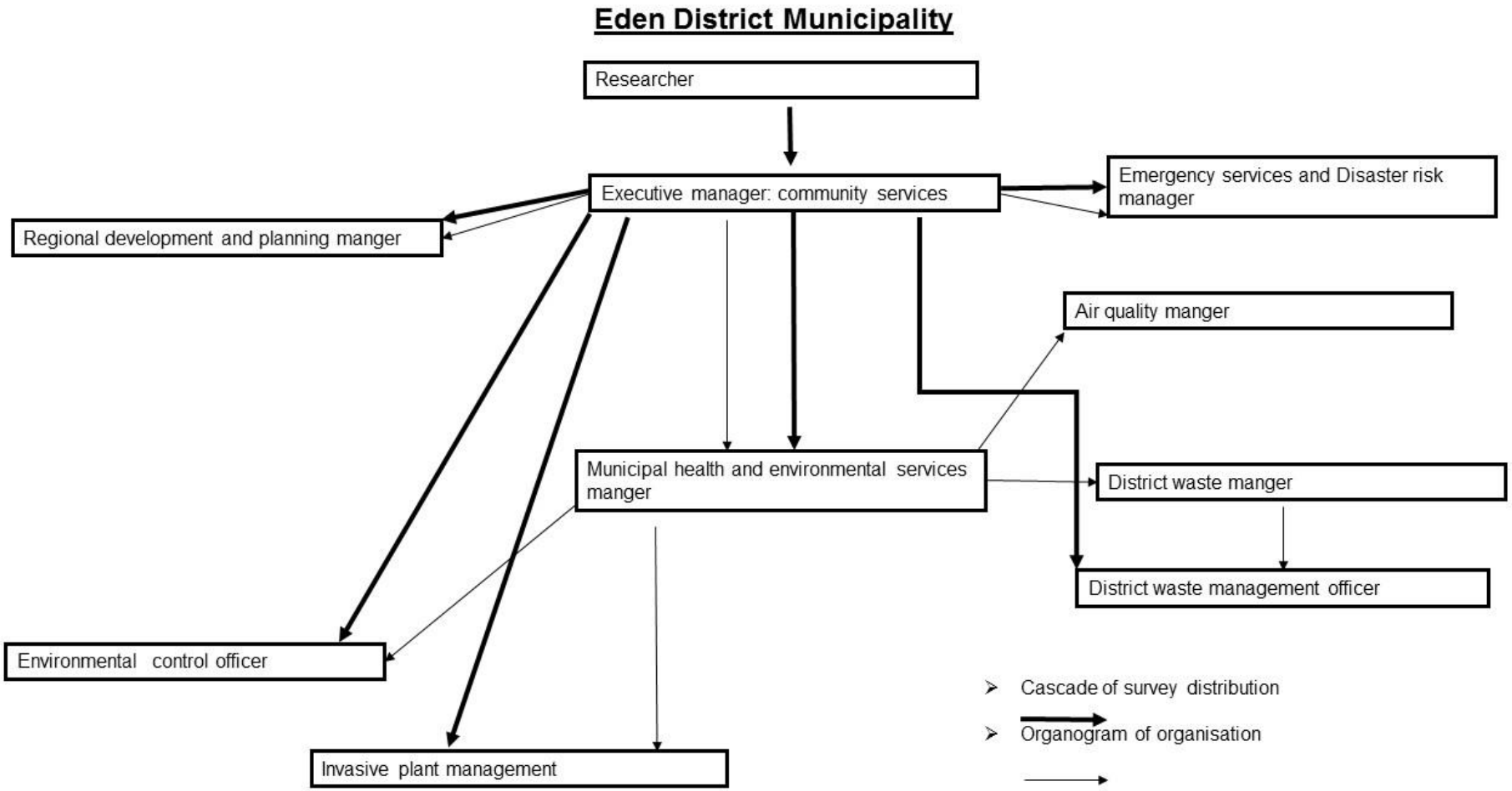

Figure 3: Diagram showing how the distribution of the survey cascaded from upper management to other departments for EDM

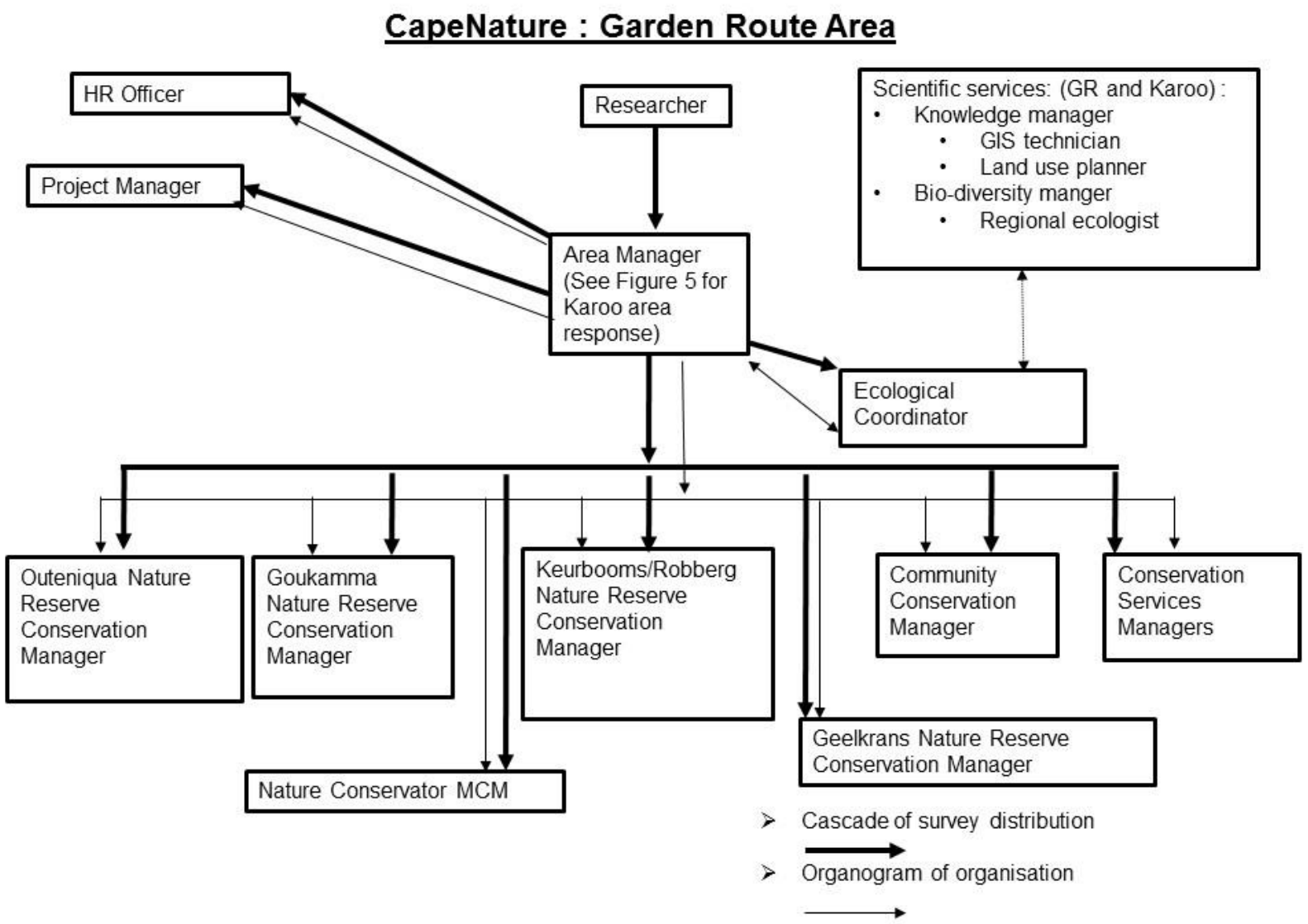

Figure 4: Diagram showing how the distribution of the survey cascaded from upper management to other departments for CN - Garden Route Area

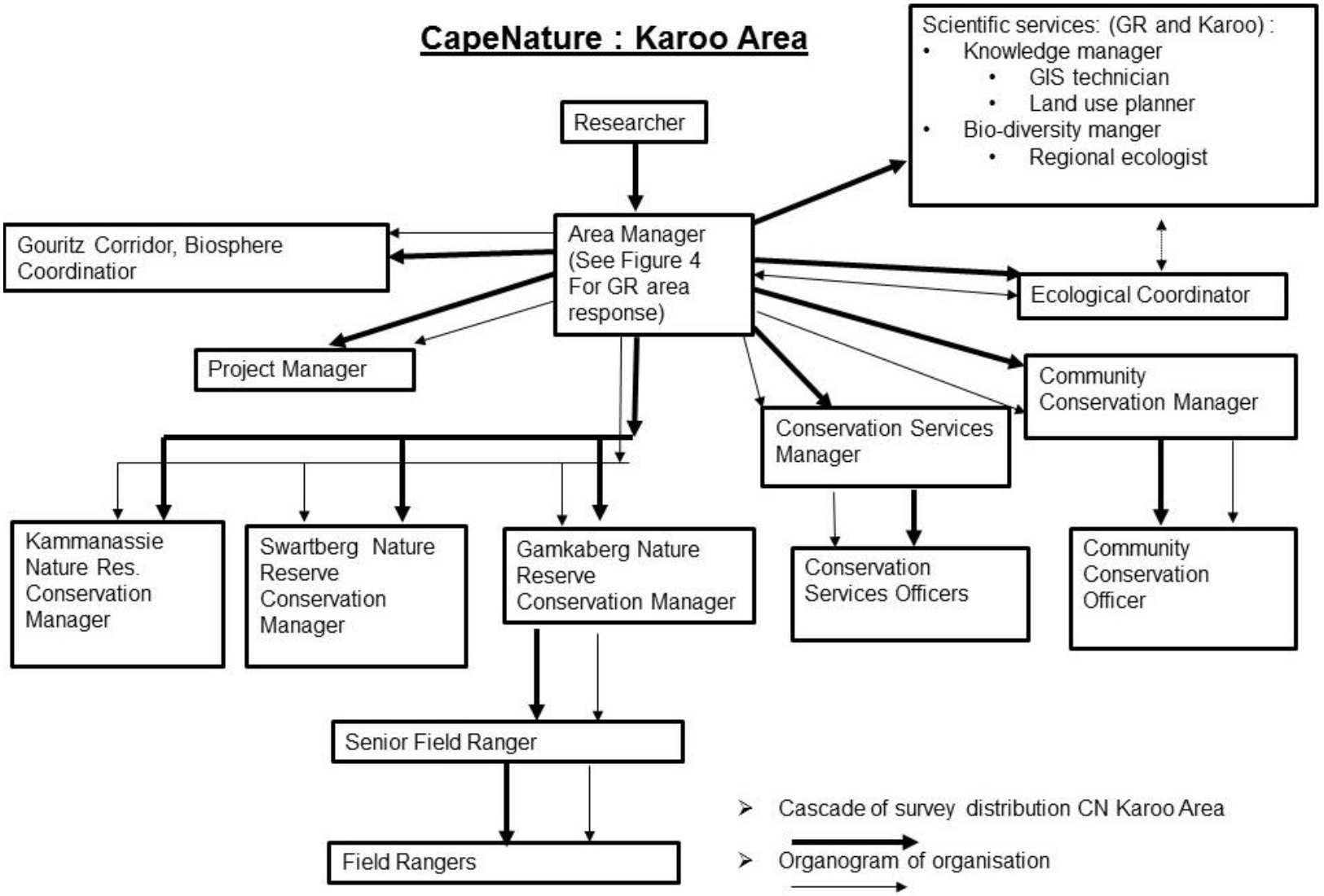

Figure 5: Diagram showing how the distribution of the survey cascaded from upper management to other departments for CN - Karoo Area

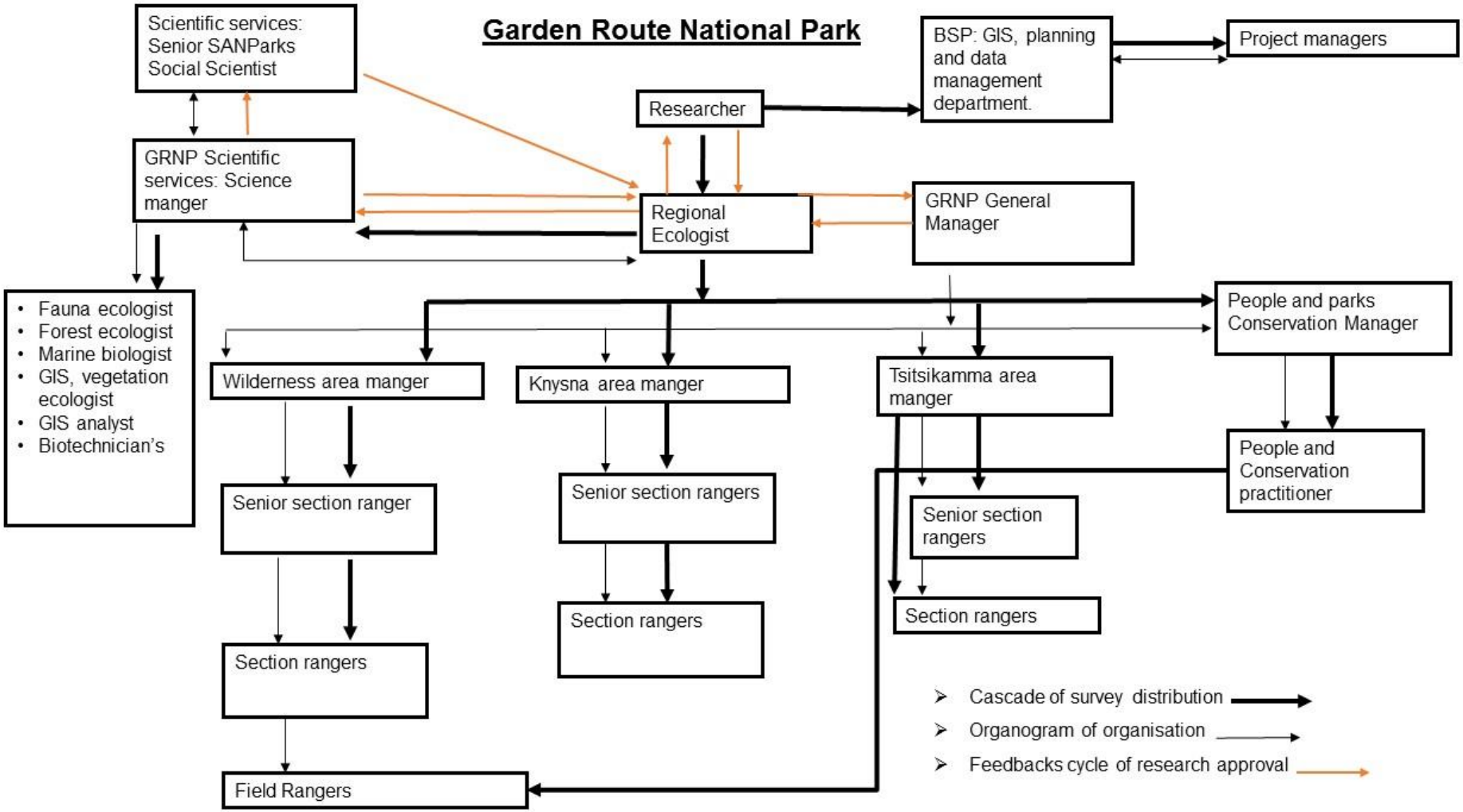

Figure 6: Diagram showing how the distribution of the survey cascaded from upper management to other departments for the Garden Route National Park

Absorptive capacity results for three public-sector organisations

Table 2: Results for the mean percentage sum of scores per dimension and the mean proportional contribution of dimension to the total AC score

Mean percentage sum of scores per dimension	EDM %	CN %	GRNP %	Total Mean %
Acquisition	69.20	63.47	74.73	70.20
Assimilation	67.93	69.60	68.47	68.80
Transformation	60.00	65.87	72.33	68.73
Exploitation	55.86	59.47	64.93	62.07
Total AC % score	63.25	64.60	70.12	67.45
Mean proportional contribution of dimensions to total AC score				
Acquisition	0.27	0.25	0.27	0.26
Assimilation	0.27	0.27	0.24	0.26
Transformation	0.24	0.26	0.25	0.25
Exploitation	0.22	0.23	0.23	0.23

Table 2 shows that, even with the disparity in the number of respondents, each organisation scored similarly in the survey. GRNP's results were, however, higher, and they had above-average percentage scores for the acquisition, transformation and exploitation sections, giving them the highest score for AC.

Table 2 also shows the results for the proportional contributions of the four dimensions to the organisations AC score were also similar. These results did, however, indicate that EDM placed a greater emphasis on knowledge acquisition than the dimensions assimilation, transformation and exploitation. CN placed a greater emphasis on knowledge assimilation than on dimensions acquisition, transformation and exploitation. GRNP placed the greatest emphasis on knowledge acquisition than the dimensions assimilation, transformation and exploitation. These results are confirmed by the organisations results for the percentage mean sum of scores per dimensions in Table 2.

Knowledge acquisition

Table 3: Selected ranks shown in percentage of knowledge acquisition per question for each organisation

Knowledge acquisition %		Strongly agree	Agree	Neither agree not disagree	Disagree	Strongly disagree
Qu 1 Info search	EDM	12.50	50.00	25.00	12.50	0
	CN	11.54	23.08	23.08	26.92	15.38
	GRNP	25.00	36.36	25.00	9.09	4.55
Qu 2 Internal info	EDM	25.00	25.00	25.00	25.00	0
	CN	19.23	30.77	38.46	11.54	0
	GRNP	34.09	27.27	31.82	6.82	0
Qu 3 External info	EDM	0	50.00	25.00	25.00	0
	CN	7.69	26.92	26.92	34.62	3.85
	GRNP	27.27	22.73	38.64	9.09	2.27

The acquisition of information is an important capability for a public-sector organisation with environmental management mandates. Table 3 summarises importance of different types of information to the respective organisations. Table 3, question 1, shows that more than 50% of respondents from EDM and GRNP acknowledged that the search for information with regard to response and adaption to environmental change is a daily activity in their organisation. E.g.:

> "Numerous scientists employed, whose job includes remaining current with literature on environmental change." GRNP 65:32

> "Information on possible environmental health diseases like Avian Influenza [H7N9]." EDM 33:29

The employees of CN, however, lean slightly more to the negative side of the scale, with more than 40% disagreeing that the search for information to respond and adapt to environmental change is a daily activity in their organisation. E.g.:

> "There is no pro-active search for such information and it is up to the individual to take note of such information and to take it into account when planning or executing projects. Little, if any such information is disseminated to staff in the organization unless it is done by the individual who deems it useful or necessary." CN 23:28

In Table 3, question 2 shows that 50% or more of the respondents from all three organisations strongly agreed or agreed that there is motivation to use internally

produced information, such as reports, policy documents and management plans for response and adaptation to environmental change. E.g.:

> "Die inligting wat op die informasie sisteem van die raad gelaai word, word gebruik om tendense te bepaal en verandering te bestuur". [The information that's loaded on the information system of the board is used to track trends and manage change]. EDM 27:32

> "Reports within organisation are being used (e.g., fire manual, ecological plan of operations, integrated work plans, etc.)." CN 11:34:

> "Required for the adaptive management approach adopted by SANParks." GRNP 72:32

In Table 3, question 3 shows that the motivation to use externally produced information that deals with response and adaptation to environmental change occurs at GRNP and EDM, with 50% or more of the respondents strongly agreeing or agreeing. E.g.:

> "[We] collect data from hospitals and clinics, to see frequent occurrence, so to prepare action plan." EDM 30:33

> "On flood warnings, we are dependent on Eden District Disaster Management for early warnings. This has indeed helped in for timeous intervention." GRNP 70:13

CN leaned to a slightly more negative, with more than 35% disagreeing to question 3. E.g.:

> "Everyone is so busy with day-to-day work that there is rarely time to focus on information produced outside of the organisation." CN 24:27

Through thematic content analysis, the researcher was able to identify key attributes that enabled and restrict the acquisition of information for these organisations (See Appendix 7). Access to information through research, monitoring, management plans, reports and policies, and scientific journals etc., was found to be the most common enabler for EDM, CN and GRNP. E.g.:

> "[We] collect data from hospitals and clinics, to see frequent occurrence, so to prepare action plan." EDM 30:33

> "We deal with biodiversity awareness so it is important to use different sources of information especially new information i.e., scientific journals." CN 20:31

> "We have monitors that patrol the park as a whole in a daily basis and they trained in alien plant identification and they come with very vital information daily, even sites with soil erosion." GRNP 50:4

The most common restrictor to knowledge acquisition was dissemination and implementation of information; the main key attribute to this was individual responsibility and motivation (See Appendix 7). This disabling factor was the most prevalent for all three organisations. E.g.:

> "There is no pro-active search for such information and it is up to the individual to take note of such information and to take it into account when planning or executing projects. Little, if any such information is disseminated to staff in the organisation unless it is done by the individual who deems it useful or necessary." CN 23:28

> "Currently national government promulgated new legislation but practitioners were not encouraged to read new legislation." EDM 34:22

> "Park management plans have scientific basis which incorporates information on environmental changes produced elsewhere. Not always implemented though." GRNP 65:37

Knowledge assimilation

Table 4: Selected ranks shown in percentage of knowledge assimilation per question for each organisation

Knowledge assimilation %		Strongly agree	Agree	Neither agree not disagree	Disagree	Strongly disagree
Qu 4 Inter department meetings	EDM	0	37.50	37.50	12.50	12.50
	CN	12.00	48.00	28.00	12.00	0
	GRNP	27.50	22.50	27.50	17.50	5.00
Qu 5 Inter department collaboration	EDM	25.00	50.00	25.00	0	0
	CN	16.00	44.00	36.00	0	4.00
	GRNP	25.00	10.00	35.00	15.00	15.00
Qu 6 Intra department collaboration	EDM	12.50	50.00	37.50	0	0
	CN	36.00	28.00	32.00	4.00	0
	GRNP	35.00	30.00	32.50	2.50	0
Qu 7 Informal inter collaboration	EDM	12.50	25.00	25.00	37.50	0
	CN	20.00	40.00	20.00	16.00	4.00
	GRNP	35.00	12.50	22.50	17.50	12.50
Qu 8 Inter innovation communication	EDM	12.50	50.00	25.00	12.50	0
	CN	12.00	20.00	24.00	40.00	4
	GRNP	35.00	7.50	27.50	20.00	10.00
Qu 9 Speed of inter communication	EDM	0	12.50	62.50	25.00	0
	CN	16.00	12.00	40.00	32.00	0
	GRNP	17.50	35.00	17.50	25.00	5.00

The assimilation of information within the respective organisations (this includes information dissemination, intra- and inter-organisational communication, coordination and collaboration), was also found to be an important capability. The emphasis on the methods used to assimilate information was varied among the organisations. Table 4 summarizes the scaled ranks about knowledge assimilation. In Table 4, question 4 showed that more than 50% of respondents at CN and GRNP strongly agreed or agreed that inter-departmental meetings were taking place. E.g.:

> "QEM [Quarterly ecological meetings] are usually the place where these exchanges take place."
> CN 9:25

> "In Garden Route National Park we have a quarterly Science Management Forum which comprises of different stakeholder, Scientist, Managers, Section Rangers, Foresters, Dept. Agric. Information regarding Environmental issue are discussed e.g., Use of Fire, Alien Clearing planning etc." GRNP 44:41

This was not as prevalent for EDM with only 37.50% agreeing and 37.50% neither agreeing nor disagreeing. E.g.:

> "Have staff forums but environmental issues does not feature on agenda." EDM 29:33

In Table 4, question 5 showed that more than 50% of respondents from CN and EDM strongly agreed or agreed that management encourages collaboration across its different departments, in an effort to respond and adapt to environmental change issues. E.g.:

> "In the Management Services Department there are 'sub-departments' e.g., Municipal Health, Environmental Services, Social Services etc. Certain 'sub-departments' have forums that meet on a quarterly basis. These forums usually consist of parties across divisions." EDM 28:90

> "Definitely with regards to fire management, flood events, oil spill events, etc." CN 11:12

The response from GRNP was, however, ambiguous, with 35% of respondents strongly agreeing and agreeing and another 35% neither agreeing nor disagreeing. E.g.:

> "It is seldom happens to all departments." GRNP 75:31

In Table 4, question 6 shows that all three organisations had more than 50% of respondents strongly agreeing and agreeing that there is encouragement to collaborate with formal organisations, (such as the Department of Water Affairs or WWF) to respond and adapt to environmental change issue. E.g.:

> "Inter owerheid samewerking tesame met die rol van NGOs word belangrik geag." [Intergovernmental cooperation, together with the role of NGOs, is increasingly important] EDM 27:12

> "Working together yields better results than being at loggerheads with each other, because at the end of the day we have the same goal." CN 20:14

> "In June [2015] the will be a workshop in Pretoria Botanical Garden where the Parks EMI - Section Rangers, DEA, WWF and other departments will meet to discuss strategies with regard to environmental issues." GRNP 44:15

In Table 4, question 7, shows that 60% of CN respondents strongly agreed and agreed that informal collaboration (such as discussions, brainstorming and time for reflection in relaxed environments) to work on strategies for response and adaption to environmental change is motivated by their management. GRNP also scored highly, with 47.50% of their respondents strongly agreeing or agreeing that this practice was motivated in their organisation. E.g.:

> "Field learning sessions with field rangers in veld." CN 10:15

> "There are always those informal discussion more especially during field visits when assessments are being conducted and during breaks when we have the Science management forums or park forums." GRNP 44:17

EDM's responses were more ambiguous, as they had 37.50% of respondents agreeing and 37.50% of respondents disagreeing with this question. E.g.:

> "Reflection Session: a compulsory meeting for all line managers to discuss general issues." EDM 33:15

In Table 4, question 8 shows that more than 50% of EDM's and GRNP's respondents strongly agreed and agreed that innovations that deal with response and adaptation to environmental change were communicated across the relevant departments. E.g.:

> "Waste Management plan to produce energy from waste." EDM 33:17

> "All new ideas, concepts, strategies and research outcomes get feedback to all relevant departments for implementation." GRNP 44:19

CN's respondents leaned more to the negative side of the spectrum, with 24% neither agreeing nor disagreeing, and 40% disagreeing. E.g.:

> "The topic appears in strategic plans and other corporate documents but little if any innovations are communicated." CN 23:18

In Table 4, question 9, shows that GRNP had more than 50% of respondents that strongly agreed or agreed that speed of information flow was good within their organisation. E.g.:

> "All new developments gets emailed to staff, posted on notice board and placed on the intranet." GRNP 44:21

Respondents from EDM and CN had 40% or more of respondents that neither agreed nor disagreed, and 25% or more disagreeing that the flow of information was good in their organisation. E.g.:

> "Some policy documents are only known through staff engagements and not through structures." EDM 29:17

> "Information often does not get communicated to staff on ground level nor are these staff consulted with decision-making." CN 16:18

Engagement through meetings, workshops, conferences and awareness-raising with stakeholders emerged as the most common enabler for EDM, CN and GRNP. E.g.:

> "Coastal Management plan engagements". EDM 33:34

> "Robberg MPA personnel interact with other MPA colleagues within the organisation." CN 17:23

> "Information discussed at Park level gets disseminated to the other parks through the Park Management forum. This is the platform where all the National Parks meet and discuss operational and environmental issues and way forward thereof gets feedback to each park for implementation." GRNP 44:44

Collaboration and coordination through formal and informal interactions with organisation and other stakeholders, including co-operative governance, emerged as the next most common attribute for enabling assimilation of information. E.g.:

> "In the Management Services Department there are 'sub-departments'; e.g., Municipal Health, Environmental Services, Social Services etc. Certain 'sub-departments' have forums that meet on a quarterly basis. These forums usually consist of parties across divisions." EDM 28:30

> "Various knowledge exchange opportunities are created such as Quarterly Ecological meetings and Regional Project Management meetings, but these gatherings seldom deal with the topic as in the question above. Individuals do however collaborate such as the Gouritz Biodiversity Corridor staff and the Gouritz Cluster Biosphere technical committee members." CN 23:37

> "We collaborate mostly with our local municipality and yes we are funded by department of water affairs and organisations as NRMP which helps in the strategies to environmental change." GRNP 50:43

The most common restrictor for all three organisations was obstacles to information flow, with the main key attribute being internal silos (See Appendix 7). E.g.:

> "New ideas, concepts etc. are shared amongst the 'sub-departments'. This information usually stays within the 'sub-division', and not communicated to other departments." EDM 28:33

"The topic appears in strategic plans and other corporate documents but little if any innovations are communicated." CN 23:43

"Inligting kom net tot op sekere vlak en nie verder nie." [Information only comes to certain levels and doesn't go further] GRNP 54:49

Knowledge transformation

Table 5: Selected ranks shown in percentage of knowledge transformation per question for each organisation

Knowledge transformation %		Strongly agree	Agree	Neither agree not disagree	Disagree	Strongly disagree
Qu 10 Combine new and old info	EDM	0	37.50	25.00	37.50	0
	CN	8.00	32.00	48.00	8.00	4.00
	GRNP	33.33	28.21	30.77	5.13	2.56
Qu 11 New info for decision-making	EDM	0	50.00	50.00	0	0
	CN	16.00	28.00	32.00	24.00	0
	GRNP	28.21	30.77	23.08	15.38	2.56
Qu 12 Regular reconstruct new info	EDM	0	25.00	12.50	50.00	12.50
	CN	12.00	24.00	40.00	16.00	8.00
	GRNP	25.64	12.82	35.90	20.51	5.13

Different aspects of the transformation of knowledge were found to be an important capability for the three organisations. Transformation of knowledge includes combining new knowledge with old knowledge, using it in decision-making and reconstructing this knowledge to make it understandable to other employees and stakeholders. There was a varied emphasis on where knowledge was transformed for use amongst the organisations. Table 5 summarizes the scaled rankings about knowledge transformation.

In Table 5, question 10 shows that more than 50% of the respondents from GRNP strongly agreed or agreed that the combination of new knowledge with existing knowledge was encouraged by management for response and adaptation to environmental change. E.g.:

"[This is] demanded by the adaptive management approach SANParks [has] adopted". GRNP 72:21

Only 40% of CN's respondents strongly agreed or agreed that this was the case for their organisation, with 48% neither agreeing nor disagreeing. E.g.:

> "Yes, but not specifically towards environmental change." CN 22:17

EDM's responses were ambiguous, with 25% neither agreeing nor disagreeing and 37.50 % agreeing and 37.50 % disagree. E.g.:

> "Happens from time to time in own department only." EDM 29:39

In Table 5, question 11 shows that 50% of GRNP's respondents strongly agreed or agreed that new information is considered for decision-making, in regard to response and adaptation to environmental change. E.g.:

> "When planning new zonation areas for recreational activities all new information is considered." GRNP 61:25

For EDM, 50% of the respondents agreed and 50% neither agreed nor disagreed. E.g.:

> "Coastline management is veral van toepassing." [Coastline management is particularly relevant] EDM 27:24

Only 44% of the respondents from CN strongly agreed or agreed, with a further 32% neither agreeing nor disagreeing that this was the case in their organisation. E.g.:

> "I think this is not done enough - maybe because one can see that implementation of these new things will be an administrative nightmare ..." CN 8:17

In Table 5, question 12 shows that with regard to the transformation of newly absorbed knowledge, 35% or more of employees from GRNP and CN strongly agreed or agreed, and 35% or more neither agreed nor disagreed with this. E.g.:

> "Pamphlet on value and purpose of biosphere reserves, pamphlet on dilemma of De Rust koppie, Stewardship program, renosterveld." CN 11:26

> "Popular articles/informal reports in SANParks Times, other media and local Park newsletters." GRNP 72:25

More than 50% of respondents from EDM either disagreed or strongly disagreed about this practice in their organisation. E.g.:

> "Organisation not open to environmental change." EDM 29:23

Information integration through research, monitoring and development came out as the most common enabler for GRNP and EDM. E.g.:

> "Word gebruik veral met monitering van water." [Especially used in monitoring of water] EDM 27:22

> "In our KPAs we have to publish at least one article annually." GRNP 78:38

Collaboration through informal and formal channels within the organisation and with stakeholders was the most common enabler for CN. E.g.:

> "Gereelde insette vanaf ons kantoor aan die plaaslike sowel as streekmunisipaliteit het daartoe gely dat die boulyne langs riviere teruggekuif is." [Regular input from our office to the local, as well as regional, municipality has led to the building lines along rivers to be moved back.] CN12:24

The most common restrictor for GRNP and EDM was information flow hindered through silos. E.g.:

> "In our department yes, not sure what happens in other departments." EDM 28:40

> "Toerisme personeel word nie betrek alhoewel ons die eerste kontak is met die publiek." [Tourism staff are not included/ involved although we are the first contact with the public] GRNP 52:53

There was no common disabling factor found for CN.

Knowledge exploitation

Table 6: Selected ranks shown in percentage of knowledge exploitation per question for each organisation

Knowledge exploitation %		Strongly agree	Agree	Neither agree not disagree	Disagree	Strongly disagree
Qu 13 External innovations	EDM	0	37.50	25.00	25.00	12.50
	CN	8.00	16.00	36.00	28.00	12.00
	GRNP	12.82	25.64	28.21	20.51	12.82
Qu 14 New info adapt innovations	EDM	0	12.50	50.00	37.50	0
	CN	16.00	16.00	40.00	20.00	8.00
	GRNP	23.08	15.38	53.85	7.69	0
Qu 15 Org. efficient adopt innovations	EDM	0	12.50	50.00	37.50	0
	CN	4.00	24.00	52.00	8.00	12.00
	GRNP	10.26	25.64	35.90	25.64	2.56

The exploitation of newly acquired knowledge includes adopting externally produced innovations and using this knowledge to adapt strategies, concepts and technologies to improve response and adaptation to environmental change. Table 6 summarizes the scaled rankings about knowledge exploitation. In Table 6, question 13 showed that more than 35% of the respondents from GRNP and EDM thought that their organisation took advantage of externally produced innovations. E.g.:

> "We have budgeted for alternative technologies for our waste management plan, they have visited Germany in this regard." EDM 33:26

> "Any innovation which may save on costs is considered and tested for viability." GRNP 61:29

However, 25% or more of the employees that responded neither agreed, nor disagreed with this statement.

Among CN's employees, 36% of the employees that responded believed that their organisation does not take advantage of these innovations, and a further 36% neither agreed nor disagreed to this statement. There were no comments to support these findings.

In Table 6, question 14 shows that more than 35% of the employees that responded from GRNP strongly agreed or agreed that management uses new knowledge to adapt current ideas, concepts, technologies and strategies. E.g.:

> "Working close with other Departments, which can bring new ideas." GRNP 53:31

However, more than 50% of GRNP's of the employees that responded neither agreed nor disagreed with this statement.

More than 50% of respondents from EDM neither agreed nor disagreed with this statement, and 37.50% disagreed that this was a practice in their organisation. E.g.:

> "Political opposition experienced." EDM 29:26

From CN, 32% of respondents strongly agree or agree that this was a practice in their organisation, and 40% neither agreed nor disagreed with this statement. E.g.:

> "Often we have financial constraints to adapt and planning to roll out new strategies in organisation takes a long time." CN 11:30

In Table 5, question 15 shows that more than 35% of GRNP's respondents agree and strongly agree and 35.90% of respondents neither agreed nor disagreed when asked whether the respondents thought that their organisations worked more efficiently by adopting externally produced innovations. E.g.:

> "After the regional meetings with stakeholders and scientist new ideas and concepts are brought to us to implement." GRNP 50:31

More than 50% of CN respondents neither agree nor disagree and a further 24% agreed that this was a practice in their organisation. E.g.:

> "Op sekere velde is ons kennis beperk en moet ons van eksterne bronne gebruik maak." [In certain fields our knowledge is limited and we have to make use of external sources] CN 12:32

For EDM, 50% of respondents neither agree nor disagree, and another 37.50% selected disagree. E.g.:

> "Werk word baie baseer op eie inligting." [Work is often based on own information] EDM 27:30

Information integration through research, monitoring and development was found to be the most common enabler for knowledge exploitation for EDM, CN and EDM. E.g.:

> "We have budgeted for alternative technologies for our waste management plan, they have visited Germany in this regard." EDM 33:49

> "GIS systems adapted from ArcView 3.3 to QGIS, a web based GIS programme. Also for the fire programme we use the AFIS systems." CN 11:58

> "We normally take strategies and lessons from other organisations and see if they are applicable to us, e.g., Patterson remuneration system..." GRNP 63:55

The most common restrictor for GRNP and EDM was information flow hindered through silos and lack of communication. E.g.:

> "In our department yes, cannot comment on other departments." EDM 28:41

> "New appointments come with new innovative ideas...SANParks has a legacy of being very nucleus healthy...employees don't easily leave the organisation resulting in old methods still implemented." GRNP 63:53

The only restrictor that was noted for CN was the lack of capacity in the form of finances and time. E.g.:

> "Often we have financial constraints to adapt and planning to roll out new strategies in organisation takes a long time." CN 11:60

Coming to grips with the silo effect: the outcome of a sustainability dialogue

Table 7: Summarized results from dialogue 1: What lies at the heart of organisational silos

What lies at the heart of the issue
• Lack of effective lateral communication • Politics - Splitting powers between government entities complicates decision-making, responsibilities and mandating. • Fractured decision-making = more silos to deal with. • Legal framework/legislation has become more demanding, technical and complex and difficult to convey and understand • Internal institutional rules may hamper collaboration • Afraid of giving away power – 'My way is the right way' • No/ very little common goals and visions • Because of your position and training and background we all see the problem through a different lens. • We don't acknowledge the differences in view, much less try to collaborate to find common solutions • At the heart of the problem lies self-preservation and trust sensitivity
Who else is involved
• Everyone is involved • Internal and external stakeholders • Those reliant on resources and environment. • Unfunded mandates are involved in breaking down silo's because they need to widen the search for resources
What's your role
• Monitoring • Get a better understanding of cross functions • Break free from your own silo and enable lateral dialogue to communicate better, more often and more structured • Take personal responsibility and lead by example, participate in the 'alliance of the willing'

Table 8: Summarized results from dialogue 2: Is there a new way?

Is there a new way
• YES, we can do it together • Cross pollination: fewer but larger and more complex projects. More value by lumping together • Alignment of legislation, organisational policies and resources • Time and place relevant research • Actively create the space and time to engage • Co-operative implementation. Set common goals with each organisation • Alignment of reporting structures • Bring in private sector to contribute to benefit the environment • NGOs, Governments, academia and private stakeholders work together. External parties have access to department information • Inter-Governmental Task Team- in the South Africa Constitution. Can work together to solve issues through bridging organisations. However, it needs to transform from reactive to proactive
What are the possibilities
• Get the right people with the right attitude into the room • Engage and act across disciplines (Academic/ Practitioners/ Community) for better solutions • Co-production of win-win solutions (for the greater good vs my own benefit) • Dialogues are good – leads to better cooperation and understanding – changes behaviour and creates a healthier dialogue – can be a catalyst towards lateral dialogue • Influencing Agenda vs Excluded politics (unrealistic?) Critical to involve political external environment. Political Buy-in is the catalyst for enabling actions
What would work be like, if this is achieved
• Job satisfaction = limitless possibilities • Less frustration • Better allocation of resources • Productivity • Better monitoring and value outputs, linking multiple projects into one • Reduced conflict

Table 9: Summarized results from dialogue 3: Was there a time when it worked differently and was more to your liking?

Was there a time when it worked differently, and more to your liking
• The past was simpler, less organisational complexity (same organisation-less departments) • Before increased regulations • Fewer things made better engagements. • Less but more comprehensive legislation = better work for action. • Less time spent on report writing and more time spent on action
What are the ingredients
• Common shared vision • Creative solutions & Collective design • ID real issues and not (political) agendas. • Less but more comprehensive legislation • Teamwork • Knowledge management systems - shared knowledge and integrated in management - Centralised information systems with open access • Simplify outputs and objectives. • Strategic visionary leadership willing to make tough decisions

Ten representatives participated in the dialogue; of these, four were from GRNP and three were from EDM. There were no representatives from CN. The first dialogue was about acknowledging the presence of silos. Table 7 summarizes the insights that emerged from the dialogue. The main insights from this dialogue were that silos are aggravated by a lack of lateral communication and that all employees play a role in contributing to and breaking down silos.

The second dialogue was a visioning exercise, aimed at discussing a new way of doing things and breaking down silos. Table 8 shows the insights that emerged from the discussion. The main insight from this dialogue was that there is the possibility of new way of doing things. This would need an alignment of legislation, policies, reporting structures and resources, as well as support from public and private spheres of society through common visioning and goal setting. Participants agreed that if this was achieved it would increase job satisfaction and productivity and decreases frustration in the work place.

The last dialogue was a reflective discussion about a time when the organisations had fewer silos and what the determinants or ingredients were that enabled this? Table 9 shows the insights that emerged out of this discussion. The main insights that emerged from this dialogue stated that in the past there was less organisational complexity due

to less regulations and more comprehensive legislation. This led to better action as there was less time spent on report writing. The ingredients that where identified and which made these conditions more favourable where common and shared visions between departments, with collective design and creative solutions.

Evaluation of the survey instrument

Table 10: Results from factor analysis, showing dominant Eigenvalues for first and second factors

Factor	Eigenvalue	Total % variance	Cumulative Eigenvalue	Cumulative %
1	6,066502	40,44335	6,066502	40,44335
2	1,504866	10,03244	7,571368	50,47579

Table 11: Factor loadings for factor one and two for all survey questionnaire items

Variable	Factor 1	Factor 2
Qu 1 – Regular info search	0,119902	0,765839
Qu 2 – Internal info	0,141174	0,767311
Qu 3 – External info	0,157860	0,719849
Qu 4 – Inter department meetings	0,618022	0,102621
Qu 5 – Inter department collaboration	0,520403	0,043962
Qu 6 – Intra department collaboration	0,608818	0,272276
Qu 7 – Informal inter collaboration	0,533291	0,082070
Qu 8 – Inter departmental innovation communication	0,710995	0,163026
Qu 9 – Speed of inter departmental communication	0,603571	0,419418
Qu 10 – combine new and old info	0,738996	0,138470
Qu 11 – Use new info for decision-making	0,711808	0,255931
Qu 12 – Regularly reconstruct info	0,697050	0,401588
Qu 13 – Adopt external innovations	0,720983	-0,075371
Qu 14 – Use new info to adapt innovations	0,801525	0,198734
Qu 15 – Organisation more efficient by adopting innovations	0,474973	0,357175
Explained variance	40,44335	10,03244

Table 12: Result from Cronbach's alpha reliability test

Cronbach alpha: 0,89 ; Average inter-item correlation 0,35; Mean rank =3,4 ; Std.Dev.=0,71 ;						
Variable	Mean rank	Std.dev	r correlation	r corrected	Av r	Alpha if deleted
Qu 1	3,40	1,19	0,54	0,44	0,36	0,89
Qu 2	3,70	0,99	0,48	0,47	0,36	0,88
Qu 3	3,40	1,07	0,56	0,45	0,36	0,88
Qu 4	3,50	1,09	0,61	0,57	0,35	0,88
Qu 5	3,40	1,22	0,44	0,41	0,36	0,89
Qu 6	3,90	0,88	0,66	0,64	0,34	0,88
Qu 7	3,40	1,32	0,56	0,49	0,36	0,88
Qu 8	3,30	1,28	0,72	0,68	0,34	0,87
Qu 9	3,20	1,12	0,72	0,71	0,34	0,87
Qu 10	3,60	1,03	0,70	0,69	0,34	0,87
Qu 11	3,50	1,05	0,73	0,72	0,34	0,87
Qu 12	3,20	1,18	0,78	0,78	0,33	0,87
Qu 13	2,90	1,17	0,61	0,59	0,35	0,88
Qu 14	3,30	1,03	0,78	0,78	0,33	0,87
Qu 15	3,10	0,98	0,57	0,55	0,35	0,88

The data was first analysed with factor analysis with a Varimax rotation. Table 10 shows that the analysis generated two significant factors. Factor one explained 40% and Factor two explained 10% of the variance. Table 11 indicated that Factor one represented the gradient in the way information was disseminated on the one extreme, to the way knowledge was adapted and utilised on the other extreme, i.e., assimilation, transformation and exploitation of knowledge. Factor two represented the way information was mobilized and communicated, with information acquisition on the one extreme to the way knowledge was shared on the other extreme. Only item question 15 had a factor loading of less than 0.5.

Cronbach's alpha reliability correlation coefficient was used as a measure of internal consistency for the multidimensional survey used. Table 12 shows that the survey was highly reliable, with an overall $\alpha = 0.89$ for all 15 items. Upon closer examination of the alpha value, if an item was deleted, all items indicated that the overall alpha value would be equal to or less than the average alpha value if the item was deleted. The average inter-item correlation was 0.35, indicating a weak positive linear relationship. Looking at the individual items, the inter-item correlation ranged from 0.34 to 0.36,

indicating that all items had a weak positive linear relationship. The mean rank for all items was 3.4 and the average standard deviation was 0.71, with a maximum standard deviation of 1.32 and a minimum standard deviation of 0.88.

CHAPTER 6: DISCUSSION

Understanding the feedback between AC and adaptive decision-making required an understanding of the processes and routines that are evident in the three public-sector organisations. AC does not directly affect decision-making, but rather it indirectly capacitates the organisations to make decisions with the best knowledge available to them. By using the survey instrument with mixed-method triangulation the researcher was able to gain the following insights.

The value of new external knowledge

The researcher carefully observed the organisations' participation in the study as an indication of AC (See Table 1). This was justified as it is stated that the first element of AC is the ability to recognise the value of new external information (Zahra and George, 2002). Being able to recognise the value of new knowledge has been described as a function of prior in-house knowledge and in-house research capacity (Cohen and Levinthal, 1994). These capabilities give an organisation the complementary expertise to interpret new information.

CN and GRNP were the first of the organisations to agree to participate in this research. While GRNP took longer to participate, they were the only organisation that required the research to go through an approval process. Figure 7 showed how the research circulated from the Regional Ecologist to the local Scientific Services of the GRNP, then to the senior Social Scientist for SANParks. The GRNP general manager was also consulted in the process. Once the study was approved through scientific services, the researcher was requested to present the research to the three area managers of the GRNP. This was done on a one-on-one basis with each of the area mangers.

CN also has a research approval process; however, this was only applicable to biophysical ecological research as CN does not have the in-house capacity for socially based research (Personal communication, 11 February 2014). It is assumed that if the research went through an approval process, the time it took for the organisation to participate would have been similar to GRNP. The area managers asked the researcher to present this study at their Quarterly Ecological Meeting (QEM). This was to inform the employees and clarify any questions that they may have had before the survey was sent out. QEM's are the forum where all new research that is relevant to

CN is presented and discussed (CapeNature, n.d.). QEMs were developed as a means to exchange knowledge between scientists and managers (CapeNature, n.d.). QEMs are guided by strict terms of reference and are hosted within management clusters between two areas of management (in this case Karoo and Garden Route areas). These meetings are compulsory for all managers in the cluster, including nature conservators, conservation services, community services, at least one field ranger from each reserve, the Regional Ecologist, Ecological Co-ordinators and the Biodiversity Manger or a co-opted member from Scientific Services.

EDM is the only case study organisation whose mandate is not solely environmental conservation. As a district municipality, they are responsible for a number of service-related duties that are similar to CN and GRNP (tourism development, firefighting etc.), but they are also responsible for duties, such as social welfare, air quality and waste treatment. EDM, however, does not have an in-house research capacity. It took 6 months of communication to get a meeting to present this research to the executive manager of community services. It must be noted that in the prior communications, the executive manager expressed extreme interest in the research for EDM, hence, the persistence required to gain their buy-in. The reason for the initial delay in participation was a combined result of bad timing, as the executive manager went on leave and, there was no one left with the capability to approve the research in his absence. The extended delay in communication can only be assumed by the researcher as an extensive amount of time needed to catch up and complete municipal duties.

It was evident through the comments attained in the study that the employees from GRNP and CN believe that it is mainly the responsibility of scientific services to acquire new external knowledge in terms of adapting to environmental change. The employees of GRNP, however, noted that data was gathered by field rangers, working for water (WfW) teams and bio-technicians for scientific services, the latter for monitoring purposes related to environmental change. The data collected included information on water quality, freshwater and marine fauna and flora, and invasive fauna and flora. The link between acquiring new external knowledge and in-house research capacity is well documented (Cohen and Levinthal, 1989; Leahy and Neary, 2007; Oltra and Flor, 2003). At EDM, there is no in-house research capacity; however, external information is gathered for monitoring purposes related to human health and

disaster risk mitigation by the associated sub-departments of the environmental health department.

It is suggested that CN and GRNP's in-house research functions made these organisations better equipped to identify the value of this research to their organisations and that lead to a greater rate of participation (See Table 1). Secondly, it is suggested that GRNP's research approval process and CN's pre-research engagement at the QEM increased their buy-in into the research. Lastly, it is proposed the lack of in-house research capacity and lack of a research approval process or group engagement contributed to the low participation from EDM, as they did not have the capacity to recognise the value of the research and little buy-in was achieved through research engagement.

The acquisition of knowledge

The ability to acquire external knowledge has been noted as critical to innovative capabilities (Cohen and Levinthal, 1990). Organisations that are aware of complementary external knowledge are able to adopt this knowledge and, with the right internal capacities, adapt their practices, strategies or technologies. This ability gives organisations dynamic capabilities to deal with change (Zahra and George, 2002). Internal knowledge can be considered as prior knowledge and is important for interpretation of new external knowledge (Cohen and Levinthal, 1990). Van den Bosch *et al.* (1999) also noted that, what may initially be new external knowledge in some departments, can become internal knowledge once it is communicated to other departments.

At CN, internal knowledge was recognised as being more important than external knowledge sources for adapting to environmental change. Internal knowledge was mostly recognised in the form of policies, internal reports and management plans. It must, however, be noted that there is significant input by scientific services into the internal reports and management plans (Palmer *et al.*, n.d.). Nevertheless, it can only be assumed how much of these internal knowledge sources are impacted by externally produced knowledge. Many of the comments received from CN mentioned that it was not organisational practice to motivate staff to use external knowledge, but self-motivated individuals do acquire external knowledge from time to time for implementation.

At EDM, internal and external knowledge sources were recognised as being important for adapting to environmental change. Policies and legislative documentation were mentioned as internal knowledge, and this as well as external information that was acquired by others is passed down internally. Externally important knowledge sources were mostly recognised as information pertaining to disease outbreaks and weather occurrences for monitoring purposes.

At GRNP both internal and external knowledge sources were recognised as being important for adapting to environmental change. Internal knowledge sources were recognised as policies, standard monthly reports, interface sessions between science and management, as well as information published in SANParks popular media outputs and GRNP monthly newsletters. External knowledge sources that were recognised included peer-reviewed publications and external research projects.

Through thematic content analysis, the researcher was able to identify key attributes that enabled and hindered the acquisition of knowledge within these organisations. All three organisations were identified as having access to information in various forms. Individual responsibility and motivation emerged as a main enabling factor in the acquisition of external knowledge. It is suggested that the acquisition of external knowledge is taking place at GRNP, which is a function of their well-capacitated scientific services and rigorous monitoring protocols. Employees from GRNP also have access to internally produced knowledge through reports and management plans. It is suggested that at CN, their scientific services department has a limited capacity for the acquisition of external knowledge, due to austerity measures in the organisation. Therefore, the organisation is more reliant on internally produced information and self-motivated individuals who are able to recognise the value of external knowledge. Lastly, It is suggested that EDM acquires external knowledge through environmental monitoring and legislation, but they are limited in knowledge depth through the lack of in-house research capacity and therefore do not have the capabilities to identify and value peer-reviewed scientific outputs.

The assimilation of knowledge

The number of departments and levels to which the survey cascaded for each organisation provided some provisional insights into the channels of communication in the organisations. EDM had only one cascade in distribution (See Figure 4), sent

from the municipal manager to various individuals within different sub-departments. While three sub-departments were reached, the distribution did not follow the formal hierarchy for the organisation, as the survey was not distributed to the air quality manager or the district waste manager. It was, however, distributed to the district waste management officer, skipping a level in the organisation's hierarchy. In terms of who participated, no responses were received from the basic education category or from science and research support (there is no such department) or from operational management (See table 1).

At EDM, the survey data showed that, while inter-departmental collaboration is encouraged, meetings take place on an ad hoc basis and informal communication is not common. External collaboration with other organisations was noted as important and it happens regularly, especially in regards to estuary and coastal management and the Garden Route Initiative (GRI). They also indicated that communication of external innovations happened regularly, especially with regards to waste management. However, this was contradicted by a low score for speed of communication within the organisation.

At CN, the evidence showed (See Figure 5 & 6) that the survey cascaded once in the Garden Route area and three times in the Karoo area. The survey also reached seven different sub-departments and all groups in the education and job categories (See table 1). The way that the survey was disseminated indicated a formal channel of communication within the organisation. The data from the survey assimilation section shows that CN is efficient at communicating and collaborating between different sub-departments. Many of the comments revealed that the communication and collaboration was largely a function of QEM's, but also mentioned Regional Project Management meetings and Biodiversity Reviews. Informal communication was also mentioned as taking place often within the organisation between formal meetings and during field excursions. External collaboration with other organisations, such as EDM, Department of Water Affairs (DWA), Department of Environmental Affairs (DEA) and other stakeholders involved in biodiversity corridor and biosphere initiatives, are taking place regularly. There was, however, some indication that the speed of communication and communication about new innovations is slow.

At GRNP, the evidence showed (See Figure 7) that the survey cascaded three times and reached four different sub-departments. The survey also reached all groups in the education and job categories (See table 1). The way that the survey was disseminated indicated a formal communication channel within the organisation. The survey results indicated that there are inter-departmental meetings at GRNP, especially with regard to science management interface meeting, meetings with the biodiversity and Social project (BSP) coordinators, operational meetings and meetings between SANParks clusters. In terms of collaboration between departments, the results indicated that this is not common practice. Informal communication and collaboration, however, was stated as taking place on a regular basis, especially during field visits and between formal meetings. The employees rated the speed of communication internally as agreeable, due to internal intranet communications, newsletters and ad hoc meetings with scientists, bio-technicians and park operational management.

In terms of external communication and collaboration, GRNP scored highly. They mentioned municipal water forums with the DWA as being a prime example. Also mentioned were Marine Protected Area forums, World Wildlife Fund (WWF), the Wildlife and Environment Society of South Africa (WESSA) and collaborations with government departments, such as the Departments of Agriculture Fisheries and Forestry (DAFF) and the DEA. Interdepartmental communication about new external innovations was, however, rated as not being a common occurrence.

The evidence showed that GRNP and CN had to follow formal procedures not only to process the new external research, but also for dissemination (See Figures 4–7). Engagement was noted as the most prominent enabling factor for knowledge assimilation for all three organisations. Regular internal and external knowledge engagements within the three organisations are an indication of good socialization capabilities. These meetings function as a means to facilitate group learning, nurture relationships internally and facilitate a common language amongst staff (Roux *et al.*, 2008). These are all factors that contribute to creating an organisational culture and collective ideology (Van den Bosch *et al.*, 1999). However, when there is a loose coupling of sub-departments and a lack of effective cross-functional interface, high socialization capabilities can lead to organisational silos. The evidence showed that, for all three organisations, the existence of silos was the most present disabling factor for knowledge assimilation. This was most prevalent for EDM. In terms of co-ordination

capabilities and the presence of mechanisms that allow cross-functional interface, the researcher was only able to identify this in CN and GRNP. The Regional Ecologist in GRNP and the Ecological Co-ordinator in CN perform the role of liaison between science and operational management and can be considered as knowledge brokers (Murray *et al.*, 2011). These individuals are tasked with communicating and coordinating research needs between the operational management departments and scientific services departments and external researchers.

It is suggested that formalised processes are an indication of good systems capabilities for GRNP and CN, while, at EDM there is an indication of disruption to the formal channels of communicating and therefore their system capabilities. Secondly, It is suggested that CN and GRNP have co-ordination capabilities due the presence of individuals that act as knowledge brokers between departments, which appear to be absent for EDM. Lastly, it is suggested that all three organisations have good socialization capabilities. While all organisations mentioned silos as being present in their organisations, it is suggested that this is most prevalent in EDM and is due to their absence of co-ordination capabilities and the loose coupling of departments due to their broad mandates. This issue is mostly noted as a problem in their ability to transform knowledge.

The transformation of knowledge

The transformation of new knowledge involves the ability to refine the processes that combine newly assimilated knowledge with that of existing knowledge. This is achieved by either interpreting existing knowledge in a different manner or adding new knowledge or unlearning out dated knowledge (Zahra and George, 2002). GRNP has adopted a Strategic Adaptive Management (SAM) approach (Kingsford and Biggs, 2012), meaning that they treat all management policies as experiments and learning opportunities; therefore, it is their intent to revise existing knowledge through incorporating new knowledge. This response was strongly indicated by the survey results, with many employees commenting that it was required of them. Of the three organisations, GRNP scored the highest for transformation of knowledge, noting that they regularly combine new knowledge with existing knowledge, that they use new knowledge in decision-making, and that this new information is regularly reconstructed to make it understandable to other employees and stakeholders. Many of the

employees highlighted the ‘Go Wild’ magazine, the SANParks Times and monthly newsletters as the communication channels were this new information was relayed.

The data from CN indicated that, while transformation of new knowledge occurs, it is not regular. The comments from the survey indicated that this is a practice within the organisation; however, this is not done specifically towards adapting to environmental change (See comments from AC results: knowledge transformation). CN recognises climate change and biodiversity loss, rather than the broader context of environmental change (See environmental change in definition of key concepts). In their management plans and annual reviews CN’s strategies for climate change are specifically framed as managing ecosystems for resilience and they lack the recognition of complex SES approach. It is suggested that the framing of environmental change within the organisation has led CN to manage adaptation to environmental change in a business-as-usual manner, i.e. they focus their management on the mitigation of the biophysical impacts of environmental change. This is further compounded by the financial constraints the organisation face and a strong organisational culture of managing for efficiency.

The data from EDM indicates that the transformation of knowledge does not occur regularly. They do note that new knowledge is used for decision-making; however, this is not the case in terms of combining new knowledge with existing knowledge or in terms of reconstructing new information to make it available to other sub-departments in the organisation.

While all three organisations had similar scores in the assimilation of knowledge, there was a noticeable difference in the transformation of knowledge. It is suggested that GRNP and CN are more capacitated to transform newly absorbed knowledge due to their in-house research capacity and the presence of cross-functional interface mechanism (co-ordination capabilities). I also propose that GRNP’s higher score for transformation of knowledge is a direct result of their SAM approach, which results in the organisation being more flexible to external knowledge sources. I further propose that the presence of multiple communication and media channels of GRNP facilitates the transformation of knowledge into information that is more understandable to their employees and stakeholders.

The exploitation of knowledge

The exploitation of new knowledge involves using newly acquired and transformed knowledge to refine and extend existing operations or produce new ones (Zahra and George, 2002). In general, all organisations experienced a drop in scores when it came to the exploitation of knowledge. GRNP employees expressed the most positive sentiments around exploitation of knowledge for the organisation, noting that new external innovations were considered if they promised to save costs to the company. In terms of using new knowledge to adapt current practices, ideas and technologies, there was some agreement that this takes place, although not on a regular basis. Whether the organisation works more efficiently due to adopting external knowledge could not be concluded. The results for CN and EDM for all exploitation questions were vague and there were no substantial comments to aid the interpretation.

What was discovered about these organisations absorptive capacity with this tool

All the organisations have AC; however, the survey results revealed where their strengths and weaknesses lie in terms of the four dimensions of acquisition, assimilation, transformation and exploitation. Through examination of the survey results and content analysis of the comments, the researcher was able to determine enabling and disabling factors of each organisation's AC per dimension. This information was complemented by the researcher's knowledge gained through interviews, desk top studies of management plans and annual reviews, as well as through observations made during organisational meetings and workshops. The overall insights for each organisation shall be discussed separately.

EDM

Due to the small sample size received from EDM, it was difficult to come to any concrete conclusions for this organisation. However, even as the survey results for EDM were not drastically different from the other two organisations, the researcher was able to assume that the tool was effective. Therefore, with the knowledge gained though triangulation methods an assessment was obtained. EDM has good potential AC, as they are actively acquiring and assimilating external knowledge that pertains to adapting to environmental change. However, a number of weaknesses that are hindering the realisation of their AC were identified.

An assessment of EDM Integrated Development Plant 2012/13 – 2016/17 and the 2013/2014 annual review revealed that EDM does not recognise the complex interactions of social and ecological systems. However, promoting sustainable environmental management and public safety is outlined in the organisation's strategic goals of the Integrated Development Plan (IDP) (EDM, 2012). Environmental change in this organisation is very much contextualised as that which directly impacts on infrastructure and social well-being. This paradigm of thinking neglects a deeper understanding that makes the links between proactively managing the ecological environment and indirect linkages to social well-being (Folke, 2006; Anderies *et al.*, 2004).

EDM is structured in sub-departments that separately manage development, human health, waste management, air quality, ecological environment and disaster risk and emergency services. There is interaction between these departments; however, they do not seem to have a common language, as is reflected by the frequent reference to internal silos present between departments. It is suggested that these silos are intensified by the loose coupling and broad management mandates between the sub-departments of the community services department within EDM. It is further suggested that this was compounded by the lack of recognition of complex adaptive SES, the lack of in-house research capacity and the lack of co-ordination capabilities.

The Disaster Risk Management Department is involved in the planning and response to environmental disasters that can potentially impact the resilience of social systems. Many of the disasters identified are directly linked to ecological environmental change, such as storm sea surges, flooding, drought and fire. There is great potential to increase social-ecological resilience if these sub-departments would work together, by recognising that environmental management can proactively rehabilitate and restore the ecological environment to provide an effective buffer against environmental change.

My suggestions for management are not simple quick fixes, but will take time, good leadership and patience. Firstly, the organisation would benefit from a form of research capacity. The problem with developing in-house research capacity is that it needs sufficient resources in terms of skilled individuals, finances and time. As these resources are already neglected in the organisation, it is suggested that they should

form multidisciplinary learning networks through encouraging knowledge partners with universities and other private and public-sector organisations that already have in-house research capacity. Key to learning networks is for individuals from each sub-department to be involved and for the organisation to appoint a knowledge broker. A knowledge broker can be one or more individuals who have a good breadth of knowledge about the activities of the departments and can span the boundaries between sup-departments and other stakeholders. Knowledge brokers also have the role of transforming newly learned knowledge into a product that is understandable to other employees and stakeholders. Lastly, it is suggested that EDM needs to encourage learning to develop depth in SES literacy in at least some individuals. Pasquini *et al.* (2013) noticed that employees of municipalities in the Eden area, lack depth of understanding of ecosystems functioning and how this translates to human well-being.

CN

The Gouritz cluster of CN has good potential AC, as they are acquiring new information through data collection within their organisation and making active efforts to disseminate that information to other employees. Their realised AC is considered as fair as they are transforming and exploiting the knowledge that they gain, however this is limited to internally produced knowledge. This organisation is very efficient at assimilating knowledge and has a strong culture of knowledge sharing but they lack in acquisition of external knowledge. While this organisation has an in-house research capacity it is composed of two scientists, a GIS technician and a knowledge manager. These individuals are so busy supporting the organisation's operations, that they have little time for acquisition of new external information (See comments from knowledge acquisition results). Comments from the survey did, however, reveal that there are some self-motivated employees who acquire external knowledge and propose it for further use within the organisation.

The economic and political climate of South Africa has led to an extreme reduction in financial support for CN over the last few years and as such, the organisation has had to streamline its operations and to leave a number of critical posts vacant. This has resulted in the organisation focusing their practices to manage for efficiency (CapeNature, 2015). An assessment by desk top review of the 2013/14 and 2014/15

annual reports (CapeNature, 2014; CapeNature, 2015), revealed that the organisation does not explicitly acknowledge SES or complexity, but rather their focus is on efficiently managing the biodiversity of ecological systems. Managing for efficiency has been known to limit the flexibility and scope of learning and as such is unsuitable for a turbulent knowledge environment (Van den Bosch *et al.*, 1999; Roux *et al.*, 2008). It is suggested that CN's management's style of efficiency is not suited to dealing with abrupt and disorganising environmental change.

Once again recommendations for management are not simple as there is a need to address the short fall in resources available in terms of time, finance and skilled staff. In light of CN's current financial situation this seems unlikely. However, CN fastidious management of ecological systems is not in vain. By conserving and restoring ecosystem functioning, they are directly creating resilience for these systems and indirectly creating robustness of social systems to bio-physical environmental change.

GRNP

The GRNP has both good potential and realized AC, as evidence suggests that they are actively acquiring, assimilating, transforming and exploiting internal and externally produced knowledge. It is suggested that this is due to their well capacitated in-house research capacity, co-ordination capabilities and the SAM approach, which recognises the complex interactions within SES. SAM makes room for both flexibility and scope of knowledge absorption as each policy and management plan is treated as an experiment for learning and adaptation (Kingsford and Biggs, 2012). It is therefore suggested that GRNP has sufficient capabilities to adapt to abrupt environmental change.

Utility of multidimensional survey tool for public-sector organisations with environmental mandates

The researcher performed a factor analysis with Varimax rotation to assess the interrelated correlations between questionnaire items (Tredoux *et al.*, 2006). The evidence suggested that there were only two dimensions measured in this survey, rather than four dimensions, as found in Flatten *et al.* (2011). These dimensions were split into knowledge acquisition on factor two and knowledge assimilation, transformation and exploitation on factor one. Of all the questionnaire items, only question 15 obtained a factor loading of less than 0.5. This indicates that question 15

does not correlate sufficiently with the rest of the items. It is proposed that question 15 (See Appendix 5) was ambiguous leading many of the respondents to select “neither agree nor disagree”. The Cronbach’s alpha reliability test (See table 12) showed an overall alpha statistic of 0.89, therefore indicating that the survey had internal consistency and was a reliable measurement tool (Oppenheim, 1992).

It is therefore suggested that the multidimensional survey tool was a reliable and consistent measure of AC. In Addition, the two factors suggest that assimilation of knowledge was related to the transformation and exploitation of knowledge, i.e., realised AC. It is suggested that in environmentally mandated public-sector organisations, AC starts to become realized at the knowledge assimilation stage. It is argued that this is due to the fact that public-sector organisations with environmental mandates have to deal with complex issues related to the delivery of ecosystems services in a SES which are constantly under threat from predicted and unpredicted environmental change. To further complicate the issue, these organisations are often under-resourced in terms of finances, time and skilled personal (Roux *et al.*, 2008). As such, these organisations are mandated under the South Africa constitution to co-operate with one another and with other stakeholders. Therefore, through sharing knowledge in a social learning environmental, knowledge networks are created with both depth and breadth of knowledge. In these learning environments, knowledge is exchanged between individuals from different organisations and different backgrounds. Here, knowledge is either challenged as outdated or it may be complemented with new knowledge. Therefore, it is possible that for public-sector organisations, transformation of knowledge may begin at the assimilation stage in effective group learning networks and as such begin moving towards realizing their AC.

Overall the tool adapted from Flatten *et al*. (2011) was useful to gain basic insights into the perceptions of routines and processes that enable and disable AC within public-sector organisations. The tool was especially strong in terms of the insights gained through qualitative data for the dimensions acquisition and assimilation of information within the three public-sector organisations. In terms of transformation and exploitation of knowledge there is room for improvement. While statistical results showed that the tool was reliable and internally consistent, the data gathered for the transformation and especially the exploitation sections were found to be a bit lacking

in terms of insights to the perceptions of employees. This may have been due to survey fatigue or it may be that the questions in these sections were not designed in a suitable manner to reflect these practises, it is therefore recommended that the questions for these sections be reviewed and refined in a workshop with professionals in the industry who have experience with practises of adapting to environmental change.

CHAPTER 7: CONCLUSION

The ability to adapt to predictable and unpredictable environmental change is becoming increasingly important for public-sector organisations that are custodians of SES. A basic SES can be considered as being composed of resources, resource users, public-infrastructure providers (i.e., public-sector organisations) and public-infrastructure (Anderies *et al.*, 2004). Public-sector organisations need to understand that there are multiple forms of feedback between all of these components, and that these are further complicated by the pressures of external drivers that impose environmental change. The interactions between the components of a SES and the pressure from external drivers highlight the complexity of managing these systems. As such, the management of SES is often characterised by uncertainty and trade-offs (Funke *et al.*, 2008).

Public-sector originations that are mandated stewards of these systems need to recognise and make peace with the complexities associated with SES. Maintaining the robustness and resilience of SES requires an approach that prevents the ecological systems upon which society relies for moving into a new domain of attraction that cannot support human well-being (Anderies *et al.*, 2004). To do this, public-sector organisations need to cultivate a set of capabilities with strong emphasis on continued learning and adaptive practices that promote experimentation, reflection and innovation (Armitage *et al.*, 2008).

In an era when knowledge is readily available and produced at an alarming pace, it is important that public-sector organisations acknowledge their learning capabilities and manage them constructively, to prevent information overload and inertia. Organisational learning and AC are considered as mutually reinforcing activities (Roux *et al.*, 2008). AC is considered as a set of routines and processes that give organisations the ability to value externally produced knowledge and acquire, assimilate, transform and exploit it (Lane *et al.*, 2006). There is a distinction between the routines and processes that enable potential AC and those that enable the realisation of AC (Zahra and George, 2002). Extensive research into organisational science has shown that organisations that are able to realise the potential of absorbed knowledge have dynamic capabilities (Zahra and George, 2002). Such capabilities allow them to recognise rapidly changing environments and address undesirable

change by renewing and building of their levels of skill and knowledge to adapt to change.

While AC has been extensively researched in organisational science, it has only been theoretically suggested as a desirable capability for environmentally mandated public-sector organisations (Murray *et al.*, 2011). The purpose of this research was to gain an understanding about the current state of AC, in three public-sector organisations with environmental mandates, and its feedback towards decision-making for adapting to environmental change. To achieve this, a mixed-method triangulation approach was used with the aid of an adapted multidimensional survey tool, developed for commercial businesses. The tool was used to assess the perceptions of routines and processes that relate to the four dimensions of AC, and to gain insight into their capacity to adopt external information and use this for adaptive decision-making towards environmental change.

Two research questions were suggested to guide the study:

1. What are the types of feedback between the processes and routines that determine AC and decision-making to deal with environmental challenges for public-sector organisations with environmental mandates?
2. Is the multidimensional measure of AC adapted from Flatten *et al*. (2011) a reliable useful instrument to assess AC of public-sector organisations with environmental mandates?

The findings on the perceptions of specific routines and processes that determine the strengths and weaknesses for the four dimensions of AC are summarized in the discussion section (Chapter 6). Here, I will synthesise how the findings feed back into adaptive decision-making for environmental change.

Feedback between the processes and routines that determine AC and decision-making

The most notable processes and routines identified that enable adaptive decision-making was in-house research capacity and the presence of good co-ordination capabilities. The organisations with in-house research capacity were better equipped to identify and value new external knowledge. These organisations also had better environmental literacy, as they had the knowledge depth to understand and utilize

outputs, such as peer-reviewed literature. In-house research capacity was also noted as fundamentally important to the transformation of new knowledge. This again has to do with knowledge depth, as it enables the ability to recognise outdated knowledge and renew it or, the ability to combine existing knowledge with new knowledge components. This, in turn, is dependent on the availability of resources to research departments in terms of the number of skilled staff, the time available to them, and the organisation's emphasis on either efficiency or flexibility.

Internal and external engagement was another enabling factor identified as enhancing AC. External engagements give the opportunity for individuals within organisations to be exposed to knowledge breadth, through diversity of knowledge backgrounds (Drik Roux *et al.*, 2008). These environments also encourage relationships, through which knowledge networks can form. Internal engagements were noted as being hindered through silos and this, in turn, was found to impact the assimilation and transformation of knowledge. Silos were identified as being more frequently present in organisations with loosely coupled departments that have strong socialization capabilities. Through triangulation of methods, the researcher was able to expand on the causes of silos. The main findings presented for silos were a lack of effective lateral communication, lack of common vision and goals between sub-departments and other organisations, complicated or outdated policies and legislation, and lack of trust. Co-ordination capabilities were found to enhance assimilation and transformation of knowledge, as this capability enables lateral communication through liaison mechanisms and includes participation in decision-making.

Systems capabilities were also found to increase AC as they aid knowledge transfer through formal organisational mechanisms. Notable is that formal channels of communication and formal media output increased organisational AC. Socialization capabilities were found in all three organisations; however, care should be taken with socialisation tactics. Organisations with high socialisation tactics have been found to increase the efficiency within the organisation. However, too much emphasis on efficiency, can lead to the risk of becoming too reliant on prior knowledge, leading to the formation of silos and a decrease in the flexibility of the organisation to external knowledge absorption.

Overall, GRNP had the best AC score, which I interpret was a function of their SAM approach, capacitated research department and co-ordination capabilities. These three main determinants have given the organisation the ability to recognise the complexity of SES and the flexibility of knowledge to adapt their decision-making and practices. There are still silos present between departments, especially between those that are loosely coupled. The presence of the Regional Ecologist, who plays a cross-functional interface role between the Research Department and operational managers has aided in limiting silos between those departments; however, departments such as tourism still feel the impact. Motivation was also noted as a disabling factor for this organisation, especially with regard to remaining current with new environmental legislation and policy. I interpret that this organisation has the capacity to make decisions with the best available knowledge and therefore can adapt in times of abrupt environmental change.

This study has shown that AC can be useful as an indicator to public-sector organisations that needs to practice adaptive decision-making. Through the use of this tool, with a mixed-method approach, public-sector organisations would be able to assess their strengths and weaknesses in the processes and routines that enable or restrict adaptive decision-making. This study contributes to the broader scientific knowledge by highlighting that AC is not only applicable in commercial businesses but also for public-sector organisations. There are, however, distinct differences between AC for commercial business and public-sector organisations. Firstly, public-sector organisations need to promote AC for public and environmental good, rather than profit. Secondly, the term innovation in public-sector organisations takes on a new meaning. While novel technology and products play a role, it is rather innovation as ideas, strategies and practices that have a greater impact on these organisations. As such, I suggest that, for public-sector organisations with environmental mandates, further research is needed to identify whether the term innovation should become synonymous with adaptation. Therefore, it is proposed that AC can be considered as a potential transformative framework that can be used as an institutional mechanism to promote adaptive capacity, to navigate through predicted and unpredicted environmental change.

Was the adapted multidimensional AC survey tool a reliable and conventional instrument for public-sector organisations with environmental mandates

The survey gave good insight into the perceptions of routines and processes that enable or hinder AC for adaptive decision-making towards environmental change. The results showed that the survey was valid and internally consistent. I therefore propose that this is a reliable and conventional instrument to measure the AC of public-sector organisations with environmental mandates. However, the exploitation sections require critical review, as I do not think the questions accurately reflect the intention of the section. In reflection, the exploitation section needs to be workshopped, in a process similar to the sustainability dialogues, with qualified individuals who have experience with adaptive practises towards environmental change.

An interesting finding of this study is the relation of assimilation of knowledge to realised potential of AC. The results indicated that assimilation of knowledge was more related to the transformation and exploitation of knowledge than that of acquisition of knowledge, i.e., potential AC. I argued that this was due the fact that public-sector organisations deal with complex environmental problems cooperatively under cooperative governance. Therefore, engagement is a crucial enabling factor to the absorption and utilisation of new knowledge. This, however, needs further research for confirmation as there is no benchmark to validate this finding.

Strengths and weaknesses and recommendation for future research

The survey tool was an effective method to do a basic AC assessment on public-sector organisations with environmental mandates. This is especially in regard to the acquisition, assimilation and transformation of knowledge. These three dimensions of AC gave a good indication of the perceptions of routines and processes within public-sector organisations that enable or restrict adaptive decision-making to environmental change.

The exploitation questions, however, did not reveal many insights, as many respondents selected neither agree nor disagree, and there was a noticeable decline in comments for this section. It is proposed that this is due to one of two factors. One is the possibility of survey fatigue, causing respondents to select the middle option of neither agree, nor disagree. Survey fatigue is generally defined as a negative

sentiment to surveys due to the time and effort it takes to participate (Sharp *et al.*, 1983) or when an individual or organisation is overexposed to survey processes (Porter *et al.*, 2004). When this happens, it makes responders more likely to choose the easiest option so as to not need in-depth thought. Steps were taken to limit fatigue by restricting the number of questions, keeping the questions relevant and communicating effectively with respondents in terms of time needed, how many questions and the purpose of the survey. The second possibility is that the questions adopted from the Flatten *et al.* (2011) survey were not suitably adapted for public-sector organisations with environmental mandates.

Another strength of this study was the use of mixed-method triangulation. It was only through the qualitative data gathered that the true insights into the organisations processes and routines was achieved. Therefore, the qualitative data aided in the sense making of the study. The benefit of mixed-method approaches is well documented in literature as a technique that limits the bias of single-method approaches (Teddlie and Tashakkori, 2009; Creswell, 2003).

The main weakness noted for this study is that it would have benefited greatly from follow-up semi-structured interviews. Semi-structured interviews could have provided more insights into the routines and processes that facilitate the four dimensions of AC. This would have been particularly beneficial to understand the ambiguous results found in the exploitation section of the survey. Semi-structured interviews, being time-consuming, fell outside the scope of this study.

As this was a novel application of AC, there were no similar studies for comparison of the public-sector organisations results, which weakened the ability to validate the results. This study can now, however, be used as a benchmark for similar studies in the future. The researcher recommends this survey tool for doing a basic assessment of AC for public-sector organisations. The following recommendations should, however, be considered for future research.

- Further research is needed to ground truth the link between AC and whether it enables or constrains decision making, as this study focused on the perceptions of the organisations employees rather than actually causality of AC and adaptive decision making.

- Follow-up semi-structured interviews with a proportion of the respondents should be done to understand if there were any difficulties or ambiguities in the survey questions.
- A network analysis would be beneficial for understanding the channels of knowledge dissemination and the scope of knowledge networks within and outside of the organisations.
- As these three organisations work in close proximity to each other and have to work co-operatively, I would also recommend a network assessment to understand how knowledge is successfully transferred between these organisations.
- Furthermore, research is also needed to confirm or refute the finding that public-sector organisations begin to realise the potential of AC through assimilation of new knowledge.

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APPENDICES

Appendix 1: A list of the core functions that apply to EDM's mandate under the Municipal Systems Act 33 (2000)

Section 84 (1) of the Amended Structures Act (Act 33 of 2000) states the **core functions of district municipalities** as follows:

(a) A district municipality has the following functions and powers:

a) Integrated development-planning for the district municipality as whole, including a framework for integrated development plans [for the local municipalities within] the area of the district municipality, taking into account the integrated development plans of those local municipalities].

b) Bulk supply of water that affects a significant proportion of municipalities in the district

c) Bulk supply of electricity [that affects a significant proportion of municipalities in the district

d) Bulk sewage purification works and main sewage disposal that affects a significant proportion of municipalities in the district]

e) Solid waste disposal sites [serving the area of the district municipality as a whole], in so far as it relates

(i) the determination of a waste disposal strategy:

(ii) the regulation of waste disposal"

(iii) the establishment, and control of waste disposal sites, bulk waste transfer facilities and waste disposal facilities for more than one local municipality in the

f) Municipal roads which form an integral part of a road transport system for the area of the district municipality as a whole.

g) Regulation of passenger transport services,

h) Municipal airports serving the area of the district municipality whole.

i) Municipal health services [serving the area of the district municipality as a whole].

j) Fire fighting services serving the of the district municipality a whole, which

(i) planning, co-ordination and regulation of tire services;

(ii) specialised tire fighting services such mountain, veld and chemical fire services;

(iii) co-ordination of the standardisation of infrastructure, vehicles. equipment and procedures;

(iv) training of fire officers

k) The establishment, conduct and control of fresh produce markets and serving the area of [the district municipality as a whole]

l) The establishment, conduct and control of cemeteries and serving the [district as a whole]

m) Promotion of local tourism for the area of the district municipality.

n) Municipal public works relating to any of the above functions or any other functions assigned to the district municipality.

(o) The receipt, allocation if applicable. the distribution of grants 10 made to the district

p) The imposition collection of taxes, levies and duties as related to the above functions or as may be assigned to the district municipality in terms of national legislation.": and

Appendix 2: Table from 2014/2015 draft IDP indicating the alignment of EDM's strategic objectives with national and provincial stratagies

Millennium Development Goals	National Development Plan 2030	National Outcomes(s)	Provincial Strategic Objective(s)	Eden Strategic Goal(s)
MDG 1: Eradicate extreme poverty and hunger **MDG 4:** Reduce child mortality **MDG 5**: Improve maternal health **MDG 6:** combat HIV/AIDS, malaria and other diseases	**Chapter 10:** Health Care for all **Chapter 11**: Social Protection	**Outcome 2:** Improve health and life expectancy **Outcome 7:** Vibrant, equitable and sustainable rural communities and food security	**PSO 2:** Increasing wellness **PSO 3:** Increasing safety **PSO 6:** Reducing poverty **PSO 11**: Increasing social cohesion	**G1:** Healthy and Socially stable communities
MDG 3: Promote gender equality and empower women	**Chapter 9**: Improving Education, training and innovation **Chapter 15:** Nation building and Social Cohesion	**Outcome 1**: Improve the quality of basic education **Outcome 5:** A skilled a capable workforce to support inclusive growth	**PSO 1**: Improving education outcomes	**G2:** Build a capacitated workforce and communities
		Outcome 6: An efficient, competitive and responsive economic infrastructure network.	**PSO 10:** Integrated Service Delivery for maximum impact	**G3:** Conduct regional bulk infrastructure planning and implement projects, roads maintenance and public transport: manage and develop council fixed assets
MDG 7: Ensure environmental sustainability	**Chapter 5:** Environmental Sustainability and resilience	**Outcome 3:** All people in South Africa protected and feel safe **Outcome 10:** Protection and enhancement of environmental assets and natural resources **Outcome 11**: A better South Africa, a better and safer Africa and world	**PSO 9:** Mainstreaming sustainability and optimizing resource-use efficiency	**G4:** Promote sustainable environmental management and public safety
		Outcome 9: A responsive and accountable, effective and efficient local government system	**PSO 10:** Integrating service delivery for maximum impact	**G5:** Ensure financial viability of the Eden District Municipality
MDG 8: Develop a global partnership for development	**Chapter 14:** Fighting corruption	**Outcome 9:** A responsive and accountable, effective and efficient local government system	**PSO 8:** Increasing social cohesion	**G6:** Promote Good Governance
	Chapter 3: Economy and Development	**Outcome 12:** A development-orientated public	**PSO 11:** Building the best run government in the world	
		Outcome 4: Decent employment through inclusive economic growth **Outcome 6:** An efficient, competitive and responsive economic infrastructure network	**PSO 4:** Increasing opportunities for growth and jobs **PSO 5:** Creating opportunities for growth and development in rural areas	**G7:** Grow the district economy

Appendix 3: Strategic goal statements and objective for CN as ouline in their strategic plan 2010-2014...

STRATEGIC GOAL STATEMENT	STRATEGIC OBJECTIVE STATEMENT	KEY MEASURABLE OBJECTIVES
1. Securing priority biodiversity and ecosystem services through integrated biodiversity management enabling appropriate climate change response.	1.1 Effective knowledge management informs development and conservation priorities.	1.1.1 To provide biodiversity input into Western Cape Provincial land use planning and decision-making. 1.1.2 To manage biodiversity knowledge to ensure effective conservation management.
	1.2 Implementation of the Western Cape Biodiversity Plan and Protected Area Expansion Strategy secure priority biodiversity.	1.2.1 To ensure rigorous conservation planning in the Western Cape within the national legislative framework. 1.2.2 To implement measures to ensure resilience and persistence of biodiversity of the Province in the light of anticipated climate changes. 1.2.3 A network of Protected Areas with appropriate status and effectively managed by CapeNature (incorporating terrestrial, freshwater and marine).
	1.3 Sustained conservation management in priority catchments maintains ecosystem services.	1.3.1 To ensure the implementation of effective conservation management interventions in the Western Cape.
	1.4 Legal and wildlife support services and biodiversity crime prevention result in the protection and sustainable use of biodiversity.	1.4.1 To enhance biodiversity protection and conservation in areas outside the formal CapeNature Protected Area Network.
2. Contributing to the reconstruction and development of social capital.	2.1 Facilitate youth and community development through environmental awareness and assist in developing the knowledge, skills, values and commitment necessary to achieve sustainable development.	2.1.1 To provide learners with access to a quality environmental education programme. 2.1.2 To provide experiential service learning opportunities in the conservation sector.
3. Promoting socio-economic development through the conservation economy.	3.1 Develop and implement strategies to facilitate equitable access to and participation in the conservation economy through a People and Parks Programme.	3.1.1 To provide access to work opportunities through implementation of conservation and tourism management services. 3.1.2 To improve access to protected areas for sustainable traditional, cultural and spiritual uses. 3.1.3 To enhance opportunities for stakeholder participation in protected area management.

STRATEGIC GOAL STATEMENT	STRATEGIC OBJECTIVE STATEMENT	KEY MEASURABLE OBJECTIVES
		3.1.4 To grow and effectively deploy volunteer capacity.
4. Ensuring an efficient and effective institution.	4.1 Increased sustainable revenue is attained through enhanced tourism product development and the development of a system for payment of ecosystem services.	4.1.1 Create awareness/market the tourism products within our portfolio to domestic and international visitors, and contributing positively towards sustainable tourism. 4.1.2 To establish partnerships that will improve corporate and social investment into our reserves and by so doing positively impacting on visitor expectations and the livelihoods of local communities. 4.1.3 Develop sustainable tourism products while providing access to both the domestic and international market. 4.1.4 To establish a system for payment for ecosystem services management as a sustainable basis for income in the MTEF allocation.
	4.2. Develop policies, systems and processes to support service delivery.	4.2.1 Support strategic decision-making to ensure good corporate governance. 4.2.2 Ensure all CapeNature's activities are executed within a framework of sound controls and the highest standards of corporate governance. 4.2.3 To develop and implement an effective and efficient communication strategy for all internal and external stakeholders and role-players. 4.2.4 To implement Information Technology and Systems that are compliant and support the core business of the organisation.
	4.3. Institution building enables a supportive working environment.	4.3.1 To provide a professional human resource management support service.

Appendix 4: Multidimensional survey tool developed by Flatten *et al*. (2011)

Final ACAP scale	
Acquisition	
Please specify to what extent your company uses external resources to obtain information (e.g., personal networks, consultants, seminars, internet, database, professional journals, academic publications, market research, regulations, and laws concerning environment/technique/health/security):	
Acquire 4	The search for relevant information concerning our industry is every-day business in our company.
Acquire 5	Our management motivates the employees to use information sources within our industry.
Acquire 7	Our management expects that the employees deal with information beyond our industry.
Assimilation	
Please rate to what extent the following statements fit the communication structure in your company:	
Assimilate 1	In our company ideas and concepts are communicated cross-departmental.
Assimilate 2	Our management emphasizes cross-departmental support to solve problems.
Assimilate 4	In our company there is a quick information flow, e.g., if a business unit obtains important information it communicates this information promptly to all other business units or departments.
Assimilate 5	Our management demands periodical cross-departmental meetings to interchange new developments, problems, and achievements.
Transformation	
Please specify to what extent the following statements fit the knowledge processing in your company:	
Transform 1	Our employees have the ability to structure and to use collected knowledge.
Transform 4	Our employees are used to absorb new knowledge as well as to prepare it for further purposes and to make it available.
Transform 6	Our employees successfully link existing knowledge with new insights.
Transform 10	Our employees are able to apply new knowledge in their practical work.
Exploitation	
Please specify to what extent the following statements fit the commercial exploitation of new knowledge in your company (NB: Please think about all company divisions such as R&D, production, marketing, and accounting):	
Exploit 2	Our management supports the development of prototypes.
Exploit 4	Our company regularly reconsiders technologies and adapts them accordant to new knowledge.
Exploit 5	Our company has the ability to work more effective by adopting new technologies.

Appendix 5: Multidimensional survey that was distributed to the three participating public-sector organisations

Absorptive CapacityAn assessment of environmentally mandated public-sector organisations

Dear participant

I would like to start off by thanking you for your participation in this short survey. It has received human ethical clearance (Ref: H13SCISRU 004) and all personal information will be kept confidential.

Background:
In this time of vast global environmental change, it is crucial for the organisations that formally govern our natural resources to continuously learn and adapt in response to this change (e.g. Climate change, invasive plant infestation, increasing habitat loss due to human population growth...).

Absorptive capacity is the ability of an organisation to realise the value of new externally generated information by acquiring, assimilating, transforming and exploiting it, and it has a positive correlation to innovative capabilities. The ability of organisations to absorb and use the best available information is crucial for continuous adaptation and sustainable ecosystem management.

This survey is the first of two methods that will be used to assess the absorptive capacity of your organisation. This will indicate the capacity of your organisation to innovate and transform in response to environmental change. The second method will be structured interviews with a proportion of the respondents. Once all the data has been collected and analysed, the results will be communicated in the form of a feedback session for all interested parties. This information will be written up in a Master's thesis and scientific publications, and copies will be sent to all participating organisations. The data from this research will also feed into a larger collaborative project with the CSRI, WWF, SANParks and NMMU that is looking at building resilient landscapes by linking social networks and social capital to the maintenance of nature's infrastructure.

Geagte deelnemer

Dankie vir u deelname aan hierdie kort opname! Dit het menslike etiese klaring (Verw. : H13 SCI SRU 004) ontvang en alle persoonlike inligting sal vertroulik hanteer word.

Agtergrond:
In hierdie tyd van globale omgewingsverandering, is dit noodsaaklik vir die organisasies wat die amptelike reguleerders van ons natuurlike hulpbronne is om voortdurend te leer en aan te pas by hierdie verandering (bv. klimaatsverandering, verspreiding van indringerplante, verlies van habitat as gevolg van menslike bevolkingsgroei...).

Die absorberingsvermoë (Absorptive capacity) van 'n organisasie is die vermoë om die waarde van nuwe inligting wat ekstern gegenereer word te besef, dit te bekom, te benut, te verwerk en aan te wend sodat dit bruikbaar vir die organisasie is. Daar is 'n positiewe verband tussen die absorberingsvermoë en die innoverende vermoë van 'n organisasie. Die vermoë van organisasies om die beste beskikbare inligting op te neem en te gebruik is noodsaaklik vir voortdurende aanpassing en volhoubare ekosisteembestuur.

Hierdie opname is die eerste van twee metodes wat gebruik sal word om die absorberingsvermoë van u organisasie te evalueer. Dit sal 'n aanduiding gee van die vermoë van u organisasie om te vernuwe en verander in reaksie op veranderinge in die omgewing. Die tweede metode sal gestruktureerde onderhoude behels wat met 'n persentasie van die respondente gevoer sal word. Sodra al die data ingesamel en ontleed is, sal die resultate in dievorm van 'n terugvoersessie deurgegee word aan alle belangstellendes. Hierdie inligting sal aangewend word vir 'n Meestersgraad en vervat word in wetenskaplike publikasies. Afskrifte sal aan alle deelnemende organisasies gestuur word. Die data van hierdie navorsing sal ook deel vorm van 'n groter gesamentlike projek saam met die WNNR, WWF, SANParke en NMMU waar navorsing gedoen word oor hoe om robuuste landskappe te kweek deur sosiale netwerke en kundigheid aan die instandinghouding vandie natuur se infrastruktuur te verbind.

1. Please state the name of the organisation you work for. ***Meld asseblief die naam van die organisasie waarvoor u werk.***

2. How many years have you been employed with this organisation? ***Hoeveel jaar is u in diens by hierdie organisasie?***

3. Please select your highest level of education. ***Kies u hoogste kwalifikasie.***

- Matric *Matriek*
- Diploma *Diploma*
- Degree *Graad*
- Postgraduate degree *Nagraadse studies*
- Other *Ander*

4. If you have completed or are currently enrolled in tertiary education, please state the major discipline of you qualification (e.g. environmental science). ***Indien u onlangs 'n kwalifikasie ontvang het van, of ingeskryf het vir een aan 'n tersiêre instelling, meld asseblief die studie of vakrigting van u kwalifikasie (bv. omgewingswetenskap).***

5. Please select the job description that best describes the position you currently hold. ***Kies die beste term wat u huidige posisie by die werk beskryf.***

- Top management *Topbestuur*
- Senior management *Senior bestuur*
- Middle management *Middelbestuur*
- Junior management *Junior bestuur*
- Scientificand technical support e.g. research *Wetenskaplike en tegniese ondersteuning bv. navorsing*
- Operational support e.g. administration *Operasionele ondersteuning bv. administrasie*
- Field worker *Veldwerker*
- Other *Ander*

Knowledge Acquisition

Please specify the extent to which the following statements best describes the acquisition of information in your organisation. *Spesifiseer asseblief die mate waarin die volgende stellings die verkryging van inligting in jou organisasie beskryf.*

6. The search for information concerning response and adaptation to environmental change is an everyday activity in our organisation. ***Die soeke na inligting oor die reaksie en aanpassing by veranderinge in die omgewing vind op 'n daaglikse basis in ons organisasie plaas.***

- Strongly disagree *Verskil sterk*
- Disagree *Stem nie saam nie*
- Neither agree or disagree *Stem nie saam of verskil nie*
- Agree *Stem saam*
- Strongly agree *Stem beslis saam*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

7. Management motivates employees to work with information sources produced within our organisation (e.g. internal reports, policy documents, journals and newsletters) and to include this in plans that respond and adapt to environmental change. ***Die bestuur motiveer werknemers om te werk met inligtingsbronne wat binne ons organisasie gegenereer word (bv. interne verslae, beleidsdokumente, tydskrifte en nuusbriewe) en dit te gebruik om ons reaksie op en aanpassing by veranderinge in die omgewing te beplan.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

8. Management motivates employees to work with information produced outside our organisation (e.g. scientific journals, local, global and historical knowledge) and to include this in plans for response and adaptation to environmental change. ***Bestuur motiveer werknemers om te werk met inligting wat buite ons organisasie gegenereer word (bv. wetenskaplike tydskrifte, plaaslike, globale en historiese kennis) en dit te gebruik in beplanning vir die reaksie en aanpassing by veranderinge in die omgewing.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

Knowledge Assimilation

Please specify the extent to which the following statements best describes the communication structure in your organisation. *Spesifiseer asseblief die mate waarin die volgende stellings die kommunikasie struktuur in u organisasie beskryf.*

9. Our management requires across departmental meetings to share new developments, problems and achievements with regard to response and adaptation to environmental change issues. ***Ons bestuur vereis interdepartementele vergaderings om nuwe ontwikkelings, probleme en prestasies ten opsigte van reaksies en aanpassings by omgewingskwessies te deel.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

10. Our management encourages collaboration across its departments (e.g. Town planning and Disaster & risk management departments) in effort to respond and adapt to environmental change issues. ***Ons bestuur moedig samewerking aan tussen departemente (bv. Stadsbeplanning en Rampbestuurs& Risikobestuurs departemente) in 'n poging om op veranderinge in die omgewing te reageer en aan te pas.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

11. Our management encourages collaboration with formal organisations (e.g. government departments such as the Department of Water Affairs, or non-government departments such as the World Wildlife Fund) to work on response and adaptation strategies to environmental change. ***Ons bestuur moedig samewerking aan met formele organisasies (bv. Staatsdepartemente, soos die Departement van Waterwese, of nie regeringsorganisasies, soos die World Wildlife Fund) om reaksie en aanpassingstrategieë wat omgewingsverandering teweeg bring, te formuleer.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

12. Our management encourages informal collaboration with colleagues in the work place (this includes discussions, brainstorming and time for reflection in relaxed environments such as the tea room or out in the veld). ***Ons bestuur moedig informele samewerking met kollegas in die werkplek aan (soos besprekings, dinkskrumsessies en tyd vir oordenking in ontspanne omgewings soos die teekamer of in die veld)***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

13. In our organisation, innovations (i.e. new ideas, concepts, technologies and strategies) that deal with response and adaptation to environmental change, are communicated across the relevant departments. ***In ons organisasie word innovasies (dit wil sê nuwe idees, konsepte, tegnologie en strategieë) wat handel oor die reaksie en aanpassing by veranderinge in die omgewing, aan alle betrokke departemente gekommunikeer.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

14. In our organisation there is quick flow of information. In other words, if a department obtains new information relevant to the response and adaptation to environmental change, they will communicate it promptly to all other departments. ***In ons organisasie is daar 'n vinnige vloei van inligting. Met ander woorde, as 'n departement nuwe inligting kry, wat relevant is in ons reaksie en aanpassing by veranderinge in die omgewing, sal hulle dit dadelik aan alle ander departemente kommunikeer.***

- Strongly disagree *Verskil sterk*
- Disagree *Saam nie stem nie*
- Neither agree or disagree *Stem nie saam of verskil nie*
- Agree *Stem saam*
- Strongly agree *Stem beslis saam*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

Knowledge transformation

Please specify the extent to which the following statements best describes the information processing in your organisation. *Spesifiseer asseblief die mate waarin die volgende stellings die verwerking van inligting in u organisasie beskryf.*

15. Our management encourages employees to combine new information with existing knowledge to respond and adapt to environmental change issues (e.g. using projected sea level rise data to determine new coastal set back lines and development zones). ***Ons bestuur moedig werknemers aan om nuwe inligting te kombineer met bestaande kennis in reaksie tot, en om aan te pas, by omgewingsveranderingskwessies (bv. die gebruik van data om seevlakstyging te voorspel wat nuwe kuslyne en ontwikkelingsones bepaal).***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

16. Our management strongly considers new information for decision making in regard to response and adaptation to environmental change issues. ***Ons bestuur oorweeg nuwe inligting wat besluitneming rondom ons reaksie op en aanpassing jeens omgewingskwessies beïnvloed of rig.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

17. Our employees regularly restructure newly absorbed information for further purposes, to make it understandable and available too stakeholders and other staff members (e.g. using the information from a published scientific article to create a brochure on the importance of corridors for biodiversity conservation in a changing environments). ***Ons personeel vereenvoudig gereeld nuwe inligting om ook ander doelwitte te bereik, soos om dit verstaanbaar en beskikbaar te maak aan belanghebbendes en ander personeel (bv. om die inligting uit 'n gepubliseerde wetenskaplike artikel te gebruik in 'n brosjure oor die belangrikheid van korridors vir die bewaring van biodiversiteit in 'n veranderende omgewing).***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

Knowldge Exploitation

Please specify the extent to which the following statement best describes the use of new knowledge in your organisation (NB: Please think about all company divisions such as research and development, marketing, etc.). *Spesifiseer asseblief die mate waarin die volgende stelling die gebruik van nuwe kennis in jou organisasie beskryf (NB: Dink asseblief aan al die maatskappy se afdelings, soos navorsing en ontwikkeling, bemarking, ens).*

18. Our management takes advantage of externally produced innovations (i.e. ideas, concepts, technologies and strategies), adapting them if necessary, for public and environmental benefit (e.g. Wind powered turbines that were designed in Europe for greener energy production). ***Ons bestuur gebruik innovasies wat ekstern geskep word (dit wil sê idees, konsepte, tegnologieë en strategieë), en pas dit aan, indien nodig, tot voordeel van die publiek asook die omgewing (bv. windaangedrewe turbines wat in Europa ontwerp is vir energieproduksie).***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

19. Our management takes advantage of newly acquired information to adapt innovations (ideas, concepts, technologies and strategies) in response and adaptation to environmental change. ***Ons bestuur gebruik nuwe inligting wat verkry is tot die maatskappy se voordeel om innovasies (idees, konsepte, tegnologieë en strategieë) aan te pas om ons reaksie op veranderinge in die omgewing te bepaal.***

- Never *Nooit*
- Rarely *Selde*
- Sometimes *Soms*
- Often *Dikwels*
- Always *Altyd*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

20. Our organisation works more effectively by adopting externally produced innovations (ideas, concepts, technologies and strategies). ***Ons organisasie werk meer doeltreffend deur innovasies (idees, konsepte, tegnologie en strategieë) wat ekstern gegenereer word, te aanvaar of toe te pas.***

- Strongly disagree *Verskil sterk*
- Disagree *Saam nie stem nie*
- Neither agree or disagree *Stem nie saam of verskil nie*
- Agree *Stem saam*
- Strongly agree *Stem beslis saam*

Please give an example if possible. *Gee asseblief 'n voorbeeld, indien moontlik.*

Thankyou very much for your participation in this survey.

The ethical integrity of this survey is supported by the Nelson Mandela Metropolitan University Human Research Ethics Committee (Ref: H13 SCISRU004) (clickhere).

If you have any queries please feel free to contact me by clicking on the link provided (EmailMe). The next step for this study will take the form of structured interviews with a proportion of the participants. Once the final results have been analyzed, a feedback session will be held for all interested parties. This will take place towards the end of 2014. A copy of the final thesis and all publications will be made available to all participating organisations.

Kind regards,

Baie dankie vir jou deelname aan hierdie opname.

Die etiese integriteit van hierdie opname word ondersteun deur die Nelson Mandela Metropolitan Universiteit Menslike Navorsingsetiekkomitee (Verw: H13SCISRU004)(clickhere).

Indien u enige navrae het, kontak my gerus deur op die volgende skakel te kliek (EmailMe). Die volgende stap in die studie sal gestruktureerde onderhoude met 'n deel van die respondente wees. Sodra die finale uitslae ontleed is, sal 'n terugvoersessie gehou word vir alle belangstellendes. Dit sal teen die einde van 2014 gehou word. 'n Afskrif van die finale verhandeling en allepublikasies sal beskikbaar gestel word aan alle deelnemende organisasies.

Vriendelike groete,

Samantha Mc Culloch
MTech Nature Conservation
Nelson Mandela Metropolitan University
Sustainability Research Unit member
samantha.mcculloch@nmmu.ac.za

Appendix 6: Letter of ethics approval by the NMMU Faculty of Science Ethics Commitee

Faculty RTI Committee (Faculty of Science)
Tel: +27 (0) 41 5042268
E-mail: lynette.roodt@nmmu.ac.za

Ref: H13-SCI-SRU-004

Contact person: Mrs L Roodt

Date: 14 October 2013

Miss S McCulloch
c/o Prof C. Fabricius
Saasveld
NMMU
Port Elizabeth
6001

Dear Ms S McCulloch

TITLE OF PROJECT: ASSESSING THE ABSORPTIVE CAPACITY OF ORGANS OF STATE FOR ECOLOGICAL INFRASTRUCTURE MANAGEMENT IN THE GARDEN ROUTE

Your above-entitled application was considered and approved by the Sub-Committee for Ethics in the Faculty of Science on 25 September 2013.

The Ethics clearance reference number is **Ref: H13-SCI-SRU-004** and is valid for three years. Please inform the Committee, via your faculty officer, if any changes (particularly in the methodology) occur during this time.

An annual affirmation to the effect that the protocols in use are still those, for which approval was granted, will be required from you. You will be reminded timeously of this responsibility, and will receive the necessary documentation well in advance of any deadline.

We wish you well with the project. Please inform your co-investigators of the outcome, and convey our best wishes.

Yours sincerely

Lynette Roodt
Manager: Faculty Administrator
Faculty of Science

Appendix 7: Table of thematic content analysis for multidimensional survey comments

Primary theme	Secondary theme	Key attributes		Acq	Ass	Trans	Exp	Total
Enabling processes	Access to Information	• Internal communication • Legislation • Management plans & policies • Media • collaborators and scientific journals	EDM	6	2	1	0	9
			CN	8	4	1	2	15
			GRNP	38	20	3	2	63
	Adaptive management	• Adaptive planning, • Adaptive implementation • Adaptive evaluation	EDM	1	0	1	0	2
			CN	0	1	2	0	3
			GRNP	6	1	2	1	10
	Bridging agent	• Liaison between management and other departments	EDM	0	0	0	0	0
			CN	0	0	0	0	0
			GRNP	0	1	0	0	1
		•						
	Collaboration:	• Formal and informal within the organisation and with other stakeholders • Co-operative governance collaboration	EDM	0	15	1	0	16
			CN	1	21	3	0	25
			GRNP	7	37	3	2	49
	Cost benefit	• The availability for funds for innovations that are without doubt beneficial	EDM	0	0	0	1	1
			CN	0	0	0	0	0
			GRNP	2	1	0	1	4
	Engagement	• Awareness raising to stakeholders • Meetings, workshops and conferences	EDM	1	6	2	0	9
			CN	2	19	1	0	22
			GRNP	16	54	5	5	80
			EDM	1	3	5	5	**14**

	Information integration	• Research, monitoring and development • Environmental change mitigation management • Publishing information in popular articles, newsletters and peer-reviewed journals	CN	4	3	1	4	**13**
			GRNP	24	8	30	10	**72**
Restricting process	Capacity	• Available funding and resource • Time • Knowledge	EDM	0	2	0	0	**2**
			CN	4	6	1	1	**12**
			GRNP	3	6	3	1	**13**
	Co-operative governance	• Collaboration between government departments	EDM	0	0	0	1	**1**
			CN	0	2	0	0	**2**
			GRNP	0	0	0	0	**0**
	Collaboration	• Formal and informal within the organisation and with other stakeholders (non-government)	EDM	0	0	0	0	0
			CN	0	2	1	0	3
			GRNP	0	14	0	0	14
	Knowledge acquisition / dissemination	• Individual responsibility and motivation • Reactive applications • Out of date policies • High turnover of procedure • Low staff turn over • Research and development	EDM	3	0	0	0	**3**
			CN	9	4	1	0	**14**
			GRNP	9	8	2	2	**21**
	Info flow hindered	• Silos • Lack of communication • Information hierarchy • Silver back mentality	EDM	0	6	3	3	**13**
			CN	3	8	0	0	**11**
			GRNP	7	17	7	7	**38**
	Not specific to environmental change	• Actions not linked to environmental change	EDM	1	1	1	0	**3**
			CN	2	5	1	0	**8**
			GRNP	1	0	0	1	**2**