**A Multi-Level Examination of The Role of Middle Managers in
Developing Absorptive Capacity: Towards a Theory of
Knowledge Utilization in Organizations**

A Dissertation

Presented to the Faculty of the Sprott School of Business

Carleton University

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

by

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January 26, 2004

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Abstract

A Multi-Level Examination of The Role of Middle Managers in Developing Absorptive Capacity: Towards a Theory of Knowledge Utilization in Organizations.

Gregory S. Richards

Carleton University, 2003

The purpose of this thesis was to contribute to the development of a theory of knowledge utilization (i.e., how knowledge is created, transferred and applied) in organizations. Despite years of research on this topic in a variety of disciplines, a theoretical framework of knowledge utilization in organizations is still in its infancy. This state of affairs is attributed to the complexity of knowledge itself, which makes it a difficult construct to study in an empirical manner (Grant, 1996; Spender, 1996; Alavi and Leidner, 2001; Schulz, 2003).

Over the past few years, the construct of absorptive capacity (ACAP), defined as the ability of organizations to recognize, capture and apply external knowledge (Cohen and Levinthal, 1990), has emerged as a conceptual basis for the development of a theory of knowledge utilization in organizations (Zahra and George, 2002). Theoretical development of ACAP, however, has not progressed much since its introduction into the organizational theory literature in the 1990s (Lane, Koko and Pathak, 2002). For example, existing research on ACAP tends to focus on firm-level aspects; very little has been done to examine ACAP at operational levels in the organization. Furthermore, although management practices have been identified as

a potential key influencer of ACAP (Zuboff, 1988; Nonaka and Takeuchi, 1995; Bartlett and Ghoshal, 1998; Zahra and George, 2002), few empirical studies have examined the impact of managers on ACAP in organizations.

To contribute to filling these gaps in the literature, this thesis was designed to examine the role middle managers play in building ACAP in work groups. Twenty-eight groups (179 individuals) from seven different public sector organizations participated in the study. Data were collected from work groups on 2 different occasions separated by approximately 6 months.

Results of the study support a model of ACAP in which higher-level middle managers were shown to influence the ACAP of work groups through behaviours that helped to clarify the organization's mission and vision. In addition, organizational culture and homogeneity of prior-related knowledge were shown to be significantly related to ACAP. Finally, the findings demonstrate that ACAP itself is a more complex construct than previously thought.

Acknowledgements

It has been said that writing a Ph.D thesis is a solitary task. This was not the case in this instance; I received a great deal of support from my committee, my family and my colleagues.

My thesis committee, comprised of Gerry Grant, Roland Thomas, David Cray, and Linda Duxbury was a great source of ideas and was always willing to provide advice when needed. Professor Duxbury, as my thesis supervisor, was the driving force keeping the process on track. I owe her a great debt of gratitude for her insights, inspiration and encouragement.

To my family: Audrey, my wife, and my children Cassandra and John, I extend sincere thanks for your unwavering support.

In terms of colleagues, I also extend thanks to Professor Swee Goh, who provided exceptional guidance before, during and after the process. Robin McNeill at Cognos Incorporated was a font of intriguing ideas; our deep conversations about performance in organizations were helpful in framing my approach to the study. Overall, it was an exceptional journey of learning and development that I could not have taken without the support of good friends and family.

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CHAPTER 1: Introduction

1.0 Background

The ability to use knowledge effectively is widely recognized as a core competence of contemporary organizations (Drucker, 1978, 1980; Hamel and Prahalad, 1994; Senge, 1990; Leonard-Barton, 1992, 1995; Grant, 1996; O'Dell and Grayson, 1998; Garvin, 1993, 2000; Von Krogh, Ichijo and Nonaka, 2000; Dixon, 2000, Schulz, 2001, 2003). The notion that the wise use of knowledge contributes to an organization's success however, has a long pedigree in organizational theory. Early in the 1900s, Frederick Taylor examined how procedural knowledge could be developed and used to improve productivity in organizations (Taylor, 1911; Wren, 1972; Drucker, 1980). Similarly, the publications of Max Weber (which became known to North American managers in the 1940s) addressed the appropriate application of knowledge and expertise within organizations (Wren, 1972; Schultz, 2001). Furthermore, the work of Herbert Simon (1945) and his colleagues stimulated decades of research on the use of managerial information systems to leverage knowledge effectively.

It is evident therefore, that since the early 1900s, managers and researchers have recognized the importance of knowledge as a contributor to organizational effectiveness. Contemporary organizations however, face a dramatic increase in the

volume and complexity of available knowledge (Maholtra, 1993; Nohria and Berkley, 1994; Nonaka and Takeuchi, 1995; Malone, 1998; Dixon, 2000). Accordingly, the issues that Taylor, Weber and Simon confronted in the early 1900s are compounded today because of the rapid increase in knowledge and the new competitive environment in which modern day organizations operate (Jarillo, 1993; Hammer and Champy, 1993; Hammer and Stanton, 1995;; Bettis and Hitt, 1995; Hesselbein et al., 1997). In this environment, organizations must work even harder to find ways of harnessing a rapidly growing base of knowledge. In short, they must find ways of creating, transferring and applying knowledge more effectively in order to maintain productivity and innovation.

A review of the literature in a number of diverse fields such as economics (Penrose, 1959; Nelson and Winter, 1982; Barney, 1995; Spender, 1996; Teece, 2000), strategy (Hamel and Prahalad, 1994; Andrews, 1997), information systems (Checkland and Howell, 1998; Alavi and Leidner, 2001) and organizational theory (Drucker, 1978, 1980; Nonaka and Takeuchi, 1995; Dixon, 2000) reveals a great deal of interest in identifying factors related to the effective utilization of knowledge in organizations. Topics such as the role of Research and Development in facilitating knowledge absorption (Cohen and Levinthal, 1990); inter-firm knowledge transfer (Zander and Kogut, 1995; Appleyard, 1996; Gupta and Govindarajan, 2000; Wang et al., 2001); transfer among Research and Development team members (Truran, 1998); knowledge transfer efficiency (Verkasalo and Lappalainen, 1998);

the role of weak ties between work units (Hansen, 1999); factors impeding transfer (Szulanski; 2000); integration of knowledge production and transfer (Schultz, 2001), the impact of knowledge sharing on outsourcing success (Lee, 2001), and the organization of practice-based knowledge (Dougherty, 2001) have been addressed. Despite this outpouring of research, however, a theoretical framework of how organizations create, transfer and apply knowledge¹ has not been developed (Spender, 1996; Gupta and Govindarajan, 2000; Schulz, 2003). For example, Spender (1996) argues that even basic questions such as what the output of effective knowledge utilization would be, and what organizational systems and processes affect the ability of an organization to utilize knowledge effectively have not been clearly articulated.

Over the past ten years or so, the construct of absorptive capacity (ACAP), introduced into the organizational theory literature by Cohen and Levinthal (1990), has been used by a number of researchers as a model for examining knowledge utilization within and between organizations (Boyton, Zmud and Jacobs, 1994; Szulanski, 1996, 2000; Lane and Lubatkin, 1998; Gupta and Govindarajan, 2000; Tsai, 2001; Matusik and Heeley, 2001). Cohen and Levinthal (1990, p. 128) originally defined ACAP as “. . .the ability to recognize the value of new information, assimilate and apply it...”. Based on a review of studies conducted since Cohen and

¹ Note: the term *knowledge utilization* (Hayek, 1945) will be used in this thesis to refer to the overall process of creation, transfer and application of knowledge.

Levinthal's original article, Zahra and George (2002) suggest that the construct of ACAP, with its three components of capturing, assimilating and applying knowledge, could form the basis of a sound theoretical framework explaining knowledge creation and use within organizations. Taking a similar viewpoint, Lane, Koko and Pathak (2002) suggest that ACAP is the most important construct to emerge in organizational theory over the past few decades.

At the moment however, development of ACAP as a construct is in its infancy (Gupta and Govindarajan, 2000; Matusik and Heeley, 2001; Zahra and George, 2002, Lane, Koko and Pathak, 2002). The early work by Cohen and Levinthal (1990) focused on ACAP at the firm level, and the main determinant of ACAP was modeled as expenditures in Research and Development. Although Cohen and Levinthal (1990) did suggest that other organizational processes play a role in ACAP at the firm level, very little research has been done to examine what these processes might be (Lane, Koka and Pathak, 2002; Zahra and George, 2002).

To contribute to a deeper exploration of the construct of ACAP, Zahra and George (2002, p. 186), proposed a reconceptualization of ACAP as a "dynamic organizational capability" developed through "...organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge...". This conceptualization also proposes a broad managerial role that includes influencing knowledge search patterns, identifying triggers for knowledge search,

and actively transforming knowledge within the organization.

The research conducted on ACAP thus far however, have not explored in great detail the underlying processes that develop ACAP in organizations (Lane, Koki and Pathak, 2002). A variety of issues have been examined such as the role of organizational climate (Boyton, Zmud and Jacobs, 1994; Szulanski, 1996; 2000), similarity between organizational structures of firms sharing knowledge (Lane and Lubatkin, 1998), and the role of formal integrative mechanisms in organizations (Gupta and Govindarajan, 2000). Most of these studies however, have been at the firm level and have not explored the mechanisms that influence ACAP at lower levels in the organization.

In addition, ACAP has been operationalized differently from study to study and in many cases modeled as an independent, not a dependent variable. In other words, much of the research assumes that ACAP can be measured through a variety of proxy indicators and used to predict other issues related to knowledge utilization, such as the efficient transfer of best practices. As Lane, Koka and Pathak (2002) point out, few studies have empirically examined the construct of ACAP itself. Finally, the reconceptualization of ACAP proposed by Zahra and George (2002) suggests that managers play a critical role in enabling development of ACAP, but research on management practices related to ACAP is exiguous.

In modern organizations, it is thought that middle managers are especially critical in enabling knowledge absorption within and among work groups (Kanter, 1982; Nonaka and Takeuchi, 1995; Janczak, 1999; Huy, 2002). Indeed, Zuboff (1988), Nonaka and Takeuchi (1995), and Bartlett and Ghoshal (1998) suggest that middle managers form the core of knowledge creation and utilization in modern organizations. Few empirical studies exist, however, that explore specific middle management practices that influence ACAP in organizations.

It has also been suggested that in contemporary organizations, work groups² are the main mechanisms through which knowledge in organizations is created, transferred and applied (Hedlund, 1994; Spender, 1996; Dixon, 2000). The literature, however, reveals very few group-based studies of ACAP. Accordingly, this thesis sought to examine empirically the construct of ACAP by exploring the role of middle managers (managers occupying a range of positions 2 levels below the head of the organization and 1 level above line workers and professionals) on ACAP within work groups.

² The term "work group" has been adopted to include the various forms of groups found in organizations. Accordingly, for the purposes of this thesis, the term refers to individuals working within an organizational sub-unit, or work teams who have specific responsibilities within the organization reporting to a common manager.

1.1 Objectives of the Thesis

Based on the foregoing, the objectives of this thesis were as follows:

1. To contribute to the theoretical development of knowledge utilization in organizations by examining factors that influence ACAP; and
2. To specifically examine middle management practices that influence the ACAP of work groups in organizations.

This thesis will have both theoretical and practical relevance. First, it will help to identify relationships among some of the organizational factors that are thought to influence ACAP in organizations. Second, it will provide guidance for the development and implementation of middle management practices that facilitate ACAP.

This thesis is expected to make a unique contribution in that it focuses on ACAP at the level of the work group, it specifically addresses the middle management cadre, and it uses a longitudinal research methodology. No existing research has examined ACAP in organizations from these perspectives.

1.2 Outline of the Thesis

Chapter 1 has provided an overview of the proposed research and identified the objectives of the study. Chapter 2 provides a review of the theoretical and empirical literature on ACAP and the role middle managers play in building ACAP in organizations. This chapter concludes with a critique of the literature and a description of the theoretical framework proposed for this study. Chapter 3 outlines the theoretical framework adopted for the thesis and the research hypotheses to be tested. Chapter 4 describes the methodology used, the sample and the analytic approach. Chapter 5 presents the results of the data analysis. Chapter 6 provides a discussion of the findings, and Chapter 7 outlines conclusions and recommendations for future research.

CHAPTER 2: Review of Literature

2.0 Introduction

Verkasalo and Lappalainen (1998) identify 3 schools of thought that address knowledge utilization in organizations. The "core competence" school includes the strategy and economics literature, which examine factors that create competitive advantages for firms. The "knowledge base" school addresses the use of information systems in developing knowledge repositories in organizations. The emerging literature on Knowledge Management is representative of this school of thought. The third school of thought, referred to as "knowledge creation" includes research on how knowledge is created and transferred in organizations. This school encapsulates the literature on organizational learning and on knowledge creation and transfer. These schools of thought are not mutually exclusive as there is considerable conceptual overlap among them. This categorization is useful, however, in that it provides a general topography of the literature that was reviewed for this thesis.

Various theoretical models exist within each of the three schools of thought. Generally speaking, most of the empirical research related to knowledge utilization in organizations however, has been conducted in the "knowledge base" and

"knowledge creation" schools. The concept of ACAP falls within the research area of knowledge transfer, which in turn is within the general domain of knowledge management (Johnson, 2000; Birkinshaw, 2001; Meckler, 2001). Accordingly, ACAP is a topic that appears to bridge the core competence, knowledge base and knowledge creation schools of thought.

In each of the schools of thought, the literature is voluminous. This thesis does not profess to provide a comprehensive review in each area; rather, a cross-sectional look at the major themes emerging from each of the schools of thought that address the concept of ACAP will be provided. Accordingly, this review of literature is necessarily selective: it will focus only on literature that is directly relevant to the proposed theoretical framework developed for this thesis.

The chapter begins by defining the term "knowledge" as it is used in this thesis. Next, to provide a context for the theoretical framework developed in the study, the role of knowledge in organizations as it appears in the "core competence" school is discussed. This is followed by a brief overview of core themes in the knowledge management literature (which integrates literature from the knowledge base and knowledge creation schools of thought). Next, the historical development of ACAP is discussed followed by selected empirical studies on the broader topic of knowledge transfer. This part of the review was done in order to identify additional factors that, according to the research, appear to influence ACAP. A review of research into

the potential roles of middle managers in knowledge utilization in organizations is then presented. The chapter concludes with a critique of the current literature.

2.1 Definition of Knowledge used in this Study

Most studies in which the concept of knowledge is involved begin with a definition of the term. These definitions are an important starting point because many different conceptions of knowledge are available. For example, Machlup (1980), who has produced possibly the most comprehensive report on the role of knowledge in North American society, identified 15 different definitions of knowledge and outlined 33 different ways of looking at how knowledge is used in society.

The Organization for Economic Corporation and Development (2000) developed a taxonomy of knowledge terms that provides a number of definitions helpful in situating the construct of ACAP in the broader domain of knowledge in organizations. This taxonomy includes the following:

- Know-what: data or discrete facts (i.e., explicit knowledge (Nonaka and Takeuchi, 1995) or declarative knowledge (Gupta and Govindarajan, 2000; Szulanski, 2000)).
- Know-how: experiential knowledge (tacit or procedural knowledge).

- Know-why: a category that seems to bridge know-what and know-how...understanding why things happen, or why certain procedures work in certain circumstances and not in others would fall into this category.

This taxonomy provides a vocabulary that enables positioning of the construct of ACAP within the terminological morass that is typically encountered in research related to knowledge. ACAP refers to the assimilation and application of knowledge. Application of knowledge implies "know-how". "Know how" in turn, might draw on a number of other categories of knowledge such as "know-why" or "know-what". The connotations of the various terms notwithstanding, the important point is that "know how" closely resembles the meaning of ACAP in that it implies an ability to assimilate and apply knowledge.

In a similar vein, O'Dell and Grayson (1998, p. 5) suggest that, as far as organizations are concerned, "Knowledge is information in action". Dixon (2000, p. 13) argues that, "Knowledge...is defined as the meaningful links people make in their minds between information and its application in action in a specific setting". The problem with this definition is that when people make "meaningful links" in their minds, the knowledge created is not readily observable. It may exist as tacit knowledge (Polanyi, 1966), but in the absence of observable action, one is hard pressed to determine if new knowledge has in fact been assimilated.

Nonaka and Takeuchi (1995) address the tacit-explicit problem by suggesting that a conversion cycle exists in that tacit knowledge is converted to explicit knowledge and vice-versa during the process of knowledge creation. Both types of knowledge are used to inform action, which is the outcome of interest as far as the organization is concerned.

This "action-oriented" approach to defining knowledge within an organizational context has been adopted by a number of researchers. Nonaka and Takeuchi (1995), for example argue that information is a flow of messages; knowledge is created by this flow of information when the information is assimilated in the current beliefs of the individual. This approach emphasizes the fact that ". . .knowledge is essentially related to human action" (Nonaka and Takeuchi, 1995, p. 58).

Based on the foregoing, the overall conception of knowledge used in this thesis reflects the "action orientation" proposed in the definitions provided by Nonaka and Takeuchi (1995), O'Dell and Grayson (1998) and Dixon (2000). Knowledge was defined simply as "information that can be assimilated and applied to a person's work". This definition implies that a mixture of tacit and explicit knowledge is used to enable action (Nonaka and Takeuchi, 1995; O'Dell and Grayson, 1998; Cook and Seely-Brown, 1999) therefore, for the purposes of this thesis, no distinction was made as to whether knowledge is tacit or explicit.

2.2 Overview of the Role of Knowledge in Organizations

As discussed earlier in this thesis, the recognition that knowledge plays an important role in organizational success is not a recent phenomenon. The issue was first addressed by management theorists in the early 1900s (Taylor, 1911; Wren, 1972). Within the economics and strategy literature, questions about how firms differentiate themselves in the marketplace, and the concept of the “core competence” of the organization, popularized by Hamel and Prahalad (1994) helped to focus this discussion on the complex interaction of organizational process and individual skills and competencies. Two main themes emerge from this discussion that are of importance to this thesis. First, the concept of “routines”, and the role of management in developing routines suggest that managers play a critical role in leveraging knowledge in organizations. Second, the fact that knowledge resides in two main areas in the organization: in the heads of employees and captured within organizational systems and processes, suggests that leveraging knowledge within firms requires interventions at both the individual and systemic levels.

The underlying dynamics of why firms exist, how they grow and why they succeed are some of the key themes addressed by industrial economics. Orthodox economics however, considered firms as decision-making “black boxes”; the specific operational processes within the organization were not often addressed. Later developments in economics focused on how decisions were made and the role of management in the

overall process of strategy making. Edith Penrose (1959) was one of the early economists who began to explore the internal dynamics of the firm in more detail. Penrose pointed out that the resources of a firm are only useful in that they provide a service to the organization. How a firm links these resources together, therefore, has a significant impact on its performance. Firms who are better, or more creative, in establishing productive linkages can achieve sustainable competitive advantages in the marketplace (Nelson and Winter, 1982; Nelson, 1994).

This discussion gave rise to the resource-based view of organizational strategy, which suggested that most of the resources a firm uses to create competitive advantage are intangible—largely centered on the skills and knowledge of employees. The processes that emerged when these resources were linked together were referred to as “routines” by Nelson and Winter (1982). Similarly, Hamel and Prahalad (1994) introduced the concept of “core competencies”, defined as a bundle of skills, technologies, and a means of integration of these resources. As such, the core competency concept is consistent with Nelson and Winters’ idea of “routines” in that both suggest that individual knowledge and technology form critical resources of the firm. How these resources are linked together influence the way in which the firm performs. It is the role of managers to create these routines—systems of interrelationships among resources that enable high productivity and in the long run, sustainable competitive advantage (Nelson and Winter, 1982; Andrews, 1997). Indeed, Andrews (1997) suggests that the principal knowledge-based resources of a

firm are technical competence and managerial skill, with managerial skill thought to be more important in terms of conferring competitive advantage to an organization. Mata, Fuerst and Barner (1995), in discussing the competitive advantage provided by information technology, also argue that the path to sustained competitive advantage lies primarily in the skills managers possess to integrate technology into day to day operations.

While the foregoing discussion did much to focus attention on internal resources of the firm and the capability of the management cadre to integrate these resources, Nelson and Winter (1982) also introduced the notion of dynamic capabilities. In essence, the concept of dynamic capabilities suggests that to remain competitive a firm must continually invent new routines or core competencies. To do so, firms need to import new knowledge in order to continually update routines in response to changes in the marketplace. Thus, the firm's ability to absorb knowledge and integrate this knowledge into productive routines is seen as an important capability enabling sustained organizational success.

In summary, this brief review of the core competence school, which embraces the industrial organization economics and strategy literature, points out that the role of knowledge in the firm is manifested at two levels: resident in the heads of employees, and integrated into organizational routines. Managerial skill is thought to be an important factor enabling the development of routines that leverage employee

skills and knowledge. Importation of knowledge is important if routines are to be adapted to changing conditions.

2.3 An Overview of Knowledge Management

This overview discusses the literature on knowledge management as it relates to ACAP.

Although a number of consulting firms have been implementing knowledge management systems since the mid 1970s, (Galagan, 1997, Hansen, Nohria and Tierney, 1999), the field of knowledge management fully emerged as a focus of study in the early 1990s (Leibowitz, 1999, Birkinshaw, 2001). Since that time, a number of definitions of knowledge management have been proposed:

"Knowledge management is the process of capturing a company's expertise...and distributing it wherever it can produce the biggest payoff."

(Leibowitz, 1999; p. 16).

"A conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in

ways that strive to improve organizational performance” (O’Dell and Grayson, 1998; p. 6).

“Knowledge management is seen as techniques used to facilitate the flow of knowledge into and within the organization” (Birkinshaw, 2001; p. 33).

Teece (2000), recapitulates the essence of these definitions in proposing three broad objectives of knowledge management systems:

1. improved storage capacity;
2. improved access to stored information; and
3. enhancement of the organization’s knowledge environment.

According to Teece the first two objectives are typically accomplished through the use of information technology (IT). The third requires development of a supportive cultural atmosphere as well as processes that enable and encourage knowledge development and transfer. The outcome, as implied by the definitions quoted above, is that knowledge is readily available and accessible for use by people in the organization.

In a recent review of the knowledge management literature, Alavi and Leidner (2001) summarized the various approaches to knowledge management in a

framework that identified 3 common factors: coding and sharing of best practices, creation of corporate knowledge directories, and creation of knowledge networks. According to the authors, the overall objective of the knowledge management system is to enable the organization to better create, transfer and apply knowledge; in other words, to facilitate knowledge utilization (as the term has been defined in this study).

In a discussion of the strategic aspects of knowledge management, Hansen, Nohria, and Tierney (1999), defined two strategic approaches which they referred to as the "personalization" and "codification" models. The personalization approach relies primarily on connecting people within an organization to enable information sharing. The codification approach relies on the use of IT to store and disseminate information. The authors argued that most firms include a mix of both personalization and codification processes.

The key observations to be drawn from this literature are that knowledge management practices include the development of repositories of knowledge and the capability to efficiently transfer this knowledge to users, usually through some technological system. The "environment" of the organization however (Hansen, Nohria and Tierney; Teece, 2000), also needs to be developed such that people have the capability and motivation to capture and apply knowledge. This viewpoint is shared by authors such as Engelbart (2000), who argues that the "human system"

in organizations must keep pace with the evolution of information technology tools. A similar argument is made by Davenport (2000) who suggests that most organizations find it easier to deal with the technological aspects of knowledge management than with the human factors. Similarly, Bontis (2001) argues that most organizations leverage only 2% of the knowledge available within the enterprise due in part to the lack of attention they pay to the human element.

Following these arguments, the definition of ACAP as the ability to recognize, capture and apply knowledge suggests that it reflects the capability of an individual or organization to capture and apply knowledge available in the knowledge management systems or from other sources (inside or outside of the organization). Accordingly, ACAP can be positioned as a component of knowledge transfer (i.e., the receiving end according to Suzlanski, 2000), and can be seen as representing the "personalization" component of a knowledge management strategy. That is, while knowledge management is about developing systems to store and transfer knowledge, ACAP represents the processes (primarily human) that enable capture and application of knowledge. Indeed, given that the advancement in information technology allows organizations to easily store and transfer large amounts of knowledge, ACAP could well represent the key component of knowledge management initiatives.

2.4 Absorptive Capacity

This section discusses the historical development of the construct of ACAP. It then provides a description of the modern understanding of the term and introduces empirical research that has helped to frame this understanding. Relevant research on the broader topic of knowledge transfer is then discussed.

2.4.1 Historical Development of ACAP

Cohen and Levinthal (1989, 1990) first identified the concept of ACAP (as it applies to organizations) in an investigation of how organizations capture information from external sources. Their research sought to add to the theoretical development of the concept of organizational learning, which up until then was primarily focused on learning curve theory.

Learning curve theory has been a feature of the economics literature since the early 1950's (Wright, 1953). The basic idea behind learning curves was that companies developed experience with a particular operational process allowing them to decrease costs or increase outputs over time (Ross, 1986; Cohen and Levinthal, 1989; Argote, Beckman and Epple, 1990; Adler, 1990; Darr, Argote and Epple, 1995). Research in this area typically applied mathematical models to determine the effects of experience that allowed an organization to improve performance. The

general form of the mathematical model is $y=ax^{-b}$ where y represents production cost per unit, a represents the cost of producing the first unit, x represents the cumulative number of units produced and b is a parameter measuring the rate at which costs are reduced as production increases. Learning is not usually measured directly, but is implied from the fact that production costs decrease as cumulative output increases (Darr, Argote and Epple, 1995).

While learning curves are an important aspect of organizational learning, the concept is related to improvements in efficiency over time due to accumulated experience. Cohen and Levinthal (1989) introduced the concept of ACAP to represent a different type of learning—learning that could lead to innovations in work routines. According to Cohen and Levinthal (1989, 1990), this form of learning usually requires capturing new information from external sources and integrating it into current work routines. In this case, efficiencies are gained by applying knowledge in new and innovative ways rather than through incremental changes over time.

2.4.2 Modern Understanding of ACAP

An overview of the key studies on ACAP covered in this thesis is provided in Table 1. To show how the construct of ACAP has developed to the point in time the research for this thesis was conducted, the studies are arranged in chronological order. A quick scan of the studies in this table reveals two key points: (1) ACAP is operationalized and measured in many different ways, and (2) ACAP is typically treated as an independent variable: very few studies examine the factors that influence ACAP. The studies identified in Table 1 are discussed in more detail in the remainder of this section.

Table 1: Overview of Studies on ACAP

Author	Operationalization of ACAP	Data Collection/Sample
Cohen and Levinthal (1990)	R&D expenditure.	R&D expenditures from 1719 business units in 319 firms. Likert scale questionnaire data from previous study on lab managers used to assess degree of use of external knowledge sources.
Boyton, Zmud and Jacobs (1994)	Manager's IT-related knowledge and the organization's IT process effectiveness.	Data collected from 132 companies.
Lane and Lubatkin (1998)	Perceived learning of one partner in an alliance.	Data collected from 69 alliances in the pharmaceutical industry measured on a Likert scale.
Verkasalo and Lappalainen ³ (1998)	Efficiency index of knowledge transfer over time measured as time it took to distribute information to people within the organization.	Pre-post questionnaire assessing number of people within one organization reached by specific types of knowledge distribution strategies.
Szulanski (2000)	Ability of individuals to absorb knowledge.	Likert scale used to collect data on various barriers to the transfer of 38 best practices among 8 companies.
Gupta and Govindarajan (2000)	The number of parent country nationals working in subsidiaries used as an index of parent company knowledge available to the subsidiary.	Likert scale and company records. Interviews with company staff used to clarify questionnaire data.
Tsai (2001)	R&D expenditure.	Likert questionnaire used to collect data on network centrality of business units and company records to collect data on R and D expenditure and number of innovative products marketed.
Stock, G.N., Greis, N.P., Fischer, W.A. (2001)	R&D expenditure.	Data collected from company records.
Matusik & Heeley (2002)	At the individual level, measured by the percentage of employees who have certain skills and knowledge. At the organizational level, measured by the presence of routines and structures that facilitate integration of knowledge. At the firm level, measured by R&D expenditure.	Questionnaires used to collect data from senior managers in the organizations.

³ Please note, although Verkasalo and Lappalainen's study did not specifically use the term "ACAP", the study examined the ability of work groups to absorb knowledge and so is included in this table.

2.4.2.1

Cohen and Levinthal's "Ease of Learning"

Figure 1: Cohen and Levinthal's "Ease of Learning" Model

Figure 1 depicts the theoretical framework used in Cohen and Levinthal's (1990) study of ACAP. The rationale behind this model can be summarized as follows: an organization's Research and Development (R&D) expenditures will develop firm-specific technical knowledge. R&D expenditures will also develop ACAP because investment in R&D provides a base level of knowledge that allows the firm to recognize and capture new knowledge from the industry and from competitors. This knowledge adds to the firm's base of technical knowledge.

Cohen and Levinthal's study (1990) suggested that the amount a firm invests in R&D depends, in part, on the complexity of knowledge to be absorbed and the rate of change of this knowledge. The study addressed a number of issues, but the main hypothesis of importance to this thesis is that the type of knowledge a firm needs to acquire (categorized as "easy to learn" vs "difficult to learn") will have an influence on how much firms invest in R&D.

Historical data from 1719 business units in 319 firms were used to conduct the analysis. ACAP was operationalized as R&D expenditures. The results of this study showed that firms who relied on more complex knowledge from the industry and from competitors tended to invest more heavily in R&D in order to better understand this knowledge. In other words, investment in a base level of knowledge (i.e., prior-related knowledge⁴) in firms varied according to the complexity of knowledge the firm needed to acquire.

Cohen and Levinthal's (1990) work provided the basic theoretical model of ACAP used in a number studies, including this thesis. It introduced the construct of "prior-related knowledge" to the field of organizational knowledge transfer and demonstrated that the degree to which an organization invests in the development of ACAP is influenced by the complexity of knowledge used in the organization. Although Cohen and Levinthal (1990) did not examine in great detail factors other

⁴ Prior-related knowledge refers to knowledge already existing in the firm.

than R&D that influenced ACAP, they did suggest that the organization would also have to invest in ways of disseminating knowledge to ensure that it reaches the people who need to use it.

2.4.2.2 Boyton, Zmud and Jacob's Structural Equation Model

Figure 2: A Structural Equation Model of ACAP

Boyton, Zmud and Jacob (1994) examined factors that influenced IT use in large organizations. As shown in Figure 2, the authors operationalized ACAP as two separate but related constructs: managerial IT knowledge and IT process effectiveness. They hypothesized that IT management climate (i.e., whether the culture of the organization was positive or negative towards the use of IT in general) would influence both aspects of ACAP which in turn would influence IT use in the organization.

The constructs were measured through questionnaires sent to senior IT managers in 132 large organizations. Factor analysis of responses to the climate questionnaire revealed three main types of climate:

- organic climates: characterized by clarity of mission around the use of IT, planning and commitment to IT proliferation, and a tendency towards information sharing among work units,
- “temporary” climates: characterized by a project-based mentality towards IT and;
- mechanistic climates: characterized by centralized decision making and the use of standard operating procedures related to IT.

A Structural Equation Model was developed to examine relationships among the variables included in the theoretical framework (see Figure 2). The results showed that organic climates were more positively related to managerial IT knowledge than mechanistic or temporary climates. In addition, ACAP was also shown to be positively related to IT use.

This study has a number of implications for this thesis. First, instead of using R&D expenditures as an indicator of ACAP, Boyton, Zmud and Jacob (1994) used a measure of managerial knowledge. Second, the study provides some evidence that

organizational culture has an influence on ACAP. Third, it introduces the notion of management process effectiveness as an element of ACAP. Accordingly, the study suggests that organizational culture and management practices may influence ACAP. It also provides precedence for operationalizing ACAP as individual knowledge and using questionnaires as a measurement tool.

2.4.2.3 Lane and Lubatkin's Relative ACAP

Figure 3: Lane and Lubatkin's Dyadic Model

Lane and Lubatkin (1998) examined relative ACAP between learning dyads. In this context, one firm was recognized as the teacher, the other as the student. As depicted in Figure 3, the authors argued that the type of knowledge being transferred, the degree of similarity in the firms' compensation and organizational structures, and the student firm's familiarity with the teaching firm would all have a

role to play in determining how well knowledge was transferred. They tested this model by studying 31 alliances between biotech (teachers) and pharmaceutical (students) firms.

Relative ACAP was assessed through the use of a panel of industry experts familiar with each firm in the dyad and with the results of the alliance. The predictor variables shown in Figure 3 were measured through a combination of archival data and questionnaires distributed to managers in the participating organizations.

The results demonstrated that similarity of basic knowledge and compensation practices were significantly related to relative ACAP. This study supports the concept introduced by Cohen and Levinthal (1990) that a base level of knowledge has an influence on ACAP. It also addresses the role of management practices (i.e., compensation systems) in developing ACAP between the organizations. Accordingly, the study expands the conceptualization of ACAP beyond R&D expenditure and provides support for the role of management practices and prior-related knowledge as possible determinants of ACAP.

2.4.2.4 Verkasalo and Lappalainen's Transfer Efficiency Model

Verkasalo and Lappalainen's (1998) study focused on internal transfer of knowledge within Nokia Telecommunications in Finland. The objective of this study was to

develop a computer-based system to monitor and to improve the rate at which employees absorbed knowledge about the company's business plans.

They characterized the knowledge transfer process as including the following five phases:

1. acquisition;
2. documentation;
3. transmission;
4. receiver; and
5. receiver perception.

The overall logic behind their study was that each of these phases could experience delays, thus compromising the efficiency of knowledge transfer. The authors' intention was to utilize IT to improve the speed of knowledge transfer and ultimately, to determine if employees could absorb knowledge of their organization's business plan more effectively using this medium.

Their research, which included monitoring how efficiently business plan information was transferred within Nokia, developed mathematical formulae for issues such as process delay, transfer width and transfer quality. They found that the use of electronic tools can speed up knowledge transfer of certain types of information.

However, the authors also suggested that while certain types of information can be transferred efficiently through the use of tools such as hypertext media, organizational factors also play a role in how quickly this information spreads.

From a theoretical perspective, this study helped to solidify the conception of knowledge transfer as a phased process as well as to introduce an objective view of how to monitor and improve knowledge transfer. Thus, Verkasalo and Lappalainen's study is relevant to this thesis in that it provides a methodology related to measuring knowledge transfer over a period of time, and it suggests that employees' ability to absorb knowledge efficiently could be dependent on the source used to disseminate such knowledge.

2.4.2.5 Szulanski's "Stickiness" Factors

Figure 4: Szulanski's Stickiness Model

Szulanski (2000) studied factors that impeded intra-firm knowledge transfer. He reasoned that certain factors promoted "stickiness", that is, slowed down knowledge transfer. His study explored in detail what aspects of an organization accounted for stickiness at various phases of the knowledge transfer process which he suggested included four main stages: initiation, implementation, ramp-up and integration.

Eight firms participated in the research, which included 38 instances of best practices transfer. Data was collected through questionnaires received from the source, from the recipient and from a third party to the transfer.

Szulanski's model identified 10 potential factors that could impede knowledge transfer. Key results of interest to this thesis are provided in Table 2 (numbers in the table represent standardized beta coefficients).

Table 2: Key Results, Szulanski (2000)

Variable	Stages in the Knowledge Transfer Process			
	Initiating	Implementing	Ramp-up	Integrating
Causal Ambiguity	0.20***	0.23***	0.24***	.016**
Organizational Context	-0.04	-0.06	0.21***	0.21***
Recipient lacks ACAP	0.11	0.47***	0.49***	0.45***
** p<.05; *** p<.01				

Causal ambiguity refers to the level of uncertainty of the sender or recipient of the real causes behind the success of the practice (Szulanski, 2000). *Organizational context* refers to whether the organization's environment was "barren" or "fertile" with respect to support for knowledge transfer⁵. Questions related to this construct included the degree to which performance is emphasized in the organization, and whether learning from other units is encouraged and supported. ACAP was defined, following Cohen and Levinthal (1990), as the ability to assimilate and apply new information. It was measured through a survey asking recipients about their existing knowledge with respect to the practice to be transferred.

⁵ Organizational context is thought to be identical to organizational culture. According to Ghoshal and Bartlett (1994) "organizational context", as defined in the strategy literature, is referred to as organizational culture in the organizational theory literature.

In terms of results, Table 2 shows that causal ambiguity and ACAP of the recipients were significantly related to stickiness. Szulanski (2000) felt that since both of these factors involve knowledge-related issues, the results suggest that the success of intra-firm knowledge transfer is strongly related to the state of prior-related knowledge. The study also found that organizational culture was a significant predictor of knowledge transfer stickiness in latter stages of the transfer process.

The results of Szulanski's (2000) study supports the knowledge management framework developed by Hansen, Nohria and Tierney (1999) which suggests that development of tools to facilitate information storage and dissemination needs to be balanced with development of a culture supportive of knowledge transfer. In terms of relevance to this thesis, Szulanski's (2000) findings support an examination of both prior related knowledge and organizational culture as potential determinants of ACAP.

2.4.2.6

Gupta and Govindarajan's "Flow of Knowledge"

Figure 5: Gupta and Govindarajan's Flow of Knowledge Model

The framework developed by Gupta and Govindarajan (2000) is depicted in Figure 5. It is a fairly complex model, accordingly this review will focus only on aspects of significance to this thesis namely: how the authors operationalized ACAP, what organizational factors influenced "knowledge inflows" and the results of the study as they pertain to objectives of this thesis.

The authors studied the transfer of procedural knowledge (i.e., "know how") among divisions in six Multi-National Corporations (MNCs). The objective of this study was to explore factors that impede or facilitate transfer between the parent organizations

and its subsidiaries. The study included 374 respondents from MNCs in Europe, the United States, and Japan. Data collection included interviews with subsidiary presidents and questionnaires distributed to directors and managers in company divisions in the US, Europe, and Japan.

In the study, ACAP was operationalized as "mode of entry" into the particular country ("greenfield" start-up vs acquisition), and as the proportion of local nationals in the subsidiary's top management team. In other words, the authors felt that both of these factors contributed to ACAP of the organizational units. The rationale behind using "mode of entry" as a measure of ACAP was that if a subsidiary had been acquired by the parent company, personnel in that subsidiary would not have deep knowledge of the organization, its culture and its operational practices. If, however, the subsidiary had been developed as a greenfield unit (i.e., started from scratch as opposed to being acquired), then personnel would tend to have more knowledge of the parent company. The authors also argued that with a greenfield startup, personnel would likely know each other and the individuals in the parent company well and that this relationship would enable knowledge transfer. Fundamentally, "mode of entry" could be construed as another way of assessing the amount of prior-related knowledge present in the subsidiary and the closeness of the relationships among employees.

The rationale behind using the relative proportion of local versus expatriates (i.e., managers from the parent corporation) as a measure of ACAP, was the argument that a heavier concentration of expatriate managers in the top management team would increase the amount of company knowledge resident in the subsidiary. That is, expatriates would have more parent-company knowledge; therefore, if a subsidiary had a high proportion of expatriates, it would also tend to have a high degree of company knowledge. Accordingly, this variable also could be construed as a measure of prior-related knowledge.

The organizational factor included in the study was the existence and richness of transmission channels. Galbraith's (1973) concept of formal integrative mechanisms (liaison positions, task forces, and permanent committees) was used as a model for identifying these transmission systems.

Knowledge flow, the dependent variable, was measured by surveying respondents to find out how much knowledge they had received from various sources. Table 3 presents the results related to knowledge inflows to a subsidiary. "Mode of entry", was not significantly related to knowledge inflows from peer subsidiaries. It was however, significantly related to inflows from the parent corporation. What this suggests is that subsidiaries with a better base of parent company knowledge tended to absorb knowledge more effectively than those without this base.

With respect to knowledge transfer from peers, no difference between the two modes of entry was noted.

Table 3: Key Results, Gupta and Govindarajan, 2000

Variable	Knowledge inflows from peer subsidiaries	Knowledge inflows from parent corporation
Mode of Entry	0.071	-0.165*** ⁶
Locals in Top Management Team	0.101	-0.009
Formal Integrative Mechanisms	0.167***	0.182***

The percentage of expatriates in top management appeared to have no impact on knowledge flow, but the existence of formal integrative mechanisms was significantly related to knowledge inflow from both peer subsidiaries and from the parent organizations.

The key findings of importance to this thesis therefore, are that current knowledge of the parent company (i.e., prior-related knowledge) and organizational processes that build relationships between organizational units represent components of ACAP. These results support those noted by Cohen and Levithan (1990), Lane and Lubatkin (1998), and Szulanski (2000) that prior-related knowledge does seem to form the building block of ACAP within organizations. This research also suggests

⁶ The negative relationship here indicates that greenfield subsidiaries tended to receive more information from the parent corporation.

that mechanisms that develop relationships among teams within the organization are needed in order to help integrate new knowledge within and across organizational units.

2.4.2.7 Tsai's "Network Centrality" Model

Figure 6: Tsai's Network Centrality Model

Tsai (2001) investigated the concept of knowledge access and ACAP in intra-organizational networks. Tsai argued that ACAP has an influence on business performance and innovation in organizations, but ACAP is not of much use if sub-units within the organization do not have access to knowledge. Tsai's model, depicted in Figure 6, postulates that network centrality⁷ determines how much well sub-units could access knowledge. In addition, ACAP, operationalized as R&D

⁷ Network centrality was defined as the amount of interaction an organizational sub-unit had with other sub-units. The higher the interaction, the more central the sub-unit was thought to be within the network of other sub-units.

expenditure, was thought to influence the ability of the sub-unit to absorb knowledge. Access to knowledge and the ability to absorb knowledge were hypothesized to be processes through which network centrality and ACAP influenced business performance and innovation.

Tsai collected information from 120 business unit leaders in two multinational companies. Dependent variables were business performance (profitability) and innovation (number of new products created). Information from company records provided measures for these variables.

The independent variables were defined as the work unit's position in the network (i.e., centrality) and ACAP. Following Cohen and Levinthal (1990), R&D expenditure was used as a measure of ACAP, and network position was measured by asking respondents to identify from whom they received information and to whom they sent information. Work units with the most transactions with other work units were thought to be more centrally situated within the company.

The results indicated that ACAP was significantly related to both innovation and business performance. Moreover, an interaction effect between ACAP and network position was noted suggesting that as centrality increased, ACAP became more important to successful knowledge transfer. Tsai (2001) reasoned that as network centrality increased, the amount and complexity of knowledge of importance to the work unit also increased calling for more investment in ACAP.

Tsai's study has relevance to this thesis in that it supports the results noted by Cohen and Levinthal (1990), Lane and Lubatkin (1998), Szulanski (2000) and Gupta and Govindarajan (2000) that prior-related knowledge does have an impact on ACAP. It also suggests that other organizational factors, in this case network centrality, influence the ability of work units to absorb knowledge.

2.4.2.8 Stock, Greis and Fischer's Product Development Model

Figure 7: Stock, Greis and Fischer's Product Development model

Stock, Greis and Fischer (2001) examined the influence of ACAP on the effectiveness of product development. Using archival data from 131 firms in the computer modem industry, they hypothesized that ACAP (as measured by R&D expenditures) would be positively related to product development effectiveness. They measured the dependent variable in terms of the baud rate of modems over a 23-year period (1970-1993) reasoning that more effective product development would lead to faster modem speeds.

The authors found that ACAP was correlated with product effectiveness, but that the linear model explained only a small percentage of variance. A curvilinear model showed a better fit however, suggesting that ACAP influences product development effectiveness, but only to a certain point after which it appears to have a deleterious effect. Stock, Greis and Fischer (2001) postulate that the law of diminishing returns, a phenomenon which applies to many different types of process improvement methods, may also apply to ACAP.

2.4.2.9 Matusik and Heeley's Multi-Level Model.

Figure 8: Matusik and Heeley's Multi-Level Model

Matusik and Heeley's (2002) model positions ACAP as a multi-level construct comprising of individual, organizational and firm-level components. The study is relatively complex, accordingly the discussion that follows focuses on the key issues as they relate to this thesis, namely that ACAP was shown to be a multi-level construct.

As depicted in Figure 8, Matuzik and Heeley argued that ACAP influences the firm's current level of knowledge as well as its knowledge creation activities. That is, ACAP is responsible for how much knowledge the firm currently holds, as well as how it pursues the acquisition of new knowledge.

ACAP was measured at individual, organizational and firm levels. At the individual level, ACAP was measured as the percentage of employees in the organization with knowledge of state of the art technical practices. At the organizational level ACAP was measured as the number of formal and informal structures in place to absorb knowledge. At the firm level, ACAP was measured as two different variables: current knowledge available in the firm and the degree to which the firm was exposed to external knowledge.

To test this model, the authors conducted a survey of 293 firms in the software industry. Results of the study indicate that ACAP at different levels: individual,

organizational and firm, did influence the stock of knowledge and the firm's knowledge creation activities.

As is the case with most of the other studies involving ACAP, this research did not specifically examine the factors that comprise ACAP. Rather, the argument that ACAP influences the amount of knowledge stored and created within the firm was examined. The operationalization of ACAP was similar to that used by Gupta and Govindarajan (2000): measures of individual prior-related knowledge along with organizational structural or process factors. Accordingly, this study provides support for the conclusions noted earlier in this thesis, that ACAP appears to be comprised of some form of prior-related knowledge along with organizational processes that facilitate knowledge capture and transfer. More importantly, Matuzik and Heeley (2001) were the first to specifically model ACAP at different levels within a firm.

2.4.2.10 Summary

The main conclusion to be drawn from a review of these studies is that prior-related knowledge, operationalized in a number of different ways, appears to be related to ACAP. However, the studies also imply that a number of other factors could influence ACAP. These factors are summarized as follows:

- Cohen and Levinthal's (1989, 1990) study found that "ease of learning" of external information influences investment in ACAP. This finding suggests that the type of knowledge to be gathered has an impact on how well organizations absorb knowledge.
- Boyton, Zmud and Jacobs (1994) demonstrated the impact of organizational climate (culture) on ACAP.
- Szulanski's (1996, 2000) study concluded that ACAP of the recipient is important, but that organizational culture also influences the effectiveness of knowledge transfer.
- Gupta and Govindarajan's (2000) results indicated that the existence of certain types of communication channels might have an influence on knowledge flow.
- Tsai's (2001) research demonstrated that as the need to capture knowledge from many different sources increases, investment in ACAP also increases.
- Stock, Greis and Fischer's (2001) research showed that ACAP can influence product development effectiveness, but that the relationship is curvilinear with diminishing returns after a certain level of investment in ACAP is reached.
- Matusik and Heeley (2002) demonstrated the multi-level nature of ACAP and the influence of current knowledge within the organization on organizational level knowledge creation.

Given that each of these studies used different theoretical frameworks, however, there is no clear pattern in the findings that would provide guidance on which of the variables included in these various studies (apart from prior-related knowledge, which itself has been measured in many different ways) are of real importance to the development of ACAP. The following section reviews a number of studies on knowledge transfer (i.e., they do not specifically address the construct of ACAP, but address the broader concept of knowledge transfer) that help to clarify this issue.

2.5 Review of Key studies on Knowledge Transfer

This section reviews a number of key studies that, while not addressing ACAP directly, do address the broader topic of knowledge transfer. Accordingly, they shed further light on factors that could influence ACAP. The studies are categorized in into three main groupings:

- role of organizational culture,
- complexity of information, and
- sources of information.

2.5.1 The Role of Organizational Culture

The three studies reviewed in this section (Hansen, 1999; Yeung et al, 1999; Ribiere, 2001) address the role of organizational culture on knowledge transfer. All

three support the notion that organizational culture can have a strong influence on ACAP. Hansen's (1999) study suggests that the closeness of relationships among people in organizations can have either positive or negative impact on knowledge sharing efficiency. Yeung et al (1999) and Ribiere (2001) provide information on the types of organizational cultures that seem to influence knowledge absorption efficiency.

Hansen (1999) explored the impact on knowledge transfer of the relationships between people in organizations. His basic hypothesis was that strong relationships ("strong ties") between people promote better transfer of complex knowledge. He also proposed that weaker relationships ("weak ties") might be better for exploitation of new information since groups with strong ties would likely share similar knowledge and thus might not recognize the importance of new information.

Hansen conducted field research in a large multi-divisional electronics company to explore the effect of weak ties and knowledge complexity on transfer of knowledge between sub-units. The dependent variable used was project completion speed. He assessed the strength of inter-unit relationships by asking employees in 41 sub-units in the organization to indicate other sub-units with whom they had the most contact. Knowledge complexity was estimated through a survey tool measuring the degree to which the knowledge was codifiable.

Hansen (1999) argued that the prevailing wisdom in organizational theory is that tight coupling among team members in an organization is useful in situations of high environmental uncertainty. The counter-argument noted in the literature is that such coupling might limit search behaviour. Hansen suggested that weak ties might actually encourage a wider search for knowledge (i.e., outside of existing channels), and thus might be more important in rapidly changing circumstances.

Results of the study indicated that weak ties between sub-units had a positive impact on project completion rate when the knowledge to be transferred was not complex, but a negative impact when complex knowledge was involved. Hansen suggested, therefore, that in situations of high complexity, strong ties might promote better knowledge transfer. In situations of low complexity however, weak ties appeared to have a more positive impact on knowledge transfer.

Ouchi (1991) has noted that certain types of cultures tend to promote strong relationships and a family-like atmosphere in organizations. Other cultures tend to be more formal (Cameron and Quinn, 1999). Therefore, Hansen's study implies that a culture that promotes strong relationships among team members might facilitate the flow of complex knowledge within the organization. On the other hand, such a culture might, in fact, delay importation of new knowledge crucial to adaptation in faster changing environments. A similar argument has been made by Ouchi (1991)

with respect to the impact of “clan” cultures on the ability of an organization to change.

Yeung et al. (1999), conducted a study of over 400 companies in 40 different countries to examine the factors that facilitated or constrained learning in organizations. The study used a cultural orientation scale adapted from Cameron and Quinn (1999), which included the following definitions of culture:

Clan Cultures: A very friendly place to work where people share a lot of themselves. The organization is held together by loyalty or tradition.

Adhocracy Cultures: A dynamic, entrepreneurial, and creative place to work. People stick their necks out and take risks. The leaders are considered innovators and risk takers. The glue that holds the organization together is commitment to experimentation and innovation.

Hierarchy Culture: A very formalized and structured place to work. Procedures govern what people do. The leaders pride themselves on being good coordinators and organizers who are efficiency-minded. Formal rules and policies hold the organization together.

Market Culture: A results-oriented organization whose major concern is with getting the job done. People are competitive and goal oriented. The leaders are hard drivers, producers and competitors. They are tough and demanding. The glue that holds the organization together is an emphasis on winning. (Cameron and Quinn, 1999, pg. 204).

Yeung et al (1999) developed a regression matrix seeking to understand the impact of these cultural orientations on "organizational learning disabilities" defined as factors that impede the flow of knowledge into the organization. The findings are described in Table 4.

Table 4: Effects of Organizational Culture on Organizational Learning Disabilities

	Clan	Market	Hierarchy	Adhocracy
Diffusion deficiency	-0.46* ⁸	-0.15*	-0.14*	-0.08

Key results of interest to this thesis are those related to "diffusion deficiency", a measure of how much a particular culture obstructs knowledge flow. In Table 4, we note that clan cultures have the highest negative correlation with diffusion deficiency, adhocracies do not seem to be related to diffusion deficiency, and market and hierarchies fall somewhere in-between. In other words, clan cultures, defined as those in which a "family" atmosphere is developed within the organization, appears to best enable knowledge flow.

⁸ Findings are significant at $p=0.05$

These results are not consistent with the descriptions provided by Cameron and Quinn (1999) of the key characteristics of the various cultural orientations. It would seem, according to these descriptions, that adhocracies and market cultures would be most open to innovation and thus the importation of new knowledge. Nevertheless, the study does point out that organizational culture is an important consideration in examining knowledge absorption in organizations, a conclusion also noted by Boyton, Zmud and Jacobs (1994) and Szulanski (2000).

Ribiere's (2001) Ph.D. dissertation explored relationships between successful knowledge management initiatives and organizational culture. Data was collected through a survey of 46 Chief Knowledge Officers in organizations who had initiated a knowledge management project. Two types of initiatives were examined:

1. codification (i.e., explicit knowledge storage and diffusion with a heavy investment in IT); and
2. personalization (i.e., creating personal networks within the organization to encourage tacit knowledge exchange with less of an investment in IT).

Organizational culture was assessed using the framework developed by Cameron and Quinn (1999) but modified to focus on the perceived level of trust and solidarity within the organizations. The author's definition of trust was based on the

assessment tool developed by DeFuria (1997)⁹. Solidarity was defined using the framework of Goffee and Jones (1996) as "...a measure of a community's ability to pursue shared objectives quickly and effectively, regardless of personal ties". Results of the study are outlined in Table 5.

Table 5: Success of Knowledge Management Initiatives

	Communal Culture	Fragmented Culture	Networked Culture	Mercenary Culture
Number of companies	32	6	3	5
Number with successful knowledge management initiatives	28	1	0	4

Companies having a communal culture (i.e., a family-oriented culture characterized by high solidarity and high trust) were successful with their knowledge management initiatives whether using codification or personalization approaches. Companies having a fragmented culture (low solidarity, low trust) tended to use the codification approach. Most failed to achieve expected results. Similarly, companies having a networked culture (low solidarity, high trust) and mercenary cultures (high solidarity, low trust) also adopted codification approaches. None of the initiatives in the networked companies were successful, but companies having a mercenary culture achieved expected results.

⁹ DeFuria's model of trust includes six components: sharing information, reducing controls, allowing for mutual influences, clarifying mutual expectations and meeting expectations.

The fact that organizations with “family-oriented” cultures (i.e., clan cultures according to the Cameron and Quinn model) tended to be more successful with their knowledge management initiatives suggests that this type of culture would be supportive of initiatives to capture and share knowledge. This study also extends the theoretical framework related to knowledge utilization in organizations by suggesting that different approaches to knowledge management might be successful in different types of organizational cultures. For the present study, it supports the conclusion derived from Boyton, Zmud and Jacobs (1994), Szulanski (1996, 2000) and Hansen (1999) that culture could influence ACAP of organizations.

2.5.2 Complexity of Knowledge

Two studies that address complexity of knowledge are reviewed in this sub-section. The first, by Zander and Kogut (1995), provides a framework for understanding what is meant by complexity. The second by Takeishi (2001) considers the role of prior-related knowledge under conditions of complex knowledge transfer.

Zander and Kogut (1995) conducted an important study on technology transfer that focused on the characteristics of the knowledge to be transferred. They identified “codifiability”, “teachability” , “complexity”, “system dependence” , and “product

observability” as main characteristics of knowledge. These constructs are defined as follows:

- **Codifiability** refers to how amenable the information is to being transformed into an explicit form such as a manual.
- **Teachability** refers to how easily the information could be taught to someone else.
- **Complexity** refers to the number of parameters contained within the information. For example, if the technology featured many different sub-systems it would be deemed more complex than one which featured only a few.
- **System dependence** refers to the degree to which the innovation is integrated into the innovator’s production system. With highly integrated innovations, reverse engineering might not help a competitor since the process is as crucial to the innovation as the product.
- **Product observability** refers to the degree to which competitors can manufacture the product by observing its features and functions (i.e., almost the opposite of system dependence),

The objective of this study was to explore how the characteristics of the knowledge to be transferred influenced transfer effectiveness. Using a series of questionnaires distributed to engineers familiar with development of innovations in a number of

Swedish companies, Zander and Kogut (1995) created a log likelihood estimate formula to predict the probability of early transfer of a particular innovation.

They tracked the number of innovations transferred between organizations (out of 100 major Swedish innovations identified in an earlier study), and used this data to assess the impact of the independent variables on the likelihood of transfer. Results demonstrated that codifiability (0.19, $p < .05$), and teachability (0.19, $p < .05$) were significant predictors of the probability of early transfer of the innovation. The researchers also found that the firm's competitive environment influenced how quickly innovations were developed and transferred.

From a theoretical perspective, Kogut and Zander's research provided more detail on the concept of "knowledge characteristics" initially identified by Cohen and Levinthal (1989, 1990) as "ease of learning". The implications of their study for this thesis are twofold. First, it appears that codifiable knowledge is more easily transferred. Second, it appears that the context of the business environment (i.e., the external competitive environment) has an impact on how quickly innovations are transferred.

A more recent study addressing the issue of complexity of information was conducted by Takeishi (2000), who studied outsourcing arrangements in the automotive industry in Japan. His basic argument was that the success of an

outsourcing arrangement depends, to some degree, on the knowledge and skills of the organization doing the outsourcing.

Takeishi studied the component design process in 15 suppliers providing services to the "big five" automakers in Japan (Toyota, Nissan, Honda, Mitsubishi and Mazda). Project managers on the supplier's side responded to a questionnaire that explored the process as well as outcomes of the outsourcing arrangements. Managers within the automakers were interviewed and similar questions explored.

The overall result demonstrated that the knowledge possessed by the automaker's engineers was associated with success of the outsourcing arrangement ($\beta=0.291$, $p<0.05$). More importantly, for the purposes of this thesis, the study also suggested that existing knowledge within the outsourcing company was especially important where new technology was involved. This result corroborates early work by Cohen and Levinthal (1989, 1990) that outlined the importance of prior-related knowledge to an organization's ability to capture and apply new knowledge. It also suggests that as information outside the organization increases in complexity, organizations must find ways of increasing internal knowledge in order to effectively assimilate this information.

2.5.3 Source of Knowledge

The three studies reviewed in this section explore the potential impact of the source of knowledge on the effectiveness of knowledge transfer. Appleyard's (1996) study suggests that different organizations rely on different sources of knowledge depending on their industry or strategic orientation. Meckler (2001), and Johnson (2000) suggest that different sources of knowledge might influence the rate at which employees absorb knowledge.

Appleyard (1996) hypothesized that in industries featuring rapid technological change, knowledge transfer would occur mostly through public channels (e.g., trade journals) as opposed to private channels (e.g., direct contact between employees). A sample of 134 employees in semiconductor firms in the US and Japan (96 from the US, 27 from Japan, and 11 from university laboratories and other think tanks) participated in the study. Appleyard compared results of her study to those from a previous study on the steel industry (294 respondents). Data collection was conducted through a questionnaire distributed to employees.

The results indicated that in the USA, trade journals and conferences ranked as the number 1 and 2 sources of information. In Japan, however, review of patents and use of the popular press ranked as the number 1 and 2 sources respectively. In addition, employees in the steel industry tended to share information more readily

(83% had participated in cross-company sharing versus 71% in the semi-conductor industry).

There was also some indication that the organizations' knowledge management system, which included rewards for sharing knowledge through participation in conferences and through direct contact with others inside the organization, had an impact on the types of channels used for gathering information. For example, Japanese employees indicated that patent awards, conference presentations and published journal articles were more important determinants of pay and promotions than did their US counterparts.

From a theoretical perspective, this study provides some indication that the organization's management practices (i.e., reward systems) as well as the types of media used to collect information play a role in encouraging information sharing. In terms of relevance to this thesis, Appleyard's results provide a rationale for exploration of management practices and source of knowledge as contributors to the ACAP of work groups.

Meckler's (2001) Ph.D dissertation examined a number of organizational characteristics that were thought to affect the flow of knowledge within the organization. The main independent variables were as follows:

- Perceived strategic orientation (prospector, analyzer, defender, or reactor);
- Locus of attention (tendency to search externally or internally for information);
- Sources of meaning (i.e., do employees tend to look towards the manager or to their colleagues to understand information);
- Richness of communication media used; and
- Knowledge impedance present (embeddedness of knowledge, importance of the information to be transferred, and complexity of knowledge).

Meckler hypothesized that these variables would have an impact on “knowledge discernment”, defined as the ability of employees to identify relevant knowledge.

The sample comprised 73 employees from Siemens ICN and 45 from Intel Corporation. Data were gathered through a survey developed by the author.

Regression analysis was used to examine relationships among the variables. The results demonstrate an adjusted R-square for the five constructs of 0.423. A positive relationship between discernment and knowledge transfer performance was also noted ($\beta=0.471$, $p<0.001$).

Specifically, Meckler’s results indicated that the use of videoconferencing and the Internet were positively related to knowledge discernment. In terms of implications for this thesis, this study demonstrates the importance of communication media and type of knowledge on the knowledge transfer process.

Johnson's (2000) Ph.D dissertation explored mechanisms of knowledge creation in R&D projects. He tested certain aspects of Nonaka and Takeuchi's (1995) "Knowledge Creating" framework, but also examined the type of media most often used to communicate. Data were collected from 6 case studies using semi-structured interviews and surveys distributed to 32 researchers working on the 6 different R&D projects.

An analysis of the media used for communication suggested that face-to-face contacts and phone calls, as opposed to written media, were most highly associated with success of the knowledge transfer process. For the purposes of this thesis, Johnson's study supports Meckler's results suggesting that that source of knowledge and the type of transmission channel used could influence knowledge absorption.

2.5.4 Summary of the Empirical Literature

The construct of ACAP was originally introduced by Cohen and Levinthal (1989, 1990). Over the past decade, it has been included in a variety of studies on knowledge transfer between and within organizations. While it has been operationalized differently by different authors, the concept of prior-related knowledge appears to be at the core of most of these operational definitions.

Recent studies on ACAP in particular, and on knowledge transfer in general, however, suggest that factors other than prior-related knowledge could influence ACAP. Organizational context, (also referred to as organizational culture), complexity of knowledge, and source of information were all empirically linked to ACAP. There are three main implications of these studies for this thesis:

1. Organizational Culture likely plays an important role in how knowledge is transferred and thus has an influence on ACAP (Boyton, Zmud and Jacobs, 1994; Szulanski, 1996, 2000; Hansen, 1999; Ribiere, 2001).
2. Complexity of the knowledge to be transferred may be associated with the rate of knowledge transfer (Cohen and Levinthal, 1989, 1990; Kogut and Zander, 1995; Hansen, 1999; Takeishi 2001, Meckler, 2001).
3. The media used might also be associated with the rate of knowledge transfer (Appleyard, 1996; Johnson, 2000, Gupta and Govindarajan, 2000; Meckler, 2001).

These studies further support the view of ACAP as a multi-dimensional construct as initially suggested by Cohen and Levinthal (1990), and more recently by Matusik and Heeley (2002) and Zahra and George (2002). For example, the empirical literature on ACAP provides evidence that prior-related knowledge (Cohen and Levinthal 1990; Szulanski, 2000; Tsai, 2001; Matusik and Heeley, 2002), culture (Boyton, Zmud and Jacobs, 1994; Szulanski, 2000) and formal integration processes within the

organization (Gupta and Govindarajan, 2000; Matusik and Heeley, 2002) could be important determinants of ACAP. In addition, studies in the broader field of knowledge transfer provide support for the role played by organizational culture (Hansen, 1999; Yeung et al, 1999), and introduce aspects such as complexity of knowledge (Kogut and Zander, 1995; Takeishi, 2001) and source of knowledge (Johnson, 2000; Meckler, 2001) as factors to be considered. Overall, both streams of literature strongly suggest that additional empirical research is needed to explore in more detail the relative influence of a number of variables on the development of ACAP in organizations. The key variables identified in the literature include: prior-related knowledge, organizational culture, management practices, complexity of knowledge and source of knowledge.

2.6 Role of Middle Managers in Knowledge Absorption

This section focuses on the role of the middle manager in influencing knowledge absorption in organizations. It provides a definition of middle management, and discusses research that outlines the roles of middle managers in knowledge absorption.

2.6.1 Definition of Middle Management

Since the focus of this research is on the role of middle managers, a good starting point for this section would be explore the various levels of management and

provide a definition of middle management. Definition of the term, however, is not as simple as it would first appear (Livian, 1997; Van Gils, 1997). One first has to determine the characteristics of "management" in general, and then, within that framework, identify what middle management means.

Bournois and Livian (1997), working within a project initiated in 1992 by the Human Capital and Mobility Programme in Brussels, addressed the issue by highlighting five dimensions of the managerial group:

- a certain level of education and/or experience;
- salaried;
- intellectual nature of the work;
- delegation received from employer; and
- responsibility of managing others.

In reality, the first four criteria could describe a variety of professional and/or technical jobs in the organization. These distinctions, however, especially when the final category of having responsibility for the work of others is included, are generally accepted as a workable definition of management (Bournois and Livian, 1997).

Within this framework, the Management Charter Initiative of Europe's Institute of Management identified the following levels of management (Bournois and Livian, 1997):

- senior managers;
- middle managers;
- first-line managers; and
- supervisory managers.

Thakur (1998) suggests that middle managers occupy positions 1 level below the vice-president and 2 steps above the first line supervisor. Huy (2001) defines middle managers as occupying a range of positions 2 levels below the most senior manager in the organization and 1 level above line workers and professionals. Middle managers, therefore, do not represent just one layer in an organization. Rather, this level of management stretches from the first line supervisor to the executive group (Frohman and Johnson, 1993; Livian, 1997).

With the flattening of modern organizations and the increased professionalization of staff in many fields, today's organizations might not have front-line supervisors, especially in cases where professional staff members occupy front-line positions. Accordingly, the definition provided by Huy (2001) appears to fit well with current practices in modern organizations. For the purposes of this study therefore, middle

managers will be defined as managers occupying positions that fall within a range 2 levels below the head of the organization and 1 level above supervisory staff or professional workers.

2.6.2 Historical Development of Middle Management

Between 1950 and the 1980, as organizations tried to respond to growing complexity by increasing the number of vertical layers between the operational worker and senior management (Livian, 1997), the middle management layer in most organization grew rapidly (Frohman and Johnson, 1993). Uyterhoeven (1989) suggested that this growth was a direct response to adoption of the divisionalized organizational form, which required general managers in the middle of the organization. In these new organizational structures, middle managers assumed responsibility for business units operating at intermediate levels in the organizational hierarchy and thus became important contributors to organizational success.

The roles of many of these managers were thought to be essentially supervisory—controlling the vertical flow of information within departmental channels (Albrecht, 1990; Frohman and Johnson, 1993; Livian, 1997). In the late 1980s, increasing competitive pressures encouraged organizations to flatten organizational hierarchies. As a result, a radical purging of middle management ensued such that, between 1977 and 1987, more than 1,000,000 middle managers were “outplaced” (Frohman

and Johnson, 1993). In the newly flattened organizations, many authors believed that middle managers needed to change their roles from that of routinely processing the vertical flow of information, to becoming facilitators, coaches and innovators (Livian, 1997; Wilcox-King, Fowler and Zeithamel, 2001; Kifidu and Petridu, 1997).

2.6.3 Middle Managers and Knowledge in Organizations

From the point of view of knowledge transfer, middle management has long been thought to occupy important positions in the organization. As far back as 1911, Frederick Taylor argued that in adopting scientific management, supervisory managers (there were few middle managers in Taylor's time) must adopt new roles. In Taylor's own words, ". . .I fully realized that, although I was foreman of the shop, the combined knowledge and skill of the workmen who were under me was certainly ten times as great as my own" (Taylor, 1911; pg. 53)

Taylor's scientific management sought to separate "thinking" from "doing": i.e, managers did the thinking and planning, and workers performed the job according to specifications laid out by managers or engineers. However, he also urged a new spirit of cooperation between managers and workers (Taylor, 1911).

From a more modern perspective, Shoshana Zuboff's 1988 book entitled "In the Age of the Smart Machine: The Future of Work and Power" discussed the role of

managers in what she called "informatted" organizations. Zuboff addressed a number of critical issues related to modern organizations, but most important from the perspective of this thesis, is that she specifically addressed the role of middle management. Zuboff argues that in these types of organizations "...middle management becomes the repository for the explicit knowledge of the organization" (Zuboff, 1988, p. 232). She suggests that in the bureaucratic era, middle managers served productivity best by helping employees to access this repository. But in post-bureaucratic organizations of the 21st century, managers at all levels will need to adopt different roles related to how knowledge is stored, shared and used. Figure 9 provides an outline of these roles.

Figure 9: Zuboff's Management Model

According to Zuboff (1988) those managers closest to production employees need to be concerned with intellective skill and technology development. Managers farther away from the production core of the organization should become more occupied with longer-term strategic and cultural issues. Zuboff (1988, p. 391) argues that "...the shifting grounds of knowledge invite managers to recognize the emergent

demands for intellectual skills and develop a learning environment in which such skills can develop". According to this model, middle managers would be actively involved in helping production employees learn and apply learning in the organization.

A number of case studies provide support for this view of middle management. Kanter (1982), in a study of 165 middle managers in 5 leading corporations in the USA, found that middle managers were often the bedrock of innovation in the organization. They played an especially strong role in driving change because of their understanding of both the top and bottom levels of the organization. Most of their activities in this regard were related to ensuring that key individuals had access to the right information.

Jackson and Humble (1994) suggest that there can be no integration of vision to practice without the role played by middle management. They also argue that the ways in which middle managers integrate the top and bottom of the organization has changed over the years, but that their role continues to be of critical importance in ensuring that the "translation" process among layers in the organization is conducted effectively.

Applegate (1995), conducted a 5-year study of management in "information age organizations". She concluded that many contemporary organizations delegate

authority for certain decisions to “operating teams” comprised of middle managers who are responsible for executing operating strategies. Under this scenario, middle managers work across organizational boundaries ensuring that operational strategies are implemented effectively.

Bartlett and Ghoshal (1998), in discussing a “managerial theory” of the firm, suggest that organizations are shifting from the multi-divisional form (M-form), which has dominated organizational structure since the 1920s. Based on a review of organizations such as Asea Brown Boveri, the authors outline a business model based on the “E-Form”—entrepreneurial types of structures where business units operate as internally owned small businesses. In this structure, senior managers are responsible for the creation of purpose and for consistently challenging the status quo, front line managers act as entrepreneurs and drive performance, and middle managers act as horizontal information brokers and capability integrators (Bartlett and Ghoshal, 1998). That is, according to this model, the middle manager is the centre of knowledge transfer and act as integrators of company capabilities existing in different business units.

Thakur (1998) echoes this argument in suggesting that planning frameworks in organizations need to be revised to include new roles for middle managers as “knowledge-based individuals” as opposed to technocrats. The basic argument is that without middle managers acting as “translators” between various layers in the

organization, knowledge transfer cannot be effective. Cohen and Levinthal (1990, p.132) raise a similar argument that ACAP of the firm "...depends on the individuals who stand at the interface of either the firm and the external environment or at the interface between subunits in the firm". The authors suggest that although other staff in the organization can play the role of knowledge "gatekeeper", middle managers tend to work at the nexus of organizational lines of communication, and thus represent critical links in the knowledge transfer process.

Focusing specifically on knowledge creation and transfer, Nonaka and Takeuchi (1995), who conducted a study of knowledge creation in Japanese companies, refer to middle managers as "knowledge engineers"—the core of knowledge conversion and utilization in organizations. Because Nonaka and Takeuchi's model has received a great deal of attention in the literature, and because this model is important to the theoretical framework developed for this dissertation, it is illustrated in some detail in Figure 10.

Figure 10: Nonaka and Takeuchi's Five-Phase Model of Knowledge Creation

The dotted lines in Figure 10 represent the boundary of the organization. At the bottom of the model, the flow of information into the organization is depicted. The five ellipses ("knowledge spirals" which include sharing tacit knowledge, creating concepts, justifying concepts, building an archetype, and cross-levelling knowledge) in the interior of the model represent the five phases of Nonaka and Takeuchi's knowledge creation process.

From a process perspective, five “enabling conditions” are proposed as internal systems that promote the “knowledge spirals”. Enabling conditions are created by people in the organization and are defined as follows:

- **Intention:** refers to the goals of the organization. Nonaka and Takeuchi (1995) suggest that goals and strategies related to knowledge use are especially important.
- **Autonomy:** by allowing individuals and teams to act autonomously, the model suggests that organizations can increase the chances of realizing unexpected innovations.
- **Fluctuation and Creative Chaos:** Fluctuation introduces a breakdown of organizational routines, which could occur as the result of external changes or some sort of crisis. Creative chaos can also occur when an organization faces a crisis and people have to respond in different ways. According to Nonaka and Takeuchi, it can also be generated intentionally by managers who set challenging goals that require people to find new ways of getting things done.
- **Information Redundancy:** the sharing of more information than an individual needs for his/her current job helps to promote cross-fertilization between

individuals in the organization. In other words, when people in organizations learn about each other's work units, and when the organizational context allows people to share tacit information across work unit boundaries, different perspectives can be created on how things get done.

- **Requisite Variety:** the basic notion here is that the organization's internal diversity should match that of its environment if it is to adapt effectively. According to the framework, requisite variety can be promoted within the organization by ensuring equal access to information throughout the organization to encourage a wide diversity of opinions.

Finally, the model identifies four knowledge creation activities as the "engine" of knowledge creation. These four activities make up Nonaka and Takeuchi's (1995) SECI model: Socialization, Externalization, Combination, and Internalization. They are shown in the diagram as loops connecting the knowledge spirals and are described as follows:

1. Socialization represents the first phase. Tacit knowledge held by individuals is thought to be the basis of knowledge creation; accordingly, socialization provides opportunities for individuals to share this information and to develop shared mental models—a common view of the information.

2. Externalization: shared mental models developed in phase 1 are articulated into a refined concept (e.g., a new product idea).
3. Combination: the concepts developed during "externalization" needs to be justified within the context of the organization. In this phase, people in the organization explore the usefulness of the concept for accomplishment of organizational objectives.
4. Internalization: in the fourth phase, the concept, having passed the screening stage, is converted into something tangible such as a prototype or a test case. Previous knowledge embedded in the prototype or test case triggers another cycle of knowledge creation. For example, a product innovation in one area of the company stimulates a similar innovation in another.

Nonaka and Takeuchi (1995) identify very specific roles for managers in this model. Their "middle-up-down" version of the organization's management structure suggests that although all managers are involved in knowledge creation in organizations, middle managers initiate and sustain the process. Table 6 outlines the proposed roles for various levels of management, which the authors refer to as the "Knowledge Creating Crew".

Table 6: Nonaka and Takeuchi's "Knowledge Crew"

Knowledge Category	Position in Organization
Knowledge Practitioners	Front-line employees and line managers
Knowledge Engineers	Middle Managers
Knowledge Officers	Top Managers

In this model, "knowledge practitioners" would interact with the front lines of the business and capture knowledge in both explicit and tacit forms. "Knowledge engineers" would be responsible for knowledge conversion (tacit to explicit and vice-versa), while "knowledge officers" govern the entire knowledge creation process.

Nonaka and Takeuchi (1995) suggest that the "knowledge engineers" kick-start the knowledge creation process by synthesizing tacit knowledge from the front lines and from senior management, and converting this into explicit knowledge. They also help to create a spiral of knowledge across different work units in the organization, both vertically and horizontally (i.e., the cross-levelling phase). Therefore, according to this model, middle managers play a pivotal role in ensuring that knowledge is synthesized and transferred in organizations.

Nonaka, Konno and Toyamo (2001) elaborate on the specifics of the proposed managerial roles in the four elements of the SECI process.

Table 7: Managerial Activities in the SECI Process

Stage in the Process	Managerial Activities
Socialization	Gather information, manage by walking about, promote "craftsmanship"
Externalization	Facilitate creative thinking and concept formation activities
Combination	Develop and disseminate manuals, plans etc.,
Internalization	Create liaisons, share values, build relationships

As can be seen in Table 7, the middle management roles identified by these authors are similar to what Kanter (1982), Zuboff, (1988), Jackson and Humble, (1994) and Bartlett and Ghoshal (1988) suggest: middle managers connect the organization vertically and horizontally through activities such as gathering information and creating liaisons between and among teams and individuals. Accordingly, they are thought to fulfill a vital function in translating information between various units in the organization and are in a position to leverage organizational capabilities.

In summary, theoretical development of the role of the middle manager by a variety of different authors is remarkably consistent: middle managers help to translate information for organizational members and are also responsible for establishing the

context in which this information is converted into useful knowledge. The following section reviews empirical studies related to this theoretical proposition.

2.6.4 Empirical Studies Related to the Roles of Middle Managers

Zuboff (1988), Kanter (1982), and Nonaka and Takeuchi (1995) provide case studies to support their models of middle management roles. Empirical research focusing specifically on this level of management is scarce. This section does however, review six key studies (Schilit, 1987; Wooldridge and Floyd, 1990; Leonard-Barton and Deschamps, 1988; Gunther-McGrath, 2001; Huy, 2001; and Janczak, 1999) that provide support for the model of middle manager as “knowledge engineer”.

Schilit (1987) investigated the influence of 60 middle managers on strategic decision-making in a sample of 57 organizations over a two-month period. The author found that middle managers were much more than “information filters”. In many cases, they influenced strategic decisions through persuasion and rational arguments.

Wooldridge and Floyd (1990) investigated the involvement of middle managers in the strategy process in a study that involved 157 managers in 11 banks and 9 manufacturers. The authors found that the involvement of middle managers in

strategy making had an impact on organizational performance. They concluded that this impact resulted from the ability of middle managers to contribute more accurate information to the decision-making process.

Leonard-Barton and Deschamps (1988) conducted research on managerial influence on the use of innovations by an organization. With a sample of 93 sales representatives in a computer manufacturing company, the authors collected data on how often a new software package was used and the users' perception of how much the manager influenced their decision to adopt the software. The results suggested that those who were early adopters and those who were highly skilled perceived very little managerial intervention in their adoption of the technology. However, those who were not as highly skilled and less open to experimentation with new work methods perceived more managerial urging in trying the new software. This study suggests that managers do have an influence on knowledge absorption, but that this influence is contingent to some degree on the skill or performance level of the employee, and on the employee's orientation towards using new techniques.

Gunther-McGrath (2001) addressed the role of managerial systems in knowledge transfer. She hypothesized that different types of managerial oversight might be needed for different types of knowledge transfer. Two key factors were thought to be important: goal autonomy and supervision autonomy. She postulated that in

environments characterized by rapid change, when new knowledge must be absorbed, high autonomy might be needed to allow faster exploration within the team.

Data were collected from 56 exploratory projects in large companies. Results indicated that when exploration was high, increased goal autonomy and supervision autonomy were positively related to learning effectiveness¹⁰. On the other hand, when exploration was low, more direct supervision was related to learning effectiveness. This result suggests that when the group had a high level of common knowledge, direct supervision enabled learning effectiveness. When the knowledge needed to be captured and assimilated, however, more autonomy was found to promote better learning.

Huy (2001), reporting on a six-year study of 200 middle and senior managers in a number of American corporations, suggested that contributions made by middle managers are not often recognized by senior managers. The study identified contributions in the following areas:

- developing and building support for entrepreneurial ideas;
- leveraging internal networks;
- managing relationships with employees; and
- managing tension within change efforts.

¹⁰ Note: in this study "learning effectiveness" could be interpreted as the ability of the work group to capture knowledge.

Huy (2001) notes that middle managers were key facilitators of communication throughout the organization because they often had the best social networks. These networks are often better developed than those of senior management since turnover in the executive suite tends to be higher than in the middle manager ranks. According to the study, middle managers often know who to involve in important tasks, who to contact to support new ideas, and how to get these ideas implemented (Huy, 2001).

Janczak's (1999) Ph.D study explored the roles of middle managers in knowledge integration (defined as "...the assimilation of individual knowledge by a group of people". Janczak 1999, p. 8). Using a grounded theory approach, he conducted interviews with 41 middle managers in 35 firms in Quebec, Canada. The results indicated that middle managers occupy the roles outlined in Table 8.

Table 8: Middle Manager Roles in Knowledge Integration

Middle Manager Role	Characteristics
Analytics	Took part in problem-specific search for new information and acted as "passive" filter (amended messages but did not change the content).
Intuits	Took part in searches for general knowledge that was important to the organization, acted as catalyst in generating knowledge, experimenter in trying to integrate knowledge, and "active" filter in processing information within the organization.
Pragmatics	Participated in opportunistic searches, acted as "connector" (bringing people together to influence adoption of new ideas) and "missionary" (advocating new ideas/courses of action).

Some of these roles did overlap. For example, the “connector” activities of the Pragmatics were similar to the “catalyst” role of the Intuits in that they both sought to build relationships within the organization in order to help transfer and recombine knowledge effectively. Overall, this study provides support for the notion that middle managers are key players in knowledge transfer and utilization in organizations.

2.6.5 Summary of the Literature on Middle Manager Roles

The role of middle managers has not been the subject of a great deal of empirical research. What little there is has been focused on two areas: the strategic planning process in organizations, and assessing what middle managers actually do. The overall conclusions, from both the conceptual and empirical literature is that middle managers appear to play extremely important roles in driving innovation, facilitating change, and contributing to strategy. The research suggests that, in many cases, middle managers are very effective not only in transferring information, but in facilitating action based on this information.

Therefore, according to the definition of “ACAP” as the ability of an organization to capture and integrate information into action, it does appear that middle managers occupy important roles as knowledge gatekeepers (Zuboff, 1988; Cohen and Levinthal, 1990; Nonaka and Takeuchi, 1995). What is not clear is what specific

actions they take in modern day organizations to help facilitate ACAP of work groups.

Both the empirical and theoretical literature suggests that middle managers provide an important translation role that spans both vertical and horizontal layers in the organization. The empirical literature indicates that planning and overall organizational performance is improved with more involvement from middle managers. The theoretical literature suggests that middle managers will occupy an increasingly important role in modern organizations as new organizational forms are adopted and the importance of efficient knowledge transfer is recognized (Zuboff, 1988; Frohman and Johnson, 1993; Nonaka and Takeuchi, 1995; Bartlett and Ghoshal, 1998). In summary:

- middle managers are thought to occupy a central role in the transfer of knowledge of all types from senior levels in the organization to the operating units and vice-versa;
- the exact nature of this role is presently still ill-defined, but there does appear to be a consensus that middle managers perform a vital "translation function" that transcends the mere filtering of information to include interpretation, analyzing and knowledge creation (Schilit, 1987);

- middle managers can have an impact on both the content and context of knowledge utilization in organizations.

At present, there is evidence that their ability to fulfil these roles is constrained by a number of factors such as failure in the organization to recognize the changing nature of the middle management function and the lack of authority and resources to fully accomplish these tasks (Kufidu, Petridu, and Mihail, 1997; Huy, 2001).

2.7 Critique of the Literature

This section provides a critique of the current literature examining ACAP in organizations and the role of middle managers in knowledge transfer. Studies related to ACAP will be examined first followed by a discussion of the middle management literature.

In general, the literature appears to support the notion that ACAP is important to the successful transfer of knowledge and that prior-related knowledge is an underlying component of ACAP (Cohen and Levinthal, 1990; Szulanski, 1996; 2000; Tsai, 2001). However, a number of issues remain to be explored in further detail. The main gaps noted in the literature are as follows:

- lack of an overarching theoretical framework for ACAP and no commonality in definitions and measures of the components of ACAP;

- the construct of ACAP implies a flow of knowledge over time, but few longitudinal studies have been conducted;
- despite the fact that work groups or teams are seen as the core of knowledge creation and transfer in organizations (Hedlund, 1994; Spender, 1996; Dixon, 2001) most studies thus far have focused on the firm, or on divisions within firms as the unit of analysis; and
- research on the role of management in facilitating ACAP is almost non-existent.

The following sub-sections examine each of these criticisms in more detail.

2.7.1 Lack of an overarching theoretical framework

Thus far, ACAP has been operationalized differently from study to study. Cohen and Levinthal (1989, 1990), and Tsai (2001) measured ACAP as R&D expenditure. On the other hand, Boyton, Zmud and Jacobs, (1994), used surveys to identify current knowledge of individuals and organizational climate as indicators of ACAP. Szulanski's approach (2000) was to use a survey to measure ACAP as the readiness of individuals to accept new information. Furthermore, Gupta and Govindarajan (2000) used measures of interpersonal relationships between individuals in the organization as indicators of ACAP. The many different approaches to measurement of the components that comprise ACAP frustrates development of an overall theoretical framework. While it seems plausible to consider ACAP as a multi-dimensional construct (Matusik and Heeley, 2001; Zahra and George, 2002) which

allows for a variety of empirical approaches, development of a coherent theoretical framework requires some level of commonality in definition and measurement of variables that are thought to influence ACAP.

Furthermore, many of the current studies treat ACAP as the independent variable predicting some other organizational outcome. Of the empirical studies cited in this thesis, only Lane and Lubatkin (1998) and Verkasalo and Lappalainen (1999) treated ACAP as the dependent variable. It is important to note that the term ACAP was originally defined in a paper published in *The Economic Journal* (Cohen and Levinthal, 1989). Thus, the origin of the term is steeped in neoclassical economics where the firm is treated as a "black box"—what actually happens inside the black box is often not discussed. Cohen and Levinthal's 1990 article, published in *Administrative Science Quarterly*, took a more managerial view of ACAP in recognizing that certain organizational processes could also influence ACAP¹¹. Yet, few of the papers that followed Cohen and Levinthal's (1990) work have examined these processes in any depth.

Lane, Koka and Pathak (2002, p. 1), point out that ACAP is "...one of the most important constructs to emerge in organizational research over the past decades". The authors argue that the construct has become "reified" in that the original

¹¹ Cohen and Levinthal (1990) identified factors such as the structure of communication within the firm, mechanisms to transfer knowledge within and among sub-units, and the degree of centralization of organizational units that interface with the external environment.

definition proposed by Cohen and Levinthal (1990) has not been subject to a systematic re-examination. Indeed, the reconceptualization proposed by Zahra and George (2002) stands as one of the few recent comprehensive reviews of the construct. In addition, Lane, Koka and Pathak (2002) indicate that little attention has been paid to the actual processes underlying ACAP.

Accordingly, despite the number of citations of Cohen and Levinthal's original paper introducing the concept of ACAP into the organizational theory literature, and the various empirical studies conducted thus far, attempts to examine the processes by which ACAP may be developed in organizations have been few and far between. At best, empirical studies on ACAP and on the more general issue of knowledge transfer suggest that prior-related knowledge is important, and that culture and organizational processes play a role. Since most of the studies on ACAP treat it as an independent variable, what these roles are, and how these factors relate to each other and to ACAP in general have not been examined in any systematic way.

2.7.2 Lack of Longitudinal Studies

Organizations capture knowledge over a period of time. Most of the empirical studies available, however, have been retrospective examining what information was received at a certain point in time. Szulanski's (2000) argument that knowledge transfer is a process, not an event, suggests that ACAP should be examined on a longitudinal basis, where the change in knowledge over a period of time could be

explored. The literature review discovered only one study, conducted by Verkasalo and Lappalainen in 1998, that examined ACAP as a process occurring over time. The purpose of Verkasalo and Lappalainen's study, however, was to explore the impact of technology on the flow of information, not to examine the factors directly related to ACAP of the work groups in question. Accordingly, the lack of longitudinal studies is also a critical problem with respect to development of a full understanding of ACAP.

2.7.3 A Focus on the Firm as the Unit of Analysis

It has been argued that collective knowledge is the most strategically important and stable form of knowledge an organization possesses (Spender, 1996). Further, it has also been suggested the the work group is likely the most important knowledge creation and transfer instrument in organizations (Hedlund, 1994; Spender, 1996; Dixon, 2000). Yet most of existing studies on ACAP approach the issue from the firm or organizational sub-unit level, the work group level has not been addressed in detail. Given the emphasis on work groups as critical operating units in organizations, the absence of multi-level studies that consider the development of ACAP in work group limits our understanding of the construct.

2.7.4 Research on the Roles of Managers

The literature search conducted for this thesis found only one study that examined the role middle managers play in facilitating knowledge absorption in organizations. Janczak (1999) used a grounded theory approach to examine what middle managers do to help organizations integrate and use knowledge effectively. This study was useful in that it outlined a set of management practices that seemed to be of importance to knowledge integration. It was limited, however, by the fact that data was collected through interviews with managers themselves: the perception of employees reporting to the managers, and the actual impact of the management practices identified was not addressed.

Overall, the theoretical and empirical literature recognizes the importance of knowledge in organizations, but a theoretical framework related to knowledge utilization in general, and to ACAP specifically has not been developed. In particular, ACAP has often been treated as an independent variable in much of the research; the specific components of ACAP have not been fully explored. Finally, while the theoretical research suggests that middle managers play key roles in knowledge utilization and integration in organizations (Kanter, 1982; Zuboff, 1988; Hedlund, 1994; Nonaka and Takeuchi, 1995; Bartlett and Ghoshal, 1998), few empirical studies have explored management practices that facilitate ACAP.

CHAPTER 3: A Theoretical Model of the Role of Middle Managers in Building ACAP

This section describes the theoretical framework of ACAP to be tested in this thesis.

Details are also provided on the research hypotheses to be tested.

3.0 Theoretical Framework and Research Hypotheses

Figure 11: Theoretical Framework

The overall objective of this study was to explore how middle managers influence the ACAP of work groups. In brief, the study sought to answer the following

question: *what is the role of middle managers in enabling ACAP within a work group?*

Table 9: Theoretical/Empirical Support for Variables in the study

Dependent Variable	Independent Variables	References
Absorptive Capacity		Cohen and Levinthal (1989, 1990); Szulanski (1996, 2000); Gupta and Govindarajan (2000); Tsai (2001).
	Middle Management Practices	Zuboff (1988); Nonaka and Takeuchi (1995); Bartlett and Ghoshal (1988); Janczak (1999); Huy (2001).
	Moderating Variables	
	Prior-related knowledge	Cohen and Levinthal (1989, 1990); Szulanski (1996, 2000); Gupta and Govindarajan (2000); Tsai (2001); Matusik and Heeley (2002)
	Cultural Orientation	Nonaka and Takeuchi (1995); O'Dell and Grayson (1998); Yeung et al, (1999); Von Krogh, Ichijo and Nonaka (2000, 2001), Nonaka, Konno and Toyama (2001), Ribiere (2001).

Table 9 summarizes the theoretical and empirical support for variables included in the theoretical framework. The remainder of this section provides more detailed definitions of these variables and elaborates on the hypothesized relationships between them.

As discussed earlier, the dependent variable depicted in Figure 11—"Absorptive Capacity", refers to the ability of work groups in organizations to absorb and apply knowledge. Cohen and Levinthal's (1990) original definition suggests that ACAP is

primarily concerned with absorption of knowledge from outside the organization. Kogut and Zander (1995) argue however, that the ability to recombine current knowledge already in the organization is also an aspect of ACAP. The approach taken in this thesis integrates both views such that ACAP refers to knowledge that is external to the work groups in question even though such knowledge might already be present within the organization itself.

Another distinction made in this thesis is that absorption of knowledge implies a "rate of flow". That is, the ability to recognize and assimilate knowledge cannot be measured as a static construct: absorption happens over a certain period of time. Accordingly, in this thesis, ACAP will be measured as the perceived change in knowledge of members of work groups over a period of time. In other words, this study will be longitudinal in nature. A full description of the methodology will be provided later in this document.

Figure 11 positions "Management Practices" as an independent variable influencing ACAP. The "knowledge creation" business model proposed by Nonaka and Takeuchi (1995) and Bartlett and Ghoshal (1998), and research into the roles of middle managers in general (Kanter, 1982; Schilit, 1987; Zuboff, 1988; Nonaka and Takeuchi, 1995; Bartlett and Ghoshal, 1998; Von Krogh, Ichijo and Nonaka, 2000; Huy 2001) is the theoretical basis for this proposition.

The general theme underlying most of the arguments about the importance of middle managers is that they occupy a unique position in the organization that allows them to link front-line operations to the strategic vision of the organization (Kanter, 1982, Huy, 2001). In this position, middle managers could play roles of “translator” of the organization’s vision, as well as “knowledge engineer” or “knowledge activist” (Jackson and Humble, 1994; Nonaka and Takeuchi, 1995; Von Krogh, Ichijo and Nonaka, 2000) who “kick start” the knowledge absorption process. It is likely, therefore, that middle managers would influence ACAP through two broad sets of practices: *context building behaviours* (CBBs) and *knowledge integration behaviours* (KIBs). In the case of CBBs, the literature suggests that middle managers play key roles in “translating” the organization’s vision, mission and mandate to operational units (Kanter, 1982; Frohman and Johnson, 1993; Janczak, 1999; Huy, 2001). Therefore, CBBs could help to develop a context for work groups that enables them to identify important sources of knowledge and a rationale for integrating this knowledge into their work. For example, if a work group understands that the organization has adopted a strategic focus on building client relationships, they might tend to pay more attention to knowledge about clients and actively seek to integrate such knowledge into their work. Without the strategic context that identifies the importance of client knowledge, they might ignore such knowledge.

KIBs are thought to facilitate ACAP through practices such as building relationships among group members, encouraging group problem-solving and empowering others to act (Kuboff, 1988; Nonaka and Takeuchi, 1995; Janczak, 1999, Gunther-McGrath, 2001). Collectively, KIBs help to build relationships among group members and encourages knowledge absorption by providing enough autonomy for group members to integrate new knowledge in their work routines. The specific practices middle managers may use to increase absorptive capacity of their work groups are summarized in Table 10.

Table 10:
Middle Manager Practices Related to Knowledge Absorption

Type of Practice	Specific Practices	Reference
<u>Context Building Behaviours (CBBs)</u> Sharing information Clarifying performance outcomes	Managers provide contextual information related to work being done by the team (i.e., vision, mission, strategic imperatives etc.,) as well as content-specific information. Managers help provide a context for knowledge transfer by ensuring that team members understand individual and organizational performance outcomes and how these are related to capturing and applying knowledge.	Jackson and Humble (1994), Kanter (1982), Bartlett and Ghoshal (1998), Zahra and George (2002) Nonaka, Konno and Toyamo (2001)
<u>Knowledge Integration Behaviours (KIBs)</u> Encouraging group problem solving and creative concept formation. Empowering others to act Building Relationships	Managers encourage the team to make decisions about problems and opportunities and support activities related to formation of new operating strategies. Managers encourage team members to act on new knowledge received. Managers work at developing relationships within the work group and encourage sharing of values, ideas and concepts.	Nonaka and Takeuchi (1995), Janczak (1999) Applegate (1995), Janczak (1999), Gunther-McGrath (2001) Zuboff (1988), Janczak (1999), Nonaka, Konno and Toyamo (2001)

3.0.1 Research Hypotheses related to the roles of Middle Management

Based on the foregoing discussion, three research hypotheses related to middle management practices were postulated as follows:

Research Hypothesis 1A: Middle Management practices will have a positive impact on the ACAP of work group members, controlling for task complexity and source of knowledge.

Research Hypothesis 1B: Context Building behaviours by middle managers will have a positive impact on the ACAP of work group members, controlling for task complexity and source of knowledge.

Research Hypothesis 1C: Knowledge Integration behaviours by middle management will have a positive impact on the ACAP of work group members controlling for task complexity and source of knowledge.

Janczak (1999), noted that there is considerable overlap in the roles that middle managers play related to knowledge transfer in organizations. Accordingly, the research hypotheses were structured to examine all middle management practices, and then to explore whether a difference exists in the impact of CBBs and KIBs.

For purposes of clarity, the remainder of this document will use the term *management practices* to refer to the combined set of CBBs and KIBs.

3.0.2 Research Hypothesis Related to Organizational Culture

The role of an organization's culture in enabling knowledge absorption has been discussed by authors such as Senge (1990), Schein (1993), Boyton, Zmud and Jacobs (1994), Szulanski (2000), and Von Krogh, Ichijo and Nonaka (2001). In addition, Ribiere (2001), whose Ph.D dissertation assessed the role of culture in the success of knowledge management initiatives, noted that the knowledge management literature reveals that organizational culture is cited as one of the main reasons for the failure of knowledge management initiatives. Further, O'Dell and Grayson (1998, p. 71) identify four enablers of knowledge management: infrastructure, technology, measurement and culture. They single out culture as the most potent since it represents the "...combination of shared history, expectations, unwritten rules and social mores that affects the behaviour of everyone...".

A number of other authors have also suggested that knowledge absorption is facilitated in those organizations whose culture encourages learning and sharing of knowledge (Nonaka and Takeuchi, 1995; Yeung et al, 1999; Berman Brown and Woodland, 1999; Dixon, 2000, Von Krogh, Ichijo and Nonaka, 2001;). To elaborate on the importance of organizational culture as a means of facilitating knowledge

absorption for example, Von Krogh, Ichijo and Nonaka (2001) introduced a concept they referred to as "ba": a time and space for knowledge sharing. The authors suggest that an organizational culture that encourages supportive relationships also facilitates personal contact and knowledge sharing: the more contact there is between members, the more likely they will share knowledge. Within a work group, knowledge sharing could be an important means of absorption since the more knowledge is shared, the more it become common to the group as a whole.

There is, therefore, a fair degree of support in the literature for the notion that organizational cultures that promote strong relationships between employees tend to enable knowledge transfer. The question is how does one identify these types of cultures? There are a variety of approaches for doing so. For example, Hellriegel et al (1998) define four different types of cultures: "academy, baseball team, club, and fortress". Each type has a specific set of shared values and beliefs that is distinct from the others as shown below:

Academy Culture: Employees are highly skilled and tend to stay in the organization, while working their way up the ranks. The organization provides a stable environment in which employees can develop and exercise their skills. Examples are universities, hospitals, large corporations, etc.

Baseball Team Culture: Employees are "free agents" who have highly prized skills. They are in high demand and can rather easily get jobs elsewhere. This type

of culture exists in fast-paced, high-risk organizations, such as investment banking, advertising, etc.

Club Culture: The most important requirement for employees in this culture is to fit into the group. Usually employees start at the bottom and stay with the organization. The organization promotes from within and highly values seniority. Examples are the military, some law firms, etc.

Fortress Culture: Employees don't know if they'll be laid off or not. These organizations often undergo massive reorganization. There are many opportunities for those with timely, specialized skills. Examples are savings and loans, large car companies, etc.

The cultural model discussed above is just one of the many different ways the culture of an organization could be profiled. For the purposes of this thesis, the organizational culture model developed by Cameron and Quinn (1999) was used. This model was chosen because the authors have developed an assessment tool and methodology that has been validated with over 1000 organizations. The four cultural orientations included in this model, as identified earlier in this paper, are outlined below (Cameron and Quinn, 1999, p. 96):

Clan Culture: A very friendly place to work where people share a lot of themselves. The leaders of the organization are considered to be mentors. The organization is held together by loyalty or tradition.

Adhocracy Culture: A dynamic, entrepreneurial, and creative place to work. People stick their necks out and take risks. The leaders are considered innovators and risk takers. The glue that holds the organization together is commitment to experimentation and innovation.

Hierarchy Culture: A very formalized and structured place to work. Procedures govern what people do. The leaders pride themselves on being good coordinators and organizers who are efficiency-minded. Formal rules and policies hold the organization together.

Market Culture: A results-oriented organization whose major concern is with getting the job done. People are competitive and goal oriented. The leaders are hard drivers, producers and competitors. They are tough and demanding. The glue that holds the organization together is an emphasis on winning.

According to the literature on the types of culture that should best support ACAP, the category in the Cameron and Quinn model called "clan" culture seems to be the best fit in that it emphasizes the development of close personal relationships among members. The following hypothesis therefore, was tested in this thesis:

Research Hypothesis 2: Controlling for task complexity and source of knowledge, organizational culture will moderate the relationship between middle management

practices and ACAP. Specifically, the stronger the clan orientation, the more influence management practices will have on ACAP.

3.0.3 Research Hypotheses related to Prior-Related Knowledge

Cohen and Levinthal (1990) argue that ACAP at the individual level is dependent on prior-related knowledge. That is, some prior knowledge of the topic area helps the individual makes sense of incoming information. Further, they argue that ACAP at the team level is dependent on individual ACAP, but also that speed of knowledge transfer could be dependent on the degree to which group members share common prior-related knowledge (i.e., the degree of homogeneity of knowledge within the group).

In an extensive study conducted by Yeung et al (1999), homogeneity of knowledge was thought to contribute in some cases to operational effectiveness, and in others to operational ineffectiveness. The authors suggest that in knowledge intensive environments, such as R and D labs for example, homogeneity is probably not a good thing—diversity of knowledge will likely help to stimulate innovation in these environments. For operational environments, however, homogeneity of knowledge establishes a common language so to speak, that facilitates the flow of knowledge. In other words, if group members possess a base of common knowledge, they use a “coding” system, which could include specialized jargon, or references to specific

aspects of the organization that helps them share knowledge more efficiently (Rogers, 1988; Cohen and Levinthal, 1990).

Therefore, as far as this variable is concerned, two aspects appear to be important:

1. the actual level of prior-related knowledge in that the more team members know about a particular topic, the easier it might be to integrate new knowledge on that topic; and
2. homogeneity of prior-related knowledge is important in that similarity of knowledge among the team members appears to enable faster communication¹².

Previous researchers have taken two different approaches to measuring prior-related knowledge. Cohen and Levinthal (1990), Tsai (2001), Stock, Greis and Fischer (2001), and Matusik and Heeley (2002) used R&D expenditure as a proxy for prior-related knowledge, the assumption being that the more the company spends on R&D, the more prior-related knowledge it develops. A second approach measures prior-related knowledge as current knowledge of employees in a firm (Boyton, Zmud and Jacobs, 1994; Gupta and Govindarajan, 2000; Szulanski, 2000; Matusik and Heeley, 2002). The measurement tactics vary according to the perspective of the

¹² Note: Cohen and Levinthal (1990), Yeung et al (1999), Hansen (1999) and Crampton (2001) suggest that a balance between homogeneity and heterogeneity of knowledge within the group is needed. The general notion is that homogeneity facilitates the flow of knowledge, but in more complex environments, heterogeneity of knowledge helps a group to recognize the value of new knowledge. This thesis will focus on the impact of homogeneity of knowledge.

researcher: R&D expenditure is more of a macro, firm-level metric, whereas the current base of knowledge of employees in the organization is a micro-behavioural view.

Since this thesis was focused at the work group level (i.e., a micro-behavioural view of ACAP) the second approach was adopted: prior-related knowledge was conceptualized as current knowledge of employees in the organization. Furthermore, because the focus of this study was on management practices that influence ACAP, prior-related knowledge was postulated to be a moderating variable. That is, a manager might do all of the things required to enable ACAP, but because prior-related knowledge is not adequate, people within the work group could find it difficult to absorb knowledge effectively. Accordingly, the following hypotheses were tested:

Research Hypothesis 3: Controlling for task complexity and source of knowledge, middle management practices will have more influence on ACAP in work groups with higher levels of homogeneity of prior-related knowledge than in those with lower levels of homogeneity of prior-related knowledge.

Research Hypothesis 4: Controlling for task complexity and source of knowledge, middle management practices will have more influence on ACAP in work groups with

higher levels of homogeneity of prior-related knowledge than in those with lower levels of homogeneity of prior-related knowledge.

3.0.4 Potential Control Variables

The literature identifies task complexity (Cohen and Levinthal, 1990; Zander and Kogut, 1995, Meckler, 2001) and the type of communication media (Gupta and Govindarajan, 2000; Johnson, 2000; Epstein, 2000; Meckler, 2001) used as variables that could potentially impact ACAP. The theoretical model developed for this thesis includes these factors since they could represent confounding variables. The following sections discuss task complexity and communication media (which, for the purposes of this thesis was referred to as "source of knowledge") in more detail and provide a justification for including the variables in the data collection strategy.

3.0.4.1 Task Complexity

Cohen and Levinthal's (1990) concept of "ease of learning" referred to the complexity of the knowledge to be assimilated. Their research demonstrated that when ease of learning was low, (i.e., the knowledge involved was less targeted to the firm's needs and thus more complex to assimilate) firms tended to invest more in R&D in order to build capability to absorb new information. Zander and Kogut (1995) also showed that innovations which are "codifiable" (i.e., less complex) tended to be transmitted faster than those in which the information was more difficult to explicitly express.

Admittedly, the two constructs are somewhat different. Cohen and Levinthal were addressing knowledge derived from basic as compared to applied sciences. In basic science, the knowledge tends to be more abstract and thus less amenable to integration into work routines. Zander and Kogut addressed the degree of "tacitness" involved in a manufacturing process. The fact that the knowledge is not easily codified into written format for example, implies that it may involve a level of complexity that requires more interactive forms of communication. Despite the subtle differences between these two constructs, they both introduce an aspect of "absorption difficulty" in that complex or less-targeted knowledge is more difficult to assimilate. This notion is supported by Tsai (2001) who demonstrated that organizational sub-units absorbing knowledge from many different sources needed to invest more in ACAP in order to better assimilate knowledge.

Since the authors of these studies did not address management practices, it is difficult to determine what the impact of complexity of knowledge might be for the purposes of this study. The construct of task complexity, however, might be somewhat more important to management practices. It seems reasonable to propose that work groups dealing with complex tasks might require more guidance from managers in order to determine what knowledge is pertinent (Brown and Miller, 2000). A considerable body of research suggests that complex tasks lead to the use of more consultative, decentralized decision-making, wider participation, and

more informal organizational processes (Tushman, 1979; Hirokawa, 1990; Brown and Miller, 2000). Accordingly, different levels of task complexity might call for different management practices, a factor that could confound the results of this study. In order to control for this potential confounding effect, information on task complexity was collected during the study and used as a control variable during the data analysis.

3.0.4.2 Source of Knowledge

In recent Ph.D studies, Johnson (2000), and Meckler (2001) found that source of knowledge had an impact on knowledge transfer effectiveness. In particular, Johnson (2000) tested certain aspects of Nonaka and Takeuchi's (1995) knowledge conversion model. Within this framework, his study suggested that face-to-face contact and telephone calls were most strongly related to effective knowledge transfer.

For the purposes of this study, source of knowledge was not proposed as one of the main independent variables because the focus of the study was on middle management practices. It seems reasonable to conjecture, however, that different sources of knowledge might be more or less effective in enabling knowledge absorption. Further, the role of the manager might be seen somewhat differently in work groups who rely on different sources. For example, some companies have started to use web-based videos to provide information directly from the senior

manager of the organization to front-line employees. In this scenario, the role of the middle manager in context building might not be as important as in organizations where this information is not as readily available.

Accordingly, data on the source of knowledge used by the work groups was used as a control variable in the data analysis. Table 11 provides a summary of the control variables and the references supporting their inclusion in the data collection.

Table 11: Control Variables

Control Variable	Management Strategy
Task complexity (Cohen and Levinthal, 1990; Zander and Kogut, 1995, Meckler, 2001)	Include in the survey; treat as control variable.
Communication media in use (Gupta and Govindarajan, 2000; Johnson, 2000; Epstein, 2000; Meckler, 2001)	Include in survey; treat as control variable.

3.0.5 Summary

The theoretical framework proposed for this thesis was based on the construct of ACAP articulated by Cohen and Levinthal (1990). The role of managers in developing ACAP was based on the knowledge-creating model developed by Nonaka and Takeuchi (1995) and on research examining the roles middle managers play in organizations. Prior-related knowledge and organizational culture, shown to be

potentially important factors in influencing ACAP, were integrated into the model as moderating variables. Two potentially confounding variables, task complexity and source of knowledge, were also identified.

CHAPTER 4: Methodology

4.0 Introduction

This chapter outlines the methodology used for this thesis. It describes the design of the research and the sample from which the data was collected, and then discusses the data collection and analytical procedures used.

4.1 Research Design

Ruspini (2002) identifies three different types of longitudinal studies:

- cross-sectional studies carried out with different samples over a period of time to identify trends;
- retrospective studies in which participants are asked to recall and reconstruct events; and
- prospective studies that interview the same subjects repeatedly over specific time periods.

This thesis employed a prospective longitudinal research methodology with 2 waves of data collection separated by 5-6 months. This design was adopted for a number of reasons. Ruspini (2002, p. 8) argues that prospective longitudinal studies, those

conducted by gathering data from the same participants at different time periods, tend to provide the most reliable data on change of knowledge of participants since the data is gathered while "subjective states still exist". Following the lead of Verkasalo and Lappalainen (1998), this study adopted a prospective longitudinal approach in order to gather data while it was fresh in the minds of the participants. Furthermore, previous studies on ACAP have gathered data on prior-related knowledge at the same time as they measured ACAP. If prior-related knowledge is a prior condition for ACAP, then it seems reasonable to gather data on prior-related knowledge at one point in time, and gather data on ACAP after some period of time has passed. Accordingly, the prospective longitudinal design was adopted to be able to assess prior-related knowledge as a condition for subsequent knowledge absorption.

Determining the appropriate amount of time between the waves of data collection, however, was somewhat problematic. On the one hand, the time period needed to be short enough to maintain momentum of the research project and to avoid high rates of attrition of study participants. On the other hand, a long enough period of time was required to allow for knowledge absorption to occur. The research studies reviewed in the preparation of this thesis did not provide guidance for a suitable time frame. Ultimately it was decided to allow for a minimum of 5 months and maximum of 6 months between data collection periods. This time period was determined based partially on consultations with managers participating in the study

who suggested that 5-6 months would be long enough to allow time for knowledge absorption to occur, but short enough to avoid large losses of study participants.

The level of analysis selected for the research was the work group. This contrasts with existing studies on ACAP, which tended to address ACAP at the level of the firm. The work group was chosen as the level of analysis because of the growing importance of work groups in knowledge utilization in organizations (Hedlund, 1994; Spender, 1996; Dixon 2000). Spender, for example, argues that "collective knowledge" might be the most secure and significant kind of knowledge in organizations. Hedlund (1994) suggests that the mere fact that so many organizations are organized into small work groups indicates that this is where much of the knowledge absorption and learning takes place. Dixon's (2000) research into how organizations create and use knowledge also emphasizes the importance of the work group. A focus on work groups was adopted therefore because of the importance of these groups in knowledge utilization in organizations and the paucity of research addressing ACAP at the group level.

4.1.1 Sample

Twenty-eight groups from 7 different public sector organizations participated in the study. Public sector organizations were selected for the study for a number of reasons including:

1. Convenience: (the Ottawa area has a large proportion of public service organizations);
2. Relevance: the Canadian government has a strong interest in exploring knowledge transfer in public sector organizations and has made a commitment to transforming the public service (Speech from the Throne, 1999) into a learning organization;
3. Applicability: public sector organizations represent important institutions for whom the capture and transfer of knowledge is critical for service delivery and innovation; and
4. Methodological: One of the key issues faced by researchers conducting longitudinal studies is the attrition of participants between waves of data collection. At the time this study was being conducted, private sector organizations in Ottawa were undergoing a series of downsizing exercises. Accordingly, the rates of attrition of personnel in the public sector was expected to be lower than that of private sector organizations in the Ottawa region during the period of time in which the study was conducted.

The main criterion for selection of organizations who participated in the study was that the organization had work groups of 5-15 individuals engaged in "knowledge work" who would be available for the duration of the study. The definition of "knowledge work" used to assess suitability of the type of work done by the groups as discussed by Davenport, Jarvenpaa, and Beers (1996, p. 54) was as follows:

. . .knowledge work's primary activity is the acquisition, creation, packaging or application of knowledge. Characterized by variety and exception rather than routine, it is performed by professional or technical workers with a high level of skill and expertise.

Sample selection was conducted by first identifying organizations known to the principal researcher and to the thesis supervisor. A second group of organizations participating in a government-wide middle management development initiative were also identified. E-mails were sent to senior managers in these organizations (which ultimately represented most of the Canadian federal government departments) explaining the purpose of the study and asking them to participate. In those organizations that expressed interest, the principal researcher met in person with the senior managers to provide additional details. The senior managers who agreed to participate then introduced the study to their middle managers and to their work groups.

4.2 Data Collection Procedures

Upon approval of the study by the senior managers in participating organizations, the principal researcher provided a presentation to the middle managers who would be involved. These meetings provided a background and context for the study, and gathered feedback on the process, instructions and measurement tools. Following

these meetings, a suitable time was scheduled with the work groups to provide information and to collect data. Recognizing that people's time was in short supply, the meetings were scheduled for 30-40 minutes maximum.

During the work-group meetings, the middle manager was present to introduce the researcher and to provide an overview of the organization's participation in the research project. Once this was done, the manager left the room and the researcher continued with the meeting. During the meeting, the researcher presented an overview of the study, gathered basic information from the participants in terms of the structure of their organizations and explored any major issues they faced related to knowledge utilization. Recognizing the time limitations, the presentation/exploration section of the meeting was fairly brief (10-15 minutes).

Once this section of the meeting was concluded, the questionnaires were distributed. The researcher remained in the room to answer questions and to collect the questionnaires, which included three sections:

1. The Organization Culture Assessment Instrument (Cameron and Quinn, 1999) which provided information on the organization's cultural orientation (see Appendix A);
2. A "Knowledge Assessment Inventory" that assessed prior-related knowledge (i.e., employees' current state of knowledge) on four knowledge categories (see Appendix B); and

3. A section called "Assessment of Middle Management Practices" that identified employees' perceptions of the degree to which middle managers practiced Context Building or Knowledge Integration behaviours. To gather data on task complexity (one of the potential confounding variables), this questionnaire also included a task complexity assessment (see Appendix C).

In order to match participant responses from Time 1 and Time 2, participants were asked to register on an enrolment form created for the study. To preserve anonymity, each participant in each group was then assigned a number, which was recorded on their completed questionnaire during Round 1 of the data collection. The researcher maintained a master list of participant names and numbers.

Responses for each group were entered into an Excel spreadsheet immediately upon completion of the data collection. The organization was identified in the spreadsheet, and, where multiple groups from one organization participated, the groups were identified by the initials of the middle manager involved.

Data collection at Time 2 followed a similar procedure: the researcher once again contacted the middle managers to schedule a time to meet with the work group. During these meetings, which lasted 20-30 minutes, respondents were asked to identify how much their knowledge in each of the 4 categories assessed at Time 1 changed since the last meeting. They were also asked to identify the sources of

knowledge used to capture knowledge, and to indicate whether barriers to knowledge transfer existed in the organization (note: due to time constraints, three groups responded to the Time 2 questionnaire through e-mail¹³). Responses from the Time 2 questionnaires were entered into the Excel spreadsheet matched against the scores entered from Time 1. Once the data were entered and checked for accuracy the master list of names was destroyed.

4.3 Measurement Strategies

The previous section described the general procedures used to collect the data. This section discusses how each of the variables in the study was measured. The general approach taken was to use existing measurement scales where possible, which resulted in the use of a variety of different scales. This approach, however, was deemed to be better from the point of view of reducing measurement error than attempting to develop a complete set of measurement tools.

The general approach taken was to review the literature for existing scales that could be used in this study. Where such measurement scales were not available, the theoretical and empirical literature was searched to find statements that could be used in this study. The questionnaires developed from the literature review were then distributed to the senior managers who sponsored the study in their

¹³ An ANOVA procedure revealed no significant differences in ACAP scores between groups who responded by e-mail and those who responded in person ($F=1.008$, $p=0.317$)

organizations, as well as to the middle managers whose groups would be participating. Minor modifications were made to the questions and to the instructions provided with the questions based on feedback from the managers.

Next, the questionnaires were distributed to a sub-sample of the participating groups (a total of 39 individuals¹⁴), a few refinements to the instructions were made based on the feedback from these participants, but feedback from the managers and the participants did not result in any major modifications of the measurement scales themselves¹⁵. Table 12 provides an overview of the measurement tools used; each of these tools is discussed in more detail in the following sections.

¹⁴ The scales were tested on an initial sample of 39 participants (in order to achieve a reasonable sample size, these participants were also included in the final data set).

¹⁵ This approach closely follows a model proposed by Churchill (1979) and is based on the overall framework discussed by Nunally (1970).

Table 12: Measurement Tools Used in the Study

Data to be Collected	Instrument	Source of Instrument	Reliability statistics
Cultural Orientation	24-item Organizational Cultural Assessment Instrument	Cameron and Quinn (1999)	Alpha=0.74-0.82
Prior-Related Knowledge and ACAP	4-point Self-Assessment scales	Developed and tested in this study following a competency assessment approach.	Alpha for prior-related knowledge=0.67 Alpha for ACAP=0.74
Management Practices	9-item 5-point scale comprised of two sub-scales.	Context-building behaviours, a 4-item scale (Goh & Richards 1995). Knowledge integration 5-item scale developed for this study.	Alpha=0.65 (0.81 in this study) Alpha=0.77
Task Complexity	2-item 9-point scale	Brown and Miller (2000)	Alpha=0.81
Source of Knowledge	Nominal scale	Developed in this study following the practice of Johnson (2000) and Meckler(2001), respondents were asked to indicate which sources of knowledge they used.	NA

4.3.1 Cultural Orientation

The Organizational Cultural Assessment Instrument (OCAI) developed by Cameron and Quinn (1999) was used to measure organizational culture. This instrument has 4 subscales, each of which assesses the strength of 4 different types of cultural orientation: clan, adhocracy, hierarchy and market. The OCAI has been used in a

variety of studies over the past ten years. Reliability of the four subscales has been estimated as follows (all using Cronbach's alpha).

- Clan: 0.74 to 0.82
- Adhocracy: 0.79 to 0.83
- Hierarchy: 0.73 to 0.76
- Market: 0.71 to 0.78

Criterion-referenced (i.e., the cultural orientations were noted to be consistent with practices in the organizations), convergent (correlation between two different tests ranged from 0.212 to 0.515, $p < 0.001$) and discriminant validity (Kendall's coefficient of concordance = 0.764, $p < 0.001$) were also confirmed through a number of different research studies. Cameron and Quinn (1999, p. 144) concluded that ". . . the empirical evidence suggests that the OCAI measures . . . key dimensions of organizational culture. . . [and] it measures these dimensions in a reliable way".

The OCAI is also relatively easy to administer and to score. The scale contains six sections each with 4 statements (a total of 24 statements). Each section is allocated 100 points for participants to assign to each of the statements. The points are then summed across the each section to determine the cultural orientation (see Appendix A). The OCAI results were calculated by creating formulas in an Excel spreadsheet to calculate average scores for each group. It is important to emphasize here that

even though this assessment was done at an organizational level, the clan orientation score was calculated on a work group basis. The rationale here is that even though the organization might have a specific culture as a whole, work groups within an organization would differ on the degree of "clanness". Average scores for each of the groups on clan orientation were transferred to an SPSS file once the calculations were complete.

4.3.2 Prior-Related Knowledge and ACAP

Measurement of prior-related knowledge and ACAP raised a number of interesting questions. First, the question of what aspects of knowledge to measure needed to be addressed. Second, the issue of how to conduct the measurement was also problematic.

In terms of what aspects of knowledge should be measured, it is obvious that individuals within work groups use a variety of different types and categories of knowledge to conduct their work¹⁶. On the one hand, the groups might rely on explicit knowledge such as policies and procedures that are written down in manuals and directives. On the other hand, they may also make use of tacit knowledge received by word-of-mouth from colleagues. Furthermore, they will tend to use knowledge in different categories such as knowledge of the products and services they provide, or knowledge of specific processes used to provide these services and

¹⁶ The convention adopted is that "type of knowledge" refers to either tacit or explicit, while "categories of knowledge" refers to knowledge topics.

so on. Combining the knowledge types and knowledge categories results in a complicated array of different aspects of knowledge that could be measured.

The position on tacit and explicit knowledge adopted in this thesis was that the distinction was not important for the purposes of answering the research questions since the research was focused on knowledge that could be put to use in task accomplishment. Ignoring knowledge type meant that the only remaining question concerned the categories of knowledge that should be measured.

Van den Bosch, Volberda and de Boer (1999), in a longitudinal case study on ACAP, addressed a similar question and identified the following categories of knowledge:

- Knowledge related to products and services;
- Knowledge related to production processes; and
- Knowledge related to the market.

It seems reasonable to conjecture that most of the knowledge important to task accomplishment within an organization would fall into one of these three categories. Van den Bosch, Volberda and de Boer's (1999) approach was to measure all three categories. Accordingly, this approach was adopted in this study.

A few minor modifications to the categories were needed, however. Because the public sector environment does not recognize the "market" per se, "knowledge of the market" was changed to "knowledge of the client" (a similar construct). Furthermore, consultations with participants in the study identified a fourth category

called knowledge of technology¹⁷. This category had relevance to much of the sample. Accordingly, for the purposes of this thesis, the following four categories of knowledge were used:

- Knowledge of products and services;
- Knowledge of work processes;
- Knowledge of clients; and
- Knowledge of technology

The second major question to be addressed was how to measure knowledge. A review of previous empirical work (Boyton, Zmud and Jacobs, 1994; Szulanski 1996, 2000; Verkasalo and Lapalainen 1998; Gupta and Govindarajan, 2000; and Matusik and Heeley, 2002) showed that self-assessment was the approach used most often to estimate the level of current knowledge or to measure how much knowledge was transferred between organizations. The alternative to self-assessment was to measure individual knowledge through use of a knowledge test (for example, a multiple choice quiz). This approach, however, would require a concrete description of what individuals within the groups are likely to know. Given the different organizations, groups and job roles represented by participants in this study, this strategy would have been difficult to implement from a practical perspective. Further, it would not allow for comparability across the groups.

¹⁷ The fact that 11 out of the 28 groups participating worked in the information technology field makes the identification of this category important for interpretation of results. For many of the other non-IT groups, knowledge of technology was important in getting their work done. For the IT groups, knowledge of technology could also be termed process knowledge.

Given the methodological problems inherent to conducting a direct measurement of knowledge, self-assessment of knowledge was used in this thesis to capture both prior-related knowledge and ACAP. It was recognized, however, that such an approach introduced potential problems of its own. First, the literature suggests that individuals might artificially inflate their ratings in order to meet perceived socially desirable expectations (Fox and Dinur, 1988). Related to this problem is the issue of percept-percept inflation: statistically, the use of self-reports as the sole means of gathering data could introduce spurious covariation among the variables (Crompton and Wagner, 1994). Second, individuals might not have an objective enough view of their abilities to give an accurate assessment (Mabe and West, 1982).

The research suggests, however, that these problems are not as intractable as they might appear. A meta-analysis by Shrauger and Osberg (1981), showed that self-assessments were often as good as, if not superior to, external rater assessment or test scores. Fox and Dinur (1988) argue that it seems reasonable to assume that individuals would know their own abilities better than anyone else. They tested this proposition in a field study (Fox and Dinur, 1988) demonstrating that self-assessments were significantly related to peer and supervisor assessment and were less affected by halo effect than assessments provided by external raters. A similar study by Randall, Ferguson and Patterson (2000) showed that accurate self-assessments did distinguish successful candidates from unsuccessful ones. Finally,

Crompton and Wagner (1994) specifically addressed the percept-percept issue in a meta-analysis of 581 studies. They concluded that some tendency to inflation exists, but they also found that the effect of self-assessments were just as likely to be statistically neutral.

Mabe and West (1982) and Clive and Fletcher (2002) demonstrated in their studies that the conditions under which self-assessments are conducted have an impact on the degree of inflation noted. When the questionnaires were based on behavioural elements (i.e., linked to specific behavioural descriptions), and where instructions guaranteed the anonymity of the assessments, the evaluations tended to be more accurate. Furthermore, when self-assessments were done for the purposes of selection, either of a candidate for a job or for a promotion, ratings tended to be more inflated (Clive and Fletcher, 2002).

Since the conditions of this thesis had no influence on candidate selection, and since the participants could be assured of complete anonymity, it was felt that the self-assessment approach was the best methodology to be used to measure prior-related knowledge and ACAP.

Theoretically, prior-related knowledge is thought to influence ACAP. Accordingly, prior-related knowledge was assessed during the first round of data collection to

enable determination of its influence on ACAP, which was assessed during the second round.

During the first meeting with the work groups, participants were asked to rate their current knowledge on a 4-point scale on each of the four categories of knowledge discussed earlier (client, products and services, processes and technology)¹⁸. The 4-point scale was anchored as follows: beginner (1), intermediate (2), advanced (3), or expert (4)¹⁹. The average of the scores across the 4 categories of knowledge was used as a composite score for prior-related knowledge.

ACAP was assessed during the second round of data collection, operationalized as the increase in knowledge of participants in each of the 4 knowledge categories. The rationale was that groups who indicated that they learned more were considered to have a higher level of ACAP. The scale used for assessing ACAP was similar to that used for prior-related knowledge: participants were asked to indicate how much their knowledge, in each of the 4 categories, had changed since the beginning of the study. The Likert scale used to collect these responses provided four categories: no change (1), increased a little (2), moderate increase (3), increased a lot (4). The average scores across the 4 knowledge categories were used as the ACAP score.

¹⁸ The 4-point scale was adopted based on a review of applications of competency assessment in occupational settings, which demonstrated that each of the points on the scale should be clearly defined to guide assessment (SkillScape, 2001)

¹⁹ See Appendix B

Pre-assessment of the prior-related knowledge scale with 39 participants indicated a Cronbach's alpha of 0.67. Because of the longitudinal nature of the study, it was not possible to test reliability of the ACAP measurement prior to its use. As tested during the study however, a Cronbach's alpha of 0.74 ($n=39$) was calculated.

4.3.3 Management Practices

To assess which middle management practices were demonstrated by managers in the sample, respondents were asked to indicate, on a 5-point, 9-item Likert scale, how often managers displayed Context Building and Knowledge Integration Behaviours. The specific behaviours assessed were developed through a review of a number of key articles including Kanter (1982), Zuboff (1988), Nonaka and Takeuchi (1995) and Huy (2001). Based on this literature, 4 statements related to Context Building and 5 statements related to Knowledge Integration behaviours were identified.

These sample statements were reviewed by the senior managers who sponsored the study, and by the middle managers whose groups participated. No additional questions were proposed and none of the managers involved suggested any changes to the original 9 statements. Accordingly, the original 9 statements were retained to be tested with a sub-sample of the study participants (the alpha coefficients resulting from these tests are provided in Table 12) formed the measure of Management Practices used in this study.

Context Building Behaviours were measured through a 4-item Likert scale developed and used in previous studies on organizational learning in the public sector (Richards, 1994; Richards and Goh, 1995; Goh and Richards, 1997). Respondents were asked to what extent their managers practiced certain behaviours. Anchors used in the 5-point scale included: not very often=1, sometimes=2, frequently=3, very often=4, continually=5. The specific statements used in the scale (see Appendix C) were as follows:

- Develops support and acceptance for the organization's mission statement;
- Helps employees understand how the mission of the organization is to be achieved;
- Helps to clarify the organization's vision, mission and strategic imperatives; and
- Provides feedback that helps to identify potential problem and opportunities.

The core commonality among the statements is that these behaviours establish a strategic context for the work group. This context is thought to provide an overall direction for learning within the group (Nonaka and Takeuchi, 1995). Responses to the four statements were averaged for each individual, and then averaged across all respondents in the group to form the Context Building Behaviour score for the group's manager.

This scale has been tested in prior research (Richards, 1994; Richards and Goh, 1995; Goh and Richards, 1997) and found to have a Cronbach's alpha of 0.65. As tested for this study (N=39), the Cronbach's alpha was 0.81.

No suitable scale for assessment of Knowledge Integration behaviours was found. Accordingly, this sub-scale was developed and tested specifically for this study. The Cronbach's alpha for these items as tested in this study was 0.77 (N=39). It was scored the same way as the Context-Building Behaviour scale: respondents were asked to what extent their managers practiced certain behaviours. Anchors used in the 5-point scale included: not very often=1, sometimes=2, frequently=3, very often=4, continually=5. The specific statements used in the sub-scale, developed through a review of research conducted by Kanter (1982), Zuboff (1988), Nonaka and Takeuchi (1995), Janczak, 1999; Huy (2001), and Gunther-McGrath (2001) were as follows:

- Distributes information on how the organization is performing;
- Encourages work groups to make decisions about problems and opportunities;
- Encourages team members to act on new information received;
- Helps to develop relationships within the work group; and
- Provides opportunities for self-assessment with respect to goal accomplishment.

The rationale for including these types of behaviours can be found in the literature and reflects the recent work of Janczak (1999), who demonstrated through his case study research that knowledge integration often includes a number of different but related themes. Three such themes are reflected in this subscale. First, the provision of performance information to work groups is thought to help identify gaps that motivate the identification and absorption of knowledge (Zahra and George, 2002). Second, the opportunity for group members to make decisions, to act on information, and to assess their own accomplishments is thought to create a climate of autonomy that is conducive to knowledge absorption (O'Dell and Grayson, 1998; Nonaka, Konno and Toyama, 2001). Third, development of relationships within the group is expected to create a climate that stimulates the transfer of tacit knowledge among group members (Nonaka and Takeuchi, 1995; Nonaka, Konno and Toyama, 2001).

4.3.4 Task Complexity

Data on task complexity were collected during the first round of data collection. This variable was measured using a 2-item 9-point scale developed by Brown and Miller (2000). This scale, included on the same form used to collect data on management practices, asked participants to rate first the difficulty and then the challenge implicit in their work. The scale for both ratings varied from 1 through 9,

(with 9 indicating very difficult and challenging work). Task complexity was estimated by averaging the results for difficulty and challenge²⁰.

As mentioned earlier in this thesis, task complexity was included as a means of controlling for the potential impact of the overall complexity of the knowledge used by group members. Kogut and Zander (1995) demonstrated that less complex knowledge tended to be easily codified and transferred whereas more complex knowledge was often slower to be transferred.

Further, a substantial body of research demonstrates that managerial behaviour tends to vary according to the complexity of the work being done (Brown and Miller, 2000). For highly complex tasks, it is possible that managers might pay more attention to ensuring that work groups have access to knowledge than for tasks of less complexity. Accordingly, the rationale for using this scale was to account for the potential confounding impact of task complexity.

4.3.5 Source of Knowledge

Source of knowledge was also thought to be a potential confounding variable. Accordingly, participants were asked to indicate, on the same form on which they assessed ACAP during round 2 of the data collection, the different ways in which

²⁰ Note, Brown and Miller, (2000) report a Cronbach alpha for this scale of 0.81.

they had acquired knowledge with respect to the four knowledge categories within the past 5-6 months.

A scale was not developed to gather this data. Rather, following the lead of Johnson (2000) and Meckler (2001), participants were simply asked to indicate what sources of knowledge they used. Multiple responses were possible for each of the knowledge categories (see Appendix D for the actual instrument used).

The analysis focused on identifying the most common sources of data used by the work groups. Johnson (2000) and Meckler (2001) indicated in their studies that certain sources of knowledge seemed to be more amenable to transferring knowledge than others. This data, therefore, provided an indication of whether the work groups relied on different sources of knowledge for the different knowledge categories, and whether ACAP varied among groups based on the source of knowledge used.

4.4 Data Analysis

A number of researchers argue that phenomena studied in the social sciences tends to feature hierarchical structure (Burnstein, 1980; Goldstein, 1987, 1995; Bryk and Raudenbush, 1992; Osborne, 2000; Hok, 2002) where units at one level of grouping (for example, characteristics of a work group) have an impact on units at another

level (for example, individuals in work groups). This thesis specifically modelled hierarchical relationships among the variables (i.e., management practices, an individual-level variable, was hypothesized to influence the individual-level variable ACAP of group members with the group-level variables of organizational culture and prior-related knowledge as moderators). Accordingly, a specific procedure within multiple regression, referred to as multi-level modelling (Goldstein, 1987), or Hierarchical Linear Models (HLM) (Bryk and Raudenbush, 1992) was used to analyze the data set.

Since HLM is a relatively new statistical technique in organizational studies, this section provides a brief history of HLM and then discusses key methodological issues such as centering of variables, sample sizes, and selection of HLM models. The section concludes with a description of the mathematical models for the hypotheses being tested in this thesis. To clarify the following discussion, the terminology of multi-level analysis as used by Snijders and Bosker (1999) will be adopted such that Level 1 units (individuals within groups within a sample) will be referred to as *micro-units*. The groups to which these individuals belong will be referred to as *macro-units*²¹.

²¹ Note, the HLM approach used allows for up to three levels of hierarchy. For example, the data could be modeled as individuals nested within groups nested within organizations. For the purposes of this thesis however, since the data was collected at the group and individual levels, a 2-level model seemed appropriate.

4.4.1 Description of Hierarchical Linear Modelling

HLM is based on two methodological approaches: contextual analysis and mixed effects models (Snijders and Bosker, 1999). Contextual analysis was developed in the social sciences as a means of examining the effects of the social context on individual behaviour. Mixed effects models are statistical models in ANOVA in which it is assumed that some of the coefficients are fixed and others are random. Hierarchical Linear Modelling emerged in the early 1980s through the combination of contextual and random effects methodologies to analyze data where the impact of a group-level variable can be included in a regression model through the use of random coefficient approaches (Snijders and Bosker, 1999).

4.4.1.1 HLM vs. Ordinary Least Squares

The use of Ordinary Least Squares (OLS) as an analytical tool is based on a number of basic assumptions inherent to traditional linear data analysis: independence of the observations, homoscedasticity (constant variance), normality and linearity.

Hierarchical data tends to violate the independence and homoscedasticity assumptions because the data are clustered. Thus individuals within a particular cluster (for example, groups within organizations) might be influenced by common factors related to the cluster. In order to respect the OLS assumptions, researchers tend to disaggregate the data and assign each individual score a group “marker” so

that the individual can be assigned to his or her respective group upon completion of the analysis. Another common approach is to aggregate the data and conduct the analysis at the group level using group means (Bryk and Raudenbush, 1992; Griffin and Hoffman, 1997; Osborne, 2000). The first approach violates the assumption of independence, since, as discussed above, individuals in the disaggregated data set are from a smaller number of groups. Using group means as scores in the analysis sidesteps the independence problem, but also throws away within-group variation. This practice reduces the standard error, and thus possibly overestimates the relationships between variables at the individual level (Bryk and Raudenbush, 1992; Draper, 1995; Osborne, 2000). Robinson (1950) contributed a landmark paper recognizing this phenomenon as the “ecological fallacy”, referring to the confusion that could arise when correlations between grouped variables are used to predict relationships at the individual level.

Draper (1995) suggests that HLM provides the following advantages in analyzing hierarchically structured data sets:

- a means of exploring and comparing theories about structural relationships among variables at each level of an organizational hierarchy;
- “better calibrated uncertainty assessments in the presence of intracluster correlations”, (p. 117);

- a means of combining information across different units in order to produce more precise predictions of observable outcomes.

HLM basically allows for consideration of both within-group and between-group variance at different levels of data collection. In so doing, the researcher can use all of the variance present in the data set and thus likely generate a more accurate analysis of relationships between the variables. Further, the lack of independence between individual observations is specifically modeled and taken into account when establishing samples sizes and power.

In terms of conducting an HLM analysis, the fundamental concepts are similar to those of OLS in that independent and dependent variables are identified²² and the data analyzed to explore the relationships between these variables (Osborne, 2000). HLM extends the analytical power of OLS by partitioning all the variance within the data set, both within group and between groups, and by analyzing this variance across different levels. According to Griffin and Hoffman (1997, p. 2), "...these approaches explicitly model both individual and group level residuals therefore recognizing the partial dependence of individuals within the same group". Further, the procedures can model cross-level interactions demonstrating, for example, the moderating influence of a group level variable on a first level regression equation.

²² Note, in the multiple regression literature, the terms "response" or "outcome" and predictor variables are becoming common, but for the purposes of this thesis, the classical terms "independent" and "dependent" variables will be used throughout.

4.4.1.2 The Family of HLM Models

There are a number of different models available in HLM analysis (Bryk and Raudenbush, 1992). The following models are used in this dissertation:

- one-way random-effects ANOVA;
- random coefficients model;

The one-way random-effects ANOVA model provides preliminary information on the multi-level framework of the data and generates an overall (grand) average for the variables in question. In addition, the total variance is partitioned into between and within group variation. The intra-class coefficient (ICC) is calculated as a ratio of "within" to total variance.

A one-way random-effects model is often the first step in multi-level analysis since, if there is no ICC, the multi-level nature of the data can effectively be ignored and the data set treated as independent observations (Byrk and Raudenbush, 1992; deLeeuw and Kreft, 1998).

The random coefficients model treats the coefficients at the micro-unit level as random variables to be predicted by coefficients at the macro-level. In some situations, where it is thought that group-level factors influence individual-level dependent variables, an Analysis of Co-Variance Model (ANCOVA) might be used.

According to Snijders and Bosker (1999), however, when groups are regarded as unique entities and the objective is to draw conclusions about the group, then the ANCOVA model is appropriate. On the other hand, when the groups are regarded as a sample of groups from a larger population, and the objective is to examine the impact of group-level independent variables on a dependent variable, as is the case in this thesis, then the random coefficients model is appropriate.

4.4.1.3 Sample Size

Goldstein (1995) argues that at the moment, there are no hard and fast rules related to sample size determination in HLM analysis. According to a number of authors, the most critical aspect with respect to ensuring adequate sample sizes in hierarchical linear analysis is the number of macro units (Mok, 1995; deLeeuw and Kreft, 1998; Snijders and Bosker, 1999; Hoop and Mass, 2002). Large samples (i.e., 30 or more macro-units) provide for tight confidence intervals around the parameters. However, a precise determination of sample size requirement depends on the multi-level models to be used and the parameters of interest (Hox, 1998; Snijders and Bosker, 1999).

This issue has been examined through a number of simulation studies. For example, Hox and Mass (2002) conducted a simulation study of the impact of sample sizes where the response variable is at the micro level with predictor variables at both levels. The objective of the study was to identify the sample size

that would generate accurate estimates and standard errors, and to examine the impact of non-normal higher-level errors. The simulated conditions are described in Table 13.

Table 13: Description of Simulation Study

Number of groups	Group Size	Intra-class correlation
30	5	0.1
50	30	0.2
100	50	0.3

Thus, 27 different conditions were simulated with 1000 data sets generated for each condition. The simulation results demonstrated that, where the variables showed a normal distribution, no detectable bias was found in the regression coefficients or the variances for either the micro or macro-level units.

It is difficult to draw firm conclusions about sample size based on the research thus far. A general rule of thumb has been proposed that 30 groups with 30 members per group are ideal (DeLeeuw and Kreft, 1995), but the simulation studies discussed above suggest that parameter estimation at the micro-level is generally accurate with fewer members per group. Furthermore, for experimental studies, it might be possible to conduct the research with ideal group sizes. In field research however,

one has to examine the groups as they are. DeLeeuw and Kreft (1995) note that in field studies in the educational arena, studies tend to be conducted with anywhere from 20-100 groups varying in size from 5 to 50 members. Accordingly, the sample size for this dissertation falls within the range of sample sizes noted by DeLeeuw and Kreft (1995).

Given the lack of a generally accepted approach for estimating required sample sizes in HLM analysis, it appears that a reasonable approach is to estimate the required sample size requirements as if the study were being analyzed through OLS, and then make adjustments for the estimated intra-class correlation (Snijders and Bosker, 1999). The sample size is an important contributor to the power of the statistical tests to be used in this thesis. The power of a statistical test, defined as the probability of rejecting the null hypothesis when it is false (or accepting the alternative hypothesis when it is true), also varies according to the significance level chosen for the test (i.e., alpha) and effect size.

For most social science studies, $\alpha=0.05$ has become the most commonly used level of significance for statistical tests. To estimate the required effect size, Cohen (1992) provides the following guidelines related to multiple regression studies:

	<u>R²</u>	<u>R</u>
Small:	0.02	0.14
Medium:	0.15	0.36
Large:	0.35	0.51

Cohen (1992) points out that the results from studies in various fields shows a tendency towards the medium effect size. Accordingly, the medium effect size was adopted in this thesis.

Estimation procedures provided by Cohen (1992) suggest that for a medium effect size with 3 explanatory variables (as is the case in this thesis) at $\alpha=0.05$, a total sample size of 76 micro-units would provide power of 0.80. To adjust this estimation for the expected intra-class correlation (ICC) Snijders and Bosker (1999) use a methodology that considers the "design effect" of clustered samples. The design effect is determined by the equation:

$$1 + (n-1)\rho$$

where "n" is the average group size and ρ is the ICC²³. The ICC is unknown before hand, but for studies in the social sciences domain, Snijders and Bosker (1999)

²³ Intra-class correlation is important because if the ICC were to be ignored the alpha level can be significantly inflated. For example, Kreft and Deleeuw (1998) demonstrate that with an ICC of only 0.01, and a sample size of 25, an expected alpha of 0.05 is inflated to 0.08. With a sample size of 100 and ICC of 0.20, an alpha of 0.05 is inflated to 0.70.

suggest that a reasonable estimation is 0.20. Therefore, applying this formula to the estimation of a sample size of 76 micro-units (the minimum sample size determined necessary to detect a medium effect with adequate power), with an expected average of 6 members per group, the design effect is calculated as:

$$1 + (6 - 1) * 0.20 = 2$$

Therefore, combining Cohen's (1992) sample size determination methodology with that of Snijders and Bosker (1999), the minimum total sample size (i.e., micro-units x macro-units) needed for this study in order to generate adequate power is $76 \times 2 = 152$ micro-units with average of 6 per group (i.e., 25 macro-units). This study was conducted with a total sample size of 179 (with an average of 6 members per group and a total of 28 macro-units) suggesting that power should be adequate to detect a medium effect size.

It is important to bear in mind, however, that as Goldstein (1999) points out, methodologies for determining sample size in hierarchical analysis have not been fully tested. Given that the sample size used in this thesis however, was close to the 30 groups recommended in the literature, that a number of control variables were identified and measured, and that the study was longitudinal, it is assumed that the statistical tests employed had adequate power to detect a medium effect size.

4.4.1.4 Scaling Options

The question of centering of variables has been subject to much debate in the HLM literature (Bryk and Raudenbusch, 1992; Hofmann and Garvin, 1998). Three basic options are possible:

- Use raw data in the analysis (i.e., no centering)
- Center on the group means (i.e., subtract raw scores from the group mean and use these numbers in the data analysis)
- Center on the grand mean (i.e., subtract raw scores from the grand mean...the average of the total sample, and use these figures in the data analysis).

The choice of centering approaches might appear to be a methodological issue, but Hofmann and Garvin (1998) point out that how one interprets the results of HLM depends on which centering option is selected. From a conceptual perspective, Hofman and Garvin (1998) categorize multi-level organizational research into the paradigms shown in Table 14.

Table 14: Categorization of Multi-Level Paradigms

Paradigm	Response Variable	Role of the Macro-Level Explanatory Variable	Implications for Centering
Incremental	Micro-level	Has an impact over and above that of micro-level explanatory variables	Grand mean centering needed to control for the effect of the micro-level variables allowing the incremental impact of the group variables to be detected.
Mediational	Micro-level	Influences the response variable indirectly through mediating mechanisms	Grand mean centering appropriate to control for the individual-level variables.
Moderational	Micro-level	Moderates the relationship between the micro-level variables.	Specifically models the group level variance. The moderational impact suggests that groups would have different slopes at different levels of the group variable. Group mean centering is more appropriate.
Separate	Micro-level	Separate structural models created for within and between group components of the macro variable.	Separate within and between-group models are generated. Accordingly, group mean centering is more appropriate.

Since this study postulated a moderating effect of the group-level variables (i.e., organizational culture and prior-related knowledge), group-mean centering was a more appropriate approach and was therefore the centering approach adopted.

4.4.1.5 Unequal Group Sizes and Missing Data

Group sizes in multi-level data are often not equal. The result is that some groups will contribute more to the analysis than others (i.e., smaller groups will contribute less to the variance estimation). Snijders and Bosker (1999) argue, however, that

this is not a problem in hierarchical analysis. They suggest that one way of addressing this issue is to include group size as an explanatory (i.e., independent variable) in the model. This approach has been adopted in this thesis.

Missing data is a related problem in longitudinal studies. In most situations, cases with missing data are dropped from the analysis (therefore contributing to the problem of unequal group sizes). The recommendation is that the missing data be analyzed and possibly modeled as an explanatory variable as well or “plug” the missing data with the means for that variable to avoid confounding the variance parameters (Goldstein, 1995). The latter approach has been used in this thesis for all instances of missing data.

4.4.1.6 Analytic Procedure for HLM

Typically, an HLM analysis starts with development of an OLS model for the micro-level variables. The coefficients in this model are then treated as random variables to be predicted by the statistics in the macro-level model. In other words, if the micro-level model describes ACAP (the Y or dependent variable in this study) as a function of management practices, the macro-level model asks what group level characteristics influence the micro-level coefficients. The theoretical framework introduced in Chapter 1 of this thesis is reproduced in Figure 12 in multi-level format (using the approach suggested by Snijders and Bosker, 1999) in order to provide a context for the equations which follow.

Figure 12: The Proposed Theoretical Framework as a Multi-Level Model²⁴

Variables above the dotted line represent group-level factors that may influence relationships at the individual level. The hypotheses established for this dissertation are reproduced in the following table along with the multi-level equations used to test each hypothesis.

²⁴ Note, following the logic of HLM analysis, the independent variable is measured at the micro-level. Theoretically, this approach makes sense since ACAP of the group depends on individual ACAP (Cohen and Levinthal, 1990). The HLM procedure then identifies variance at the individual (within the groups) and group levels (between the groups). Centering the predictors establishes the group mean (of ACAP) as the dependent variable in the HLM model.

Typically, most hierarchical analyses begin with an estimation of a “null model” with only an intercept term (i.e., no independent variables). This first step allows estimation of the intra-class correlation which, if not significant, means that the group effect has no influence, and the analysis could be done using OLS procedures (Bryk and Raudenbush, 1992; de Leeuw and Kreft, 1995; Maas and Hox, 2002). This methodology has been adopted in this thesis such that the general analytical framework was as follows:

- examination of the distribution of the variables at both the micro and macro-levels;
- generation of a “null” HLM model to determine if intra-class correlation exists;
- continuation of the analysis using either OLS or HLM depending on the degree of intra-class correlation present.

Table 15: Summary of Research Hypotheses and Hierarchical Linear Model Equations

Hypothesis Number	Hypothesis	Equations
1A	Management practices will have a positive impact on the ACAP of work groups.	<p><u>First level model</u></p> $Y_{ij} = \beta_{0j} + \beta_1 X_{ij} + e_{ij}$ <p>X=average aggregated frequency of all 9 management practices</p>
1B	Context building behaviours by middle management will have a positive impact on the ACAP of work groups.	$Y_{ij} = \beta_{0j} + \beta_1 X_{ij} + e_{ij}$ <p>X=average aggregated frequency of subset of management practices thought to be related to context building.</p>
1C	Knowledge integration behaviours by middle management will have a positive impact on the ACAP of work groups.	$Y_{ij} = \beta_{0j} + \beta_1 X_{ij} + e_{ij}$ <p>X=average aggregated frequency of subset of management practices thought to be related to knowledge integration.</p>
2	Organizational culture will moderate the relationship between middle management practices and ACAP. Specifically, the stronger the clan orientation, the more influence management practices will have on ACAP	<p>HLMS</p> $Y_{ij} = \beta_{0j} + \beta_{1j} X_{1j} + e_{ij}$ <p>X=management practices</p> <p><u>Second Level Model</u></p> $\beta_{0j} = \gamma_{00} + \gamma_{01} C_j + u_{0j}$ $\beta_{1j} = \gamma_{10} + \gamma_{11} C_j + u_{1j}$ <p><u>Combined Model</u></p> $Y_{ij} = \gamma_{00} + \gamma_{01} C_j + u_{0j} + \gamma_{10} (X_{ij} - M_{.j}) + \gamma_{11} C_j (X_{ij} - M_{.j}) + u_{0j} + u_{1j} (X_{ij} - M_{.j}) + e_{ij}$ <p>C=group variable "clanness"</p>
3	Middle Management practices will have more influence on ACAP in work groups with higher levels of homogeneity of prior-related knowledge than in those with lower levels of homogeneity of prior-related knowledge..	$Y_{ij} = \gamma_{00} + \gamma_{01} + u_{0j} + \gamma_{10} (X_{ij} - M_{.j}) + \gamma_{11} H_j (X_{ij} - M_{.j}) + u_{0j} + u_{1j} (X_{ij} - M_{.j}) + e_{ij}$ <p>H= standard deviation of the group variable prior-related knowledge.</p>
4	Middle Management practices will have more influence on ACAP in work groups with higher levels of prior related knowledge than in those with lower levels of prior related knowledge.	$Y_{ij} = \gamma_{00} + \gamma_{01} + u_{0j} + \gamma_{10} (X_{ij} - M_{.j}) + \gamma_{11} K_j (X_{ij} - M_{.j}) + u_{0j} + u_{1j} (X_{ij} - M_{.j}) + e_{ij}$ <p>K=average of the group variable prior-related knowledge.</p>

CHAPTER 5: RESULTS

This chapter presents the results of the study. First, a profile of the sample and a description of each of the participating organizations is provided. Second, descriptive statistics of the sample are presented followed by correlation matrices and results of the hypothesis tests. Finally, results of a number of exploratory follow-up analyses are presented. This chapter presents only the results of the data analysis; interpretation and discussion of the findings are reserved for the following chapter.

To orient the reader to this section, it is important to recall that given the fact that the theoretical framework related to ACAP is relatively undeveloped, the thesis included both confirmatory and exploratory analyses. The confirmatory aspect focused on examining relationships between variables that previous research has found to be associated with ACAP. Hypotheses generated for the confirmatory part of the thesis postulated that middle management practices, which included context building and knowledge integration behaviours, would influence ACAP. In addition, it was hypothesized that organizational culture and the amount and homogeneity of prior-related knowledge of the work group would moderate the impact of management practices.

The exploratory aspect of this thesis focused on developing a number of explanatory models to examine different relationships among the variables. The various categories of ACAP were also explored as separate constructs in this analysis.

5.0 Profile of the Sample and Qualitative Data

Thirty-three groups from 8 different organizations began the study in February, 2002. The second round of data collection was conducted October through November, 2002. One organization (a total of five groups) failed to complete the second round and, within the remaining groups, 83 participants were lost to attrition. For the most part, attrition was due to individuals who left their groups between the two rounds of data collection. In addition, some individuals were not able to participate at Time 2 due to work requirements²⁵. Accordingly, the analysis reported in this section was conducted with data from 179 individuals in 28 groups (average of 6 members per group) from 7 different organizations.

It should be noted that participation was not equally distributed among the 7 organizations. Ten out of the 28 groups were from Organization 3 (101 employees in total out of the 179 participating). Accordingly, the overall results are strongly influenced by the scores from this organization. Details on the various organizations who participated in the study are provided in Section 5.1.

²⁵ Note, data collected from individuals at Time 1 who did not participate at Time 2 were dropped from the analysis.

Within each organization, the participating groups were involved in different types of tasks. For example, while the 10 groups in ORG3 all worked in the IT field, some groups worked in maintenance of hardware and software, others were in development, and some were in operations. Table 16 provides a descriptive statistics of the work groups.

Table 16: Descriptive Statistics of the Work Groups

Organization/ Group	Average length of time in organization (years)	Average length of time in group (years)	Elapsed time (in weeks) between sessions	Group Size Round 1	Group Size Round 2	Attrition	Basic Tasks
ORG1	3.42	3.5	33	7	6	1	Research and development in the field of Human Resources
ORG2: Group 1	6.17	2.20	40	10	6	4	Development of training programs
ORG2: Group 2	2.6	2.27	41	8	3	5	Development of training programs
ORG2: Group 3	6.12	4.02	41	10	10	0	Management of overall financial and reporting
ORG2: Group 4	9.67	4.22	40	10	10	0	Development of training programs
ORG3: Group 1	7.87	3.37	37	11	8	3	Information technology management
ORG3: Group 2	6.77	3.78	35	10	10	0	Information technology management
ORG3: Group 3	9.52	2.18	39	11	10	1	Information technology management
ORG3: Group 4	13	2.8	37	10	7	3	Information technology management
ORG3: Group 5	5.48	0.93	37	10	7	3	Information technology management
ORG3: Group 6	4.53	2.21	35	15	5	10	Information technology management

Organization/Group	Average length of time in organization	Average length of time in group	Elapsed time (in weeks) between sessions	Group Size Round 1	Group Size Round 2	Attrition	Basic Tasks
ORG3: Group 7	6.22	2.13	33	11	8	3	Information technology management
ORG3: Group 8	7.64	1.54	42	10	6	4	Information technology management
ORG3: Group 9	3.84	0.84	34	12	6	6	Information technology management
ORG3: Group 10	8.10	0.90	27	6	3	3	Management of printing
ORG4: Group 1	8.08	1.72	24	8	5	3	Business solutions provision for a large public sector department
ORG4: Group 2	17.14	1.40	31	7	7	0	Preparation of briefings and reports.
ORG4: Group 3	8.22	7.06	26	8	5	3	IT services provision for a large public sector department
ORG5: Group 1	5.6	5.2	32	5	5	0	Delivery of business solutions
ORG5: Group 2	4.82	3.95	31	8	4	4	Delivery of business solutions
ORG5: Group 3	3.06	1.78	30	8	3	5	Delivery of business solutions
ORG5: Group 4	7.32	3.46	26	9	5	4	Delivery of business solutions
ORG5: Group 5	2.85	0.95	30	5	3	2	Delivery of business solutions
ORG5: Group 6	11.39	5.5	23	9	5	4	Delivery of business solutions
ORG6: Group 1	8.38	4.56	26	12	10	2	Development of policy
ORG6: Group 2	3.65	6.05	24	10	8	4	Facility management
ORG6: Group 3	2.13	1.63	24	11	5	6	Facility management
ORG7	19.36	1.28	29	11	9	2	Management of large projects
Total	8.10	2.6	32.4	262	179	83	

5.1 Management Structure of the Organizations

The structure of each organization was described to the researcher during initial meetings. Since the participating organizations prefer to remain anonymous, the following description of their organizational structures is necessarily generic in nature. The organizations are described in enough detail, however, to clearly outline the approximate size of the organization, the structure of the management cadre, and the nature of the work being done by the work groups participating in the study.

The convention established in this thesis for defining the management structure was to code the head of the organization (in the case of the organizations involved, this would be either a Deputy Minister, Chief Executive Officer, or Executive Director positions) as "0" with each level below coded as "1", "2", "3" and so on down through the management hierarchy. Using this approach, a group reporting to a middle manager with a code of "2" meant that the manager was 2 levels removed from the head of the organization.

5.1.1 ORG1

As depicted in Table 16, the only group participating from ORG1 was a group involved in conducting research into Human Resource management practices. This organization had fewer than 1000 employees in total. It featured a very flat

structure such that the "middle manager" was 2 levels removed from the head of the organization. The work done by the group tended to be project-based. Accordingly, the principal issues in terms of knowledge transfer included development of processes to manage multiple projects and ensuring that data was managed effectively within the unit.

5.1.2 ORG2

Three different groups from ORG2 participated in the study. This organization was substantially larger than 5000 employees. The groups participating in this study were from a small service unit (less than 1000 employees) within this larger organization. One of the groups provided financial management information and advice to the service unit itself. The other two groups provided program and policy support to the larger organization.

The structure of the organization was such that groups reported to a middle manager 3 levels below the head of the organization. Their work was a mix of project-based and ongoing administration of programs and policies. Accordingly, some of their key issues were related to measurement of performance and management of ongoing projects.

5.1.3 ORG3

Eleven different groups from ORG3 started the study in February 2002. One group disbanded during the study therefore, 10 groups continued through the second phase of data collection. This organization was much larger than 10,000 employees. The participating groups were all part of a large service unit (itself larger than 1000 employees) within this organization.

Structurally, the chain of command was fairly lengthy. If the entire organization was considered, the work groups reported to a middle manager 5 levels below the head of the organization. However, given the size of the service unit, and the fact that they operated more or less autonomously from the larger organization, the study was conducted with the service unit defined as the "organization". In this case, work groups reported to a middle manager 3 levels below the head of the organization.

Much of the work done in this organization was on a project basis. The organization was undergoing a series of changes brought about by a new senior manager and a new strategic plan. A number of process changes had been introduced and it was evident that many of the groups were interested in learning about the new processes as well as the impact of these changes on how they would conduct work in the future.

5.1.4 ORG4

Three groups participated from ORG4, which is an organization of over 10,000 employees involved in a wide variety of programs and services. All of the participating groups were internal service units. One group provided business solutions to the larger organization. The other provided communication support to senior managers, and the third provided information technology support to the larger organization.

The management structure was fairly standard for large public sector organizations. The middle manager was 3 levels removed from the head of the organization. A new senior manager had recently joined the organization so each group was dealing with issues related to changes in processes and procedures.

5.1.5 ORG5

ORG5 was an organization of over 5000 employees. The six groups participating in the study were all part of a smaller operating unit²⁶ (less than 1000 employees) within this larger organization. This operational unit provided services to other organizations on a cost recovery basis. Given the relative autonomy of the operating unit, the "organization" for purposes of this study was defined as the

²⁶ For the purposes of this thesis, the distinction between service unit and operating unit is that a service unit provides services to the parent organization whereas an operating unit provides services to clients outside of the parent organization.

operating unit itself. On this basis, the chain of command was relatively flat with the middle manager 2 levels removed from the head of the organization.

The work of each of the groups was conducted on a project basis. Knowledge of client needs was of high concern as well as process knowledge related to project management.

5.1.6 ORG6

Three groups from ORG6, an organization much larger than 5000 employees, participated in the study. The management structure was such that the middle manager involved was 3 levels below the head of the organization. Each of the groups participating worked in an environment that featured a variety of projects as well as basic administrative tasks. While they faced continual pressure to deliver cost-effective services, unlike some of the other groups in this study, they were not undergoing a specific change program. Overall, process issues were high on their list of knowledge transfer priorities.

5.1.7 ORG7

One group participated from ORG7, an organization of over 5000 employees involved in social research and programs. The work group was somewhat unusual as far as this study is concerned, because it was made up of a team of managers who in turn reported to a management team 2 levels from the head of the

organization. The work was project based, but was conducted under very tight time frames. Process issues were of prime importance to the group.

5.1.8 Qualitative Data

Before discussing the quantitative results, the qualitative data on source of knowledge is presented in Table 17. As mentioned in the methodology section, data related to the source of knowledge used by work groups was collected to serve as a potential control variable. In the questionnaire used during the second round data collection, participants were provided with a list of sources from which to choose. They were allowed to enter more than one source for each knowledge category. Thus the data in Table 17 represents the number of times each source of knowledge was mentioned. For the purposes of analysis, the most common source was entered as the main source of knowledge for the work groups.

Table 17: Sources of Knowledge

	Training	Intranet	Internet	Self-study	Peers	Managers	Clients	Most Common Sources of knowledge
ORG1	0	0	3	4	6	3	2	Peers/Self study
ORG2: Group 1	1	0	0	2	5	3	1	Peers/Managers
ORG2: Group 2	1	0	1	3	2	1	2	Self study/Peers
ORG2: Group 3	2	4	1	5	6	5	1	Peers/Managers
ORG2: Group 4	3	0	0	6	7	4	1	Peers/Self study
ORG3: Group 1	6	7	4	5	9	7	3	Peers/Managers/ Intranet
ORG3: Group 2	6	0	0	5	10	7	0	Peers/Managers
ORG3: Group 3	6	3	7	7	8	1	0	Peers/Self study/Intranet
ORG3: Group 4	3	3	5	4	7	4	0	Peers/Internet
ORG3: Group 5	3	2	2	5	5	5	0	Peers/ Managers/ Self-Study
ORG3: Group 6	1	3	0	2	2	3	3	Intranet/Managers /Self study
ORG3: Group 7	5	1	0	5	8	1	1	Peers/Self study
ORG3: Group 8	2	1	0	3	6	0	2	Peers/Self study
ORG3: Group 9	2	1	5	2	6	1	1	Peers/Internet
ORG3: Group 10	1	1	1	1	1	1	0	NA
ORG4: Group 1	4	3	1	2	4	4	2	Training/ Peers/ Managers
ORG4: Group 2	1	2	1	5	6	6	1	Peers/ Managers
ORG4: Group 3	1	4	2	4	6	3	1	Peers/Self study
ORG5: Group 1	1	1	2	3	3	3	5	Clients/Peers/ Managers/Self study
ORG5: Group 2	1	0	2	2	2	1	3	Clients/Intranet/ Self study
ORG5: Group 3	0	1	2	4	4	2	0	Self-study/Peers
ORG5: Group 4	3	0	2	2	4	3	0	Peers
ORG5: Group 5	3	2	2	3	3	2	2	Training/Self- study/ Peers
ORG5: Group 6	3	3	4	5	4	3	3	Self-study
ORG6: Group 1	2	1	3	7	9	8	4	Peers/Managers
ORG6: Group 2	3	1	0	6	6	4	2	Self study/Peers
ORG6: Group 3	1	2	1	2	5	5	1	Peers/ Managers
ORG7	1	2	3	4	7	5	5	Peers/Managers/ Clients
Total	66	48	54	108	151	95	46	

The following definitions were provided (see Appendix D) to guide respondents in identifying the sources used:

- "Training" referred to formal training in a classroom format.
- "Intranet": use of the organization's intranet to gather knowledge
- "Internet": use of external Internet sources.
- "Self-study": individual study using books and other resource material.
- "Peers": reliance on colleagues within or outside of the work group.
- "Managers": reliance on managers inside the organization.
- "Clients": reliance on clients as a source of knowledge.

The objective of gathering this data was to identify the most common source of knowledge used by the groups in order to determine if source of knowledge was a potential confounding variable. In Table 17, the top 2 sources (and ties) are shown.

The data demonstrates that peers represented the single most common source of knowledge; it was identified as such by 24/28 groups (86% of the sample). Various combinations of peers and self-study, and peers and managers can also be seen in Table 17, but the clear indication is that in general, many of the groups used similar sources of knowledge.

To determine if other issues were present in the organization that would obstruct knowledge absorption, the groups were asked to identify potential barriers to knowledge absorption in their workplace. All groups identified "time" and "workload" as the main issues. Only one group from ORG2 mentioned that the middle manager in question was not amenable to the importation and use of new knowledge. Accordingly, it appeared that there were no unique barriers to knowledge absorption in any of the participating groups.

5.2 Descriptive Statistics

This section presents descriptive statistics of the results, examines the data for departures from normality, and addresses a number of potential confounding factors including the different tenure of group members and the differences in elapsed time of the study across the different groups.

5.2.1 Profile of the Sample

Participants had, on average, 8 years of tenure in their organizations and 2.6 years in their groups. The sample was more or less evenly split by gender (54% males and 46% females). Seventy percent were categorized as "professional" staff, the others were either supervisory managers (20%) or support staff (10%).

As discussed in the methodology section, participants were asked to assess middle manager practices of those middle managers with whom they interacted most. The

objective was to avoid singling out specific managers while capturing data on practices of the middle management team in general. During the initial group meetings, it became evident that most of the respondents provided assessments based on the middle manager to whom they reported (given that they had most interaction with that manager).

They were also asked to identify the level of middle manager to whom they reported. The majority (74%) of the groups reported to middle managers 3 levels below the head of the organization. Twenty-six percent reported to managers at level 2.

Since the working definition of knowledge used in this thesis was "information that could be assimilated and put to use in the person's work", the data collection tool also asked for an assessment of applicability of knowledge learned throughout the duration of the study. Average applicability was 3.8 on a 5-point scale suggesting that participants felt that the material learned was actually being put to use thus meeting the definition of "knowledge" adopted for this thesis.

Table 18: Micro-Level Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable				
ACAP	1.00	4.00	2.46	0.60
Independent Variables				
Context Building Behaviours	1.00	5.00	2.80	0.88
Knowledge Integration Behaviours	1.00	5.00	2.77	0.88
Overall Management Practices	1.00	5.00	2.78	0.80
Moderating Variables				
Clan Cultural Orientation	12.00	40.00	25.25	6.83
Prior-related knowledge	1.00	3.50	2.12	0.49
Control Variable				
Task Complexity	2.00	9.00	6.48	1.42

Table 18 provides descriptive statistics of the micro-level scores. Raudenbush (2003) suggests that through a cursory examination of the means and the standard deviations, researchers can identify a “plausible interval” that contains 95% of the scores. For example, ACAP shows a mean of 2.46 and a standard deviation of 0.60 indicating that the bulk of scores falls within 2 standard deviations (1.20-3.60) of the mean. This result suggests that the distribution of this variable is more or less normal with little in the way of “floor” or “ceiling” effects. This means that, in general, all categories in the scale were used and respondents did not avoid extreme scores. Nor was there a tendency towards a neutral point. Similar results are noted for the scores on management behaviours.

Scores on clan orientation show a mean of 25.25 with a standard deviation of 6.83. Thus, 95% of the scores fall between 12 and 38. The instrument used to measure clan orientation includes 4 different cultural orientations that "share" a total of 100 points (see Appendix A). Research conducted by Kim and Cameron (1999) demonstrates that most organizations have a mix of cultural orientations. Given this tendency, a maximum score of 45-50 on the OCAI²⁷ for any one cultural orientation appears to be the norm (Kim and Cameron, 1999). In this thesis, the maximum clan orientation score of 38 represents a fairly high score relative to the norm of a maximum of 50 noted in the OCAI. Within the range of 12-38, the scores were normally distributed.

Scores on prior-related knowledge show a ceiling effect. The maximum score possible on this scale is 4, but as can be seen in Table 18, the maximum score reported by this sample is 3.5. Furthermore, the plausible interval shows that 95% of the scores fall within a range of 1.14 to 3.10. This result suggests that few participants rated themselves as "experts" in any of the knowledge categories. This result is probably not surprising. Given how quickly things seem to be changing in modern organizations, it is a reasonable finding that few employees consider themselves fully conversant with knowledge in any particular category.

Task complexity shows a mean of 6.48 and a standard deviation of 1.42. Since the

²⁷ Organization Culture Assessment Instrument, the instrument developed by Kim and Cameron used in this study as a measure of organizational culture.

task complexity scale varies between 1 and 9, this result indicates skewness towards the higher end of the scale. Ninety-five percent of the scores for task complexity fall between 3.6 and 9 suggesting that tasks performed by the work groups were thought to be relatively complex. This finding is consistent with the fact that the sample was restricted to knowledge workers who tend to work in fairly complex environments. Table 19 provides a summary of the skewness and kurtosis statistics for micro-level scores.

Table 19: Micro-Level Skewness and Kurtosis Data

	Mean	Median	Skewness	Twice Standard Error	Kurtosis	Ratio of Kurtosis to Standard Error
ACAP	2.46	2.50	-0.15	0.36	-0.05	-0.14
Context Building Behaviours	2.80	2.75	0.41	0.36	-0.27	0.74
Knowledge Integration Behaviours	2.77	2.60	0.43	0.36	0.14	0.40
Overall Management Practices	2.78	2.67	0.41	0.36	0.11	0.31
Clan cultural orientation	25.25	25.00	0.02	0.36	-0.40	1.10
Prior-related knowledge	2.12	2.08	0.07	0.36	0.07	0.02
Task Complexity	6.48	7.00	-0.93	0.36	0.59	1.65

In SPSS, tests of skewness and kurtosis indicate normality if the estimated values are equal to 0. Table 19 shows that scores on managerial behaviours are mildly right-skewed, and those for task complexity are left-skewed²⁸. An examination of the histograms for management practices confirm a slight right-tail skewness, but since the data set is greater than 100 (N=179), the impact on hypothesis testing should be negligible (Stevens, 1997). As for task complexity, this variable will be analyzed at the group level in the data analysis. As will be seen later in this section, the aggregated data reduces skewness to an acceptable level (Rummel, 1970). Accordingly, it was concluded that transformation of the management practices variables was not deemed to be necessary and, task complexity was rendered more or less normal by grouping the individual-level data.

Bryk and Raudenbush (1992) suggest that an examination of the variables at the macro-level is also a useful starting point for HLM analysis. Accordingly, descriptive statistics for the scores aggregated at the group level (N=28) are presented in Table 20.

²⁸ The rule of thumb is that if skewness is more than twice the standard error, some form of transformation might be needed. Similarly, if the ratio of the kurtosis variable to its standard error is higher than +2 or lower than -2, some form of transformation might be required (SPSS manual, 2001).

Table 20: Macro-Level Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable				
ACAP	1.65	2.97	2.40	0.33
Independent Variables				
Context Building Behaviours	2.22	3.64	2.75	0.34
Knowledge Integration Behaviours	2.00	3.80	2.71	0.41
Overall Management Practices	2.13	3.73	2.73	0.35
Moderating Variables				
Clan orientation	12.00	40.00	25.07	6.84
Prior-related knowledge	1.54	2.84	2.12	0.28
Homogeneity of Prior-related knowledge	0.13	1.16	0.59	0.19
Control Variable				
Task Complexity	5.50	7.38	6.48	0.50

Overall, the distributions of the macro-level (aggregated) scores depicted in Table 20 are similar to the micro-level scores depicted in Table 18. The means are fairly similar to the micro-level scores, but the standard deviations are lower, which is to be expected since the macro-level scores, aggregated over all individuals in the group, eliminates within-group variability. Scores on clan orientation were calculated at the group level to begin with, so these are identical to those depicted in Table 18.

Table 20 does introduce a new variable, homogeneity of prior-related knowledge. This variable is unique to the macro-level data since it represents the variability of micro-level prior-related knowledge scores (i.e., the standard deviation of the micro-

level scores). The distribution of this variable shows that 95% of the scores fall within 0.51 and 0.78 suggesting that the scores are clustered around the middle of the distribution. Indeed, an examination of the skewness and kurtosis statistics in Table 21 shows no significant departures from normality expect for the homogeneity of prior-related knowledge variable, which shows a kurtosis statistic 2.02.

Table 21: Macro-Level Skewness and Kurtosis Data

	Mean	Median	Skewness	Twice Standard Error	Kurtosis	Ratio of Kurtosis to Standard Error
ACAP	2.40	2.35	-0.09	0.88	-0.47	-0.55
Context Building Behaviours	2.75	2.69	0.61	0.88	0.56	0.06
Knowledge Integration Behaviours	2.71	2.67	0.34	0.88	0.33	0.38
Overall Management Practices	2.73	2.72	0.66	0.88	0.75	0.88
Clan cultural orientation	25.07	25.00	0.10	0.88	-0.40	0.47
Homogeneity of prior related knowledge	0.59	0.60	0.24	0.88	2.02	2.35
Task Complexity	6.48	6.46	0.192	0.88	-0.79	0.92

A test of kurtosis (calculating the ratio of the kurtosis statistic relative to its standard error) revealed a ratio of 2.35 indicating that homogeneity of prior-related knowledge distribution had a higher peak and longer tails (i.e., leptokurtosis) than a normal distribution²⁹. Stevens (1997) argues that platykurtosis (shallow peak and shorter tails) could attenuate power of the statistical tests. Leptokurtosis however, does not appear to be much of a concern. In discussing a case study related to normality of variables, Stevens (1997, p. 247) argues, “. . .we would have been concerned if we had found deviation from normality on two or more variables, and this deviation was due to platykurtosis.”

A graphical examination of this variable showed that the kurtosis resulted from 2 outlier observations, one at either end of the scale. The approach taken therefore, was to conduct the analyses in which this variable was a factor with the outlier observations deleted to determine if they had an impact on the overall results. Deletion of the two outlier cases meant that the data set included 26 groups and 166 individuals (instead of the original sample of 28 groups and 176 individuals). The results showed a slight difference in the betas for homogeneity of prior-related knowledge, but the results in terms of the hypothesis tests were essentially the same as results from the original data set. Accordingly, the original data set was used in order to maintain the larger sample size.

²⁹ The SPSS program suggests that if this ratio is greater than 2, then transformation of the variables might be warranted.

level, this departure from normality was attenuated at the macro-level. As such, none of the variables required transformation prior to conducting the analysis.

5.2.2 Potential Confounding Factors

A number of potential confounding factors related to the demographics of the sample were identified. These factors and their potential impact are as follows:

- **Elapsed Time between Data Collection Periods:** Due to work requirements in the participating organizations, the amount of time between data collection periods varied from group to group. It is possible that groups who had a longer elapsed time between the waves of data collection might have learned more thus confounding the influence of management practices.
- **Group Tenure:** The tenure of participants in the group and in the organization varied. This could introduce variance in the ACAP scores since employees with longer tenure an organization might be more adept at identifying and absorbing knowledge than those who are relatively new.
- **Group Size:** It is possible that larger groups would have more access to knowledge simply because they have more members. Alternatively, smaller groups might have more focused tasks and thus are better able to define and assimilate the knowledge they need.

- **Attrition of Participants:** Related to the issue of group size is the rate of attrition of participants between the two rounds of data collection. The rate of attrition could indicate that the individuals were not interested in the study, or that knowledge absorption was not deemed to be an important subject in their organization. In either case, the end result could be that those participants who completed both rounds of data collection might represent people who are keenly interested in the topic and thus might be more oriented towards knowledge absorption than those who dropped out.

Table 22 shows an analysis of the correlation between these potential confounding factors and ACAP. It can be seen that ACAP is significantly correlated only with size of group at Time 1. This factor will be therefore be introduced as a control variable during the regression analysis to determine if it does in fact, account for a significant amount of variance in the dependent variable.

Table 22: Correlation Matrix of ACAP with Possible Confounding Factors

	ACAP
Elapsed Time	-0.04
Tenure in Organization	-0.06
Tenure in Group	0.020
Group Size (Time 1)	0.196**
Group Size (Time 2)	0.04
Attrition	0.124

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

5.2.3 Correlation Matrices

This section provides correlation results of the micro-level (individual scores) and macro level (grouped scores formed by aggregating the individual scores).

5.2.3.1 Micro-Level Correlations

An examination of the correlation matrix (Table 23) shows that ACAP is significantly related only to clan orientation. The three categories of management behaviours were shown to be highly inter-correlated, which is not surprising since the context building and knowledge integration behaviours are essentially subscales of overall management practices.

Table 23: Micro-Level Correlation Matrix

	ACAP	Context Building Behaviours	Knowledge Integration Behaviours	Prior-related knowledge	Clan Orientation	Task Complexity
ACAP	1.00	0.019	0.085	0.008	0.187*	0.017
Context Building Behaviours		1.00	0.669**	-0.016	0.200**	0.165*
Knowledge Integration Behaviours			1.00	-0.028	0.284**	0.156*
Prior-related knowledge				1.00	0.144	0.106
Clan Orientation					1.00	0.085
Task Complexity						1.00

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient for context building behaviours and overall management practices was 0.892 ($p=0.01$). Knowledge integration behaviours showed a correlation of 0.933 ($p=0.01$) with management practices. Accordingly, it was concluded that the variable management practices would be dropped from the analysis since the data it contains would already be captured in the two sub-scales³⁰.

³⁰ The management practices variable does not appear in Table 22 for this reason.

Prior-related knowledge did not show significant relationships with ACAP or with management practices. As can be seen, however, clan orientation was significantly related to ACAP and to management practices. Finally, task complexity was also shown to be significantly and positively related to management practices.

5.2.3.2 Macro-Level Correlations

Table 24 provides the correlation matrix of the macro-level scores. An examination of the macro-level correlations showed many of the same relationships between ACAP, prior-related Knowledge and clan orientation as those found at the micro-level. The unique macro-level variable, homogeneity of prior-related knowledge, showed no relationship with ACAP or with any of the management behaviour variables.

Table 24: Macro-Level Correlation Matrix

	ACAP	Context Building Behaviours	Knowledge Integration Behaviours	Homogeneity of prior-related knowledge	Clan Orientation	Task Complexity
ACAP	1.00	0.217	0.243	-0.198	0.339	-0.130
Context Building Behaviours		1.00	0.717**	0.116	0.597**	-0.103
Knowledge Integration Behaviours			1.00	-0.137	0.634**	-0.131
Homogeneity of prior-related knowledge				1.00	-0.152	0.356
Clan Orientation					1.00	0.177
Task Complexity						1.00

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

One other variable not shown in Tables 23 or Table 24 was postulated as a potential control variable: source of knowledge. As discussed earlier, it was thought that source of knowledge might be different for different groups and thus could account for some of the variance in ACAP. Since this variable is represented by data measured on a nominal scale (respondents indicated the number of times they used a particular source of knowledge), calculation of a correlation coefficient was not possible. Accordingly, the impact of source of knowledge was estimated through the

use of a chi-square Crosstabs procedure. Results of this analysis are shown in Table 25.

The Crosstabs test basically asks whether or not the ACAP score is dependent on the source of knowledge used. Table 25 shows that none of the results are significant indicating that source of knowledge was not associated with ACAP scores.

Table 25: Crosstabs Results, Source of Knowledge and ACAP

	Value	Degrees Freedom	ofSignificance (2-sided)
Pearson Chi-Square	101.133	100	p=0.449
Likelihood Ratio	63.210	100	p=0.998
Linear-by-Linear Association	.098	1	p=0.754

5.3 Hypothesis Tests

This section presents the results of the hypothesis tests that represent the confirmatory aspects of this thesis. As was mentioned earlier, the thesis also included exploratory follow-up analyses that focused on examining relationships between and among variables that were shown in this thesis to have a significant influence on ACAP. Results of this analysis are discussed in section 5.4.

Before discussing the results of the hypothesis tests, it would be useful to revisit the fact that this study was focused on explaining the relationships between and among variables in the theoretical framework. Therefore, the analysis does not seek a single predictive equation per se; rather the emphasis was on developing a series of different equations to test various predictor variables.

Since the HLM procedure is not well-known in organizational research, it would also be instructive to outline the basic procedures used in this analysis. Bryk and Raudenbush (1992) suggest that the first step in a multi-level analysis is to calculate an "unconditional model" (i.e., with no predictors in the model) to examine variance parameters of the dependent variable and to determine if intra-class correlation (ICC) exists. ICC is important because it represents the degree to which the observations are *not* independent. In other words, the ICC is a measure of the homogeneity of responses resulting from the clustering of individuals within groups. If there is no ICC, the data set could be analyzed through OLS (ordinary least squares).

The results for the unconditional HLM model are provided in Table 26 (note, all HLM analyses were run with the HLM5 software program). It shows that the group level variance is significant ($p < 0.001$) and that the ICC equals 0.166. The fact that the group-level variance is significant indicates that the groups differ significantly on

ACAP. The ICC indicates that the observations are not independent thus the continued use of the HLM procedure is warranted.

Table 26: Results of HLM unconditional test

	Individual variance	level	Group Variance	level	Intra-Class Coefficient (ICC)	Comment
ACAP	0.299		0.060 (p<0.001)		0.166	Significant variance between groups. ICC shows that the observations are not independent.

5.3.1 Hypothesis 1: Middle Management Practices

Hypothesis 1 included three parts. The first (1A) was stated as: "Middle Management practices will have a positive impact on ACAP of work group members". Hypothesis 1B was stated as, "Context building behaviours by middle management will have a positive impact on the ACAP of work group members". Hypothesis 1C was stated as, "Knowledge integration behaviours by middle management will have a positive impact on the ACAP of work group members".

As discussed earlier in this document, an examination of the correlation matrix found that the management practices variable was highly correlated with context building and knowledge integration behaviours. Accordingly, hypothesis 1A was

dropped from the analysis. Table 27 shows the results of the tests of hypothesis 1B and 1C.

Table 27: Tests of Hypothesis 1B and 1C

Hypothesis 1B "Context building practices by middle management will have a positive impact on the ACAP of work group members."	Hypothesis 1C "Knowledge integration practices by middle management will have a positive impact on the ACAP of work group members."
$\beta=0.003$ not significant $p=0.943$	$\beta=0.14$ not significant $p=0.718$

Hypotheses 1B and 1C were not supported. Overall, it appears that the middle management practices identified in this study did not influence ACAP of the work groups in the sample.

5.3.2 Hypothesis 2: Interaction of Culture with Middle Management Practices

Hypothesis 2 was stated as: "Organizational culture will moderate the relationship between middle management practices and ACAP. Specifically, the stronger the clan orientation, the more influence management practices will have on ACAP". The essential argument here is that the slope (i.e., the beta), which specifies the relationship between management practices and ACAP varies according to the strength of the clan orientation of the work group. Therefore, for this hypothesis to

be true, two conditions are necessary: first, management practices must influence ACAP; and second, the magnitude of this influence must vary among the groups in the study.

Given that the correlation matrix and the HLM results suggested that management practices do not appear to influence ACAP at all, it is unlikely that an interaction effect exists between management practices and organizational culture. However, for the sake of completeness, the hypothesis test of interaction was conducted.

A simple multi-level approach to testing hypotheses about interaction between group-level and individual level variables is the "slopes as outcomes" procedure. For this hypothesis, the test essentially answers the question: does the slope of management practices vary between groups in the sample?

Mathematically, the model used to estimate an interaction between management practices and clan orientation was structured as follows:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\text{CBBSS})_{ij} + \beta_{2j}(\text{KIBSS})_{ij} + e_{ij}.$$

The "i" in Y_{ij} represents an individual in a particular group while the j represents the group. β_{0j} represents the intercept of the equation (the average ACAP score for the group in this case). The variables "CBBSS" and "KIBSS" are the scores for context building and knowledge integration behaviours respectively.

The second level model then introduces clan orientation (CLANN) as a predictor of the slopes of the first level model: β_1 and β_2 .

$$\begin{aligned}\beta_{1j} &= \gamma_{10} + \gamma_{11}(\text{CLANN})_j + u_{1j} \\ \beta_{2j} &= \gamma_{20} + \gamma_{21}(\text{CLANN})_j + u_{2j}\end{aligned}$$

This multi-level model creates an interaction term between clan orientation and knowledge integration, and between clan orientation and context building behaviours. When the three equations are combined in the multi-level model, this model essentially argues that ACAP of individuals within groups depends on knowledge integration and context building behaviours of managers. In addition, knowledge integration and context building behaviours are in turn influenced by the degree of clan orientation of the group.

Results of the hypothesis test show a β of -0.007 with a p-value of 0.575 for context building behaviours. For knowledge integration behaviours, the β was 0.006 with a p-value of 0.571. Accordingly, the data indicates a lack of support for the hypothesis that clan orientation moderates the impact of management behaviours on ACAP.

5.3.3 Hypotheses 3 and 4: The Relationship between prior-related knowledge and ACAP

Hypothesis 3 was stated as “managerial practices will influence ACAP more in work groups with higher levels of homogeneity of prior-related knowledge”. Hypothesis 4 was stated as “managerial practices will influence ACAP more in work groups with higher levels of prior-related knowledge”.

The HLM models are similar to the one used to test Hypothesis 2. The first-level equation is similar to that created for the hypothesis about the relationship between clan orientation and management practices:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\text{HPRK})_{ij} + \beta_{2j}(\text{PRK})_{ij} + e_{ij}.$$

The only difference is that the variables have changed such that “HPRK” refers to the homogeneity of knowledge scores, and “PRK” refers to the level of prior-related knowledge scores.

The second level models are also similar:

$$\begin{aligned}\beta_{1j} &= \gamma_{10} + \gamma_{11}(\text{HPRK})_j + u_{1j} \\ \beta_{2j} &= \gamma_{20} + \gamma_{21}(\text{PRK})_j + u_{2j}\end{aligned}$$

The hypothesis test resulted in a β of 0.196 with a p-value of 0.278 for the relationship between homogeneity of prior-related knowledge and context building

behaviours. For level of prior-related knowledge, the β was 0.0353 with a p-value of 0.689.

The models discussed above positioned homogeneity of prior-related knowledge with context building behaviours, and level of prior-related knowledge with knowledge integration behaviours. To examine the alternate relationships: homogeneity of prior-related knowledge as a predictor of knowledge integration behaviours, and the level of prior-related knowledge as a predictor of context building behaviours, a second analysis was conducted.

This analysis resulted in a β of -0.050 with a p-value of 0.792 for the relationship between homogeneity of prior related knowledge and knowledge integration behaviours. For the relationship of level of knowledge and context building behaviours, the β was 0.075 with a p-value of 0.396.

Overall, the main hypothesis of this thesis, that management practices influence ACAP, was not supported by the data. The analysis also indicated that clan orientation and prior-related knowledge do not appear to influence the relationship between management practices and ACAP.

The results did show, however, that ACAP varies significantly among the study groups. This finding raises the following questions: if management practices do not

explain any of this variance, what does? Is it possible that any of the other variables in the theoretical framework explain this variation? The following section presents an exploratory analysis that was conducted to examine these questions.

5.4 Exploratory Analysis

The exploratory analysis was guided by three main considerations: the theoretical literature, relationships among the variables noted in the correlation matrices and results from the HLM5 software package which offers an “exploratory analysis” feature that identifies variables that appear to influence the dependent variable. The following variables were identified as being of potential interest: level of manager, clan orientation, size of group at Time 1, and homogeneity of prior-related knowledge. Details on each of these variables are provided below.

From a theoretical perspective, as discussed in the previous section, it is possible that middle managers with a good understanding of the overall strategy of the organization would likely be in a better position to provide guidance to group members. It seems reasonable, therefore, that the higher the level of a group’s manager, the more he or she is likely to know about the strategic directions of the organization. Accordingly, the impact of the level of middle manager on ACAP was explored.

The correlation matrices highlighted a number of relationships among the variables that also guided the exploratory analysis:

1. Clan orientation was shown to be significantly related to ACAP; and
2. Size of the group at Time 1 was shown to be significantly related to ACAP.

Finally, the HLM5 software program provides an “exploratory analysis” feature that identifies potential explanatory variables. An analysis of the variables using this feature showed that all of the variables identified above, along with homogeneity of prior-related knowledge, could potentially explain some of the variation in ACAP scores. Accordingly, these variables were examined in more detail in the follow-up analysis.

Before presenting the results of this analysis, a brief review of the logic of multi-level analysis is provided to clearly identify how the various exploratory predictive models were developed.

Figure 12 depicts a typical multi-level sample showing 6 groups (macro-level) each containing 3 individuals (micro-level). An average score (“grand mean”, shown in the middle box in Figure 12) for all of the individuals in the sample could be calculated. Each group also has an average score of its own (“group mean”, shown as the circled “M” in Figure 12). Variances are associated with each of the means at both the individual (i.e., the within-group or micro-level variance), and group levels

(i.e., the between-group or macro-level variance) as depicted by the lines connecting the grand mean to the groups, and the group means to the individuals within each group.

Figure 12: A Multi-Level Model

The logic of multi-level analysis, at least as it relates to the study of knowledge absorption in organizations, is that group behaviour is an aggregate of individual behaviours. Cohen and Levinthal (1990), and Grant (1996) point out that knowledge absorption of the group is a result of knowledge absorption by individuals. The group score on ACAP in this thesis, therefore, is an aggregate of the

individual scores within each group. Independent variables exist at both the micro and macro levels. In this thesis, management practices were analyzed at the micro-level based on the rationale that each individual's perception of management practices will tend to influence his or her behaviour. The level of manager, however, is obviously a macro-level variable because it is the same for all individuals in the group. Similarly, clan orientation is a macro-level variable. It was measured by asking individuals their perceptions of the cultural orientation of the organization. Accordingly the measure itself was designed as a group construct. The same argument could be made for task complexity: it was designed as an index of the overall task complexity of the group.

Finally, prior-related knowledge could also be measured as a micro (i.e., what individuals in the group knows) or a macro-level (i.e., what the group knows represented by the average of the knowledge of all individuals in the group) variable. Homogeneity of prior-related knowledge however, is measured in this thesis as the standard deviation of the group, so it is obviously a macro-level variable.

Results from the HLM analysis showed that only macro-level variables— level of manager, clan orientation, size of group at Time 1 and homogeneity of prior-related knowledge variables were significantly related to ACAP. Accordingly, these four variables were examined in more detail in the exploratory analysis. This was done as follows: The variables were analyzed as single predictors of ACAP; the results of

this analysis were then used to create a multiple regression model, which included those variables that showed a significant relationship with ACAP.

The results of the simple regression analysis (i.e., each variable as a single predictor of ACAP) are shown in Table 28.

Table 28: Exploratory Results

	Coefficient/ p-value	Unexplained Variance
Level of Manager (macro level)	$\beta = -0.513$ $p < 0.001$	Micro-level= 0.299 Macro-level=0.046
Clan Orientation (macro level)	$\beta = 0.016$ $p = 0.046$	Micro-level= 0.299 Macro-level=0.050
Size of Group at Time 1(macro level)	$\beta = 0.036$ $p = 0.065$	Micro-level= 0.299 Macro-level=0.054
Homogeneity of prior-related knowledge (macro level)	$\beta = -0.561$ $p = 0.021$	Micro-level= 0.299 Macro-level=0.053

Table 28 shows the coefficients and p-values estimated for each of the variables in separate equations. The first column identifies the individual variables, the second shows the beta coefficients and the p-values, the third identifies the unexplained macro-level variance (i.e. between groups) left after regressing ACAP on the particular variable. As can be seen in column 3, micro-level variance is not affected (since no micro-level variables are involved).

The results indicate that size of group at Time 1 is not a significant predictor of ACAP, as such, it was dropped from the analysis. The following discussion will examine in more detail results related to the level of manager, clan orientation and homogeneity of prior-related knowledge.

5.4.1 Level of Manager

As mentioned earlier in this thesis, the convention established for coding level of manager identified the most senior manager as level "0", the next level down as "1" and so on. Therefore, in this thesis, Level 2 managers are higher in the hierarchy than those at Level 3.

For level of manager, the beta was found to be negative. This finding suggests that as the level of manager to which group members report increases, ACAP also increases. To follow up on this finding, ACAP and clan orientation scores were calculated for the two different levels of managers included in this study. These data are depicted in Table 29.

Table 29: Examination of Impact of Level of Manager³¹

	Average Score for Groups reporting to Managers at Level 2	Average Score for Groups reporting to Managers at Level 3
Average score on ACAP (4-point scale)	2.50	2.38
Average score on knowledge integration behaviours (5-point scale)	2.82	2.68
Average score on context building behaviours (5-point scale)	3.05	2.68
Average score on Clan Orientation (out of a possible 100 points)	28.4	24.3

Table 29 shows that a clear difference exists in the scores for management behaviours between the two groups, especially with regard to context building behaviours. A one-way ANOVA of scores for these behaviours shows a significant difference between managers at Level 2 and Level 3 ($F=4.48$, $p=0.036$). The ANOVA test for differences between the groups on knowledge integration behaviours was not significant.

To examine the specific behaviours that account for differences between the managers at different levels, scores on each of the behavioural statements in the management practices measurement scale were compared. Table 30 depicts the

³¹ In the sample, 6 groups (36 individuals) reported to Level 2 managers; 22 groups (143 individuals) reported to Level 3 managers.

results of this analysis. An ANOVA test of the means of these statements showed a significant difference for Statement 3, "helps to clarify the organization's vision, mission and strategic imperatives" ($F=7.451$, $p=0.007$). This analysis demonstrates that higher-level middle managers tend to display more context-building behaviours. Furthermore, the most significant difference is associated with the ability of higher-level managers to help their work groups understand the organization's strategic directions.

Table 30: Examination of Impact of Level of Manager on Specific Practices³²

	Average Score for Managers at Level 2	Average Score for Managers at Level 3
Context Building Behaviours		
Develops support and acceptance for the organization's mission statement.	3.22	2.86
Helps employees understand how the mission of this organization is to be achieved.	2.97	2.59
Helps to clarify the organization's vision, mission, and strategic imperatives.	3.01	2.56
Provides feedback that helps to identify potential problems and opportunities.	3.00	2.62
Knowledge Integration Behaviours		
Distributes information on how the organization is performing.	2.85	2.67
Encourages work groups to make decisions about problems and opportunities.	2.98	2.77
Encourages team members to act on new information received.	2.98	2.77
Helps to develop relationships within the work group.	2.68	2.62
Provides opportunities for self-assessment with respect to goal accomplishment.	2.59	2.51

Given the significant difference noted between the behaviours of Level 2 and Level 3 managers, it seemed reasonable to explore whether ACAP scores were influenced by

³² Behaviours were measured on a scale of 1-5 with 5 indicating a high incidence of the behaviour.

behaviours of the Level 2 managers. Even though results from the confirmatory analysis demonstrated no relationship between management behaviours and ACAP, the overall sample included predominantly Level 3 managers (22 groups compared to 6 groups of Level 2 managers). It is possible therefore, that the finding of no relationship resulted from the large number of Level 3 managers in the sample.

Consequently, to determine if a relationship existed between ACAP and management practices of higher-level middle managers, an OLS regression was run with the sub-sample of Level 2 managers (N=36). The beta in this case was positive (0.255) and significant ($p=0.028$) indicating that higher levels of context-building behaviours in this sub-sample of managers were related to higher levels of ACAP in the work groups.

Unfortunately, given the small number of macro-units (6), an HLM analysis was not possible therefore an examination of the ICC³³ could not be conducted. It was possible, however, to conduct an HLM analysis of the moderating impact of level of manager on management practices using the full data set. This finding showed a beta of -0.147 , which was also significant ($p=0.032$) indicating that as the level of manager increased, context-building behaviours also tended to increase. Overall, these findings suggest that context-building behaviours by higher-level middle

³³ intra-class correlation

managers practices influence ACAP, and that lower level middle managers are less likely to engage in these practices.

5.4.2 Clan Orientation

The results in Table 27 show a weak relationship between clan orientation and ACAP ($\beta = 0.016$, $p = 0.046$). Although the relationship is statistically significant, practically, the beta is almost zero suggesting that clan orientation has little impact on ACAP. This result is not consistent with the theory, which suggests that organizations with clan cultures tend to promote knowledge absorption (Nonaka and Takeuchi, 1995; Yeung et al., 1999; Ribiere, 2001). Accordingly, a deeper examination of this result was conducted.

As was mentioned earlier, ACAP was measured in this thesis as a composite score comprising four different knowledge categories: client, service, process and technology. Accordingly, four separate dependent variables were created: Client ACAP, Service ACAP, Process ACAP and Tech ACAP³⁴. A simple regression analysis was conducted to examine the relationship of clan orientation to each of these categories of ACAP. The analysis showed that:

³⁴ To recap: Client ACAP refers to knowledge about clients, service ACAP refers to knowledge about services delivered by the work group, process ACAP refers to work processes used, and technology ACAP refers to knowledge about the technology used by the work group.

- the beta for clan orientation as a predictor of Client ACAP was not significant ($\beta=0.005$, $p=0.686$);
- the beta for clan orientation as a predictor of Service ACAP, was positive and significant ($\beta=0.027$, $p=0.027$);
- the beta for clan orientation as a predictor of Process ACAP ($\beta=-0.192$, $p<0.01$) was negative and significant; and
- the beta for clan orientation as a predictor for Tech ACAP ($\beta=-0.147$, $p<0.01$) was negative and significant.

The results indicate that clan orientation has no relationship with Client ACAP, a weak positive relationship with Service ACAP and negative relationships with Process and Tech ACAP.

5.4.3 Homogeneity of Prior-related Knowledge

The final variable for which a simple regression was conducted was homogeneity of prior-related knowledge. The measure used was the standard deviation of the prior-related knowledge scores. The results show a significant negative beta ($\beta=-0.561$, $p=0.021$). This finding suggests, therefore, that as the standard deviation of

knowledge scores increases, ACAP tends to decrease. That is, a higher degree of homogeneity of prior-related knowledge is related to a higher level of ACAP.

5.4.4 Categories of Knowledge

The exploratory analysis of cultural orientation demonstrated different relationships between clan orientation and the four categories of ACAP. Accordingly, it seemed reasonable to also explore the relationships between level of manager and homogeneity of prior-related knowledge with the 4 separate categories of ACAP.

In this analysis, 4 multiple regression models were developed with independent variables level of manager, clan orientation, and homogeneity of prior-related knowledge. The 4 categories of ACAP were treated as separate dependent variables.

Table 31: Models of the various categories of ACAP

	Client ACAP	Service ACAP	Process ACAP	Technology ACAP
Level of Manager	$\beta=-0.297$ $p=0.05$	$\beta=-0.755$ $p=0.002$	$\beta=-0.554$ $p<0.001$	$\beta=-0.515$ $p<0.001$
Clan Orientation	$\beta=-0.340$ $p=0.370$ not significant	$\beta=-0.45$ $p=0.120$ not significant	$\beta=0.018$ $p=0.104$ not significant	$\beta=0.004$ $p=0.681$ not significant
Homogeneity of prior-related knowledge	$\beta=-0.604$ $p=0.056$	$\beta=-0.772$ $p=0.009$	$\beta=-0.487$ $p=0.225$ not significant	$\beta=-0.569$ $p=0.198$ not significant

The results in Table 31 indicate that level of manager is a significant predictor of ACAP for all four categories of knowledge. Clan orientation is not a significant predictor for Client and Service ACAP, but does show a significant negative relationship to Process and Technology ACAP. Homogeneity of prior-related knowledge on the other hand, is a significant predictor for Client and Service ACAP, but is not significantly related to Process or Technology ACAP.

In summary, the exploratory results suggest that:

- level of manager has a moderating influence on ACAP in that higher level middle managers tended to practice more context building behaviours, which appear to have a positive influence on ACAP;
- while context-building behaviours have an impact on ACAP, knowledge integration behaviours do not;
- clan orientation and homogeneity of prior-related knowledge has different relationships with different categories of ACAP.

The implications of these findings will be addressed in more detail in the following chapter.

CHAPTER 6: Discussion

This section provides a short review of the overall objective of the thesis as a contextual background for the discussion that follows. First, an overview of the initial findings is presented. Then, the findings of the exploratory analysis are discussed. Results related to the role of middle managers are addressed first, followed by findings related to clan orientation, ACAP, and prior-related knowledge.

The objective of this thesis was to contribute to the development of a theoretical framework of knowledge utilization in organizations. Given the relatively undeveloped state of such a theory, this study followed a "realist" approach (Layder,1993) combining confirmatory and exploratory aspects. The theoretical framework adopted was based on a review of the literature, which indicated that the construct of "absorptive capacity" (ACAP) has been used in a number of studies as a means of examining factors influencing knowledge utilization. The review also indicated, however, that most of this research has not addressed knowledge utilization at the work group level. Nor has the influence of managers been examined in any detail. A subsequent review of the middle management literature indicated that these managers are seen as the core of knowledge creation and utilization in organizations. Accordingly, this study was designed to examine the impact of middle managers on the ACAP of work groups.

The initial findings indicated that middle management practices do not appear to influence ACAP. Further, organizational culture and prior-related knowledge were not shown to have a moderating impact on management practices. In other words, as mentioned earlier, the theoretical framework tested in this study was not supported by the data. These findings were not expected and, although the exact reasons for these results are not clear, a number of potential causes can be proposed.

First, it is possible that the framework itself did not apply to the sample of organizations participating in the study. The research that formed the basis of the theoretical framework used in this thesis was conducted in the private sector (Cohen and Levinthal, 1990; Nonaka and Takeuchi, 1995), but the sample used in this study was made up of public sector organizations. It is possible, therefore, that the relationships proposed in the theoretical framework developed for this study are not relevant in public sector organizations.

The construct of ACAP, however, seems applicable to any organization since all organizations use knowledge in some way and, in order to do so, each must find ways of recognizing, capturing and putting knowledge to use. Accordingly, the problem might be that the model of middle management influence proposed in the study, derived primarily from the work of Nonaka and Takeuchi (1995), does not apply in a public sector environment. Most of the public sector organizations in this

study were fairly hierarchical (i.e., the organizational structures tend to feature many levels of management). The private sector organizations included in Nonaka and Takeuchi's (1995) research could have featured different organizational structures.

Furthermore, this study used a model of organizational culture developed by Cameron and Quinn (1999) because the measurement process proposed by the authors had been well-tested. There are many different ways of measuring organizational culture however, and it is possible that different measures of organizational culture might have shown different relationships with management practices. The exploratory analysis conducted in the study did shed light on some of these issues. These findings are discussed in the following sections.

6.0 Middle Management Practices

Two main observations can be derived from the examination of the relationship between middle management practices and ACAP:

- managers at higher levels in the organizational hierarchy appear to have more influence on ACAP;
- context-building behaviours influence ACAP while knowledge integration behaviours appear to have no impact on ACAP;

The HLM analysis showed that level of manager was significantly related to ACAP. The sample in this study included two different levels of middle managers: a small number 2 levels removed from the head of the organization (6 managers, 36 employees), and the majority (22 managers, 143 employees) who were 3 levels removed. The finding that level of manager was significantly related to ACAP implies that managers closer to the strategic apex of the organization were able to influence ACAP of the work groups, while those lower in the management hierarchy were not.

The finding that not all levels of middle managers have a similar impact on knowledge absorption is consistent with the finding of Janczak (1999) who concluded that, given the different responsibilities, behaviours and outcomes of the middle managers he observed, middle managers do not represent a homogenous group. It also supports the work of Zussman and Jabes (1989) who found that a gap existed in public sector organizations between the Directors General (Level 2 managers) and Directors (Level 3 managers). Their study found that the strategic imperatives of concern to managers at Level 2 and above were not often communicated to lower levels in the management hierarchy. Furthermore, Hambrick (1981) demonstrated that the level of understanding of strategic issues declines as one moves down the management hierarchy in organizations.

Without a strong understanding of the organization's strategic context, many lower level middle managers likely engage primarily in administrative work. Kirfidu and Petridis (1997), for example, in a study of the types of tasks performed by public sector middle managers, found that many of them focused on routine, transactional types of activities. The authors attributed this to the fact that senior managers did not delegate enough authority to the middle management cadre. Most of the organizations in this study did, indeed, have fairly hierarchical organizational structures. The organization with the largest number of participating groups, ORG3, was in the process of making a number of operational changes. It was evident from the focus group discussions, however, that the middle managers were not as informed of the strategic directions of the organization as were managers in organizations with flatter organizational structures.

The theoretical work of Nonaka and Takeuchi (1995) and Bartlett and Ghoshal (1998) seems to imply that "middle management" is a single entity in the organization. In small organizations, or in larger organizations with a flat chain of command, it is possible that work groups would report to a relatively senior middle manager. The reality however, is that many large organizations have at least 3 levels of middle management.

The diagram on the left in Figure 13 depicts this model. According to the results of this study, middle managers at Level 3 in Organization A would have

no impact on the ACAP of the work group. The question of why this is so is partially addressed by the second main finding, that only certain types of middle management behaviours influence the ACAP of work groups.

The study results suggest that only context-building behaviours: communicating information on the mission, vision and strategic imperatives of the organization have an impact on ACAP. The data analysis demonstrated, through an ANOVA test, that higher-level managers were more likely to practice context-building behaviours than were lower-level managers. In addition, an Ordinary Least Squares regression with groups reporting to higher-level managers (N=36) demonstrated that these behaviours accounted for about 10% of the variance in ACAP.

This finding does support the work of those researchers especially Kanter (1982), Frohman and Johnson (1993), Nonaka and Takeuchi (1995) and Huy (2002) who suggest that middle managers play an important role in connecting the "front lines" to the strategy-making level in the organization. The fact that only higher-level middle managers appear to be involved in making these connections has not been examined in any detail in the current literature. Most of the work in this area, notably research conducted by Wooldridge and Floyd (1990) and Thakur (1998) examine the roles and impact of middle managers in the strategy-making process, but the different levels of middle managers has not been specifically considered.

It seems intuitively logical however, to argue that higher-level middle managers have more contact with senior managers and thus would receive more information on strategic issues. These managers may be inclined to share this information with their work groups in order to build a common sense of purpose. Lower level middle managers, who do not have the same level of contact with senior managers are not aware of strategic information and thus may not have the information needed to allow them to provide a strategic context for their work groups.

This thesis also found that knowledge integration behaviours did not influence ACAP in work groups. This finding does not support the current literature, which suggests that the key to knowledge creation is the exchange of tacit knowledge, and that

middle managers play an important role in building relationships within the work group to facilitate such an exchange (Nonaka and Takeuchi, 1995; Von Krogh, Ichijo and Nonaka, 2000). Rather, the findings of this study support the notion that knowledge creation is dependent on the exchange of tacit knowledge at the peer level as the data indicated that peers were the most important source of knowledge for most group members. The results do not support the idea that knowledge integration behaviours by middle managers play a strong role in promoting this peer-to-peer exchange of knowledge.

This finding is possibly related to the type of work groups involved in this study. Most were made up of professionals who were classified as knowledge workers for the purpose of this thesis. As such, the knowledge and skills of group members might act as substitutes for the knowledge integration behaviours of middle managers. Pfeffer (1977), for example, argues that certain features of the group or the organization act as "leadership substitutes" obviating the need for certain managerial behaviours. The various contingency approaches to leadership also suggest that characteristics of the organization, the work group and the task performed by group members mitigate against certain types of leadership practices (House and Mitchell, 1974). Following this reasoning, it is possible that highly-skilled groups, such as those involved in this study, might not need managers to facilitate relationships since they are capable of doing so themselves. This is an

important finding given the increased prevalence of knowledge work in Canada and other industrialized countries.

Research by Gunther-McGrath, MacMillan and Venkataraman (1995) support this notion. The authors suggest that groups who have been together for a while, and whose members have a certain level of skill attain "informational competence". If this is so, these work groups would likely rely less on managers to facilitate knowledge integration behaviours. Accordingly, it is possible that, given the skill-level of work groups in this thesis, and the fact that they had been together for an average of 2.6 years, they might have "substitutes" in place for the knowledge integration roles usually assumed by middle managers. These behaviours then, would have no impact on ACAP in this sample.

The finding that peer-to-peer learning was a key source of knowledge for the work groups supports the literature that points to the role of Communities of Practice (CoPs) as sources of knowledge utilization in organizations (Wenger, 1998; Wenger and Snyder, 2000; Storck and Lesser, 2001; Wenger, McDermott and Snyder, 2002). Wenger (1998) suggests that CoPs emerge as groups work with recurring problems. Over time, the CoP emerges as a key organizational resource to enable the capture, transfer and interpretation of knowledge. It also serves as a distributed memory system which means that no one member needs to remember the entire suite of

practices developed by the community (Wenger, 1998). Instead, members rely on each other as sources of practice-based knowledge.

Indeed, the literature on community of practices indicates that work groups may be viewed as mini-communities of practice that have an important impact on knowledge utilization in the organizations. Indeed, Wenger (1998) argues that the group itself is maintained through the shared learning that arises from their collaboration. Initial studies by Storck and Lesser (2001) indicate that CoPs help to speed up the rate at which new employees learn their roles and aids in the generation of new product ideas.

Wenger and Snyder (2000) argue that CoPs may represent an evolution of teams as learning communities. If this is so, then organizations need to find ways of cultivating CoPs in order to maximize their knowledge utilization capabilities. One of the ways in which organizations can support CoPs is to ensure that the group's agenda is aligned with business priorities (Wenger, 1998). The findings of this study then, that work groups who have been together for some time do not appear to need managers playing a knowledge integrator role, but they do require managerial support from a context building perspective, is consistent with the literature on informational competence (Gunther-McGrath, MacMillan and Venkataraman, 1995), and the emerging work on CoPs (Wenger, McDermott and Snyder 2002). It may be that work groups in knowledge intensive environments,

who have been together for some time, develop the self-organizing characteristics of a CoP. As Wenger (1998) points out, these types of groups still need managerial intervention to ensure that their priorities are aligned with business objectives, but they tend to manage the group process themselves.

A secondary explanation of the importance of context on the ability of group members to absorb knowledge can be found in the literature on knowledge adoption (Sussman and Siegal, 2003). The concept of knowledge adoption is closely aligned with the construct of ACAP in that it refers to the process of understanding and incorporating new knowledge into a person's cognitive schemas and mental models (Sussman and Siegal, 2003).

Adoption theories argue that relevance of knowledge, as determined by perceived usefulness to task, determines whether knowledge is attended to and ultimately integrated. Schulz (2003), makes a similar argument using linguistic relevance theory. Relevance in this case refers to the implications the knowledge has for previously learned knowledge, and the ease with which the individual can derive these implications. Both theories support the argument that knowledge is more likely to be absorbed if it is perceived to be of use to the individual's task.

It is possible then, that managers who provide a clear strategic context for work group members help them to make better distinctions about knowledge that has

relevance for their tasks. Sussman and Siegal (2003), in a study that integrated knowledge adoption theory with theories of informational influence, also suggest that perceived usefulness of knowledge will be influenced by the credibility of the source. It is possible that peers were perceived to be the key source of knowledge for group members because they were seen as having the most credibility to provide practice-based knowledge. Accordingly, the findings of this thesis related to the context-building role of middle managers and the role of peers as a key source of knowledge might be partially explained by theories of knowledge adoption and informational influence.

In sum, the results of this thesis introduce the notion of a middle management hierarchy in which managers at different levels impact ACAP in different ways. It has also provided additional insights into the specific behaviours of these higher-level middle managers that influence ACAP. Despite research suggesting that knowledge integration behaviours are important aspects of what middle managers do to facilitate tacit knowledge flow, the findings of this thesis suggest that these behaviours might not be important to ACAP in relatively mature work groups comprised of knowledge workers. On the other hand, context-building behaviours appear to have an impact with these types of work groups.

6.1 Cultural Orientation

Based upon prior research (Nonaka and Takeuchi, 1995; Cameron and Quinn, 1999; Nonaka, Konno and Toyamo, 2001), it seemed plausible to conjecture that clan orientation would be positively associated with ACAP. The results of this thesis, however, suggest that clan orientation could have a negative or positive influence on ACAP, depending on the type of knowledge to be absorbed.

The analysis of the relationships of clan orientation with the four separate components of ACAP found a negative influence on Process and Technology ACAP, no influence on Client and a positive relationship with Service ACAP. In general, the negative relationships tended to be stronger (i.e., the betas were higher). One possible explanation for this finding is that clan cultures promote strong relationships among people within the organization and, because of the strength of these relationships, the organization avoids importing new knowledge that could change the status quo (Ouchi, 1991; Van den Bosch, Volberda and de Boer, 1999).

Van den Bosch, Volberda and de Boer (1999) point out that the culture of an organization represents a system of ideas that includes a coherent set of beliefs, a common language and a high degree of shared values. This system of ideas does not necessarily allow for assimilation of knowledge that does not fit with the current

ideology. The stronger the currently held beliefs, the more the organization tends to resist importing new knowledge.

Hansen (1999) also argues that "tight coupling" among team members, such as that noted in clan cultures, might limit the search for new knowledge. His research demonstrated that "loose coupling" encouraged a greater degree of knowledge absorption from outside usual channels.

Similarly, Crampton (2001), refers to a phenomenon called the "mutual knowledge problem". This problem manifests itself as a predilection for members of work groups to continually sample their common base of knowledge while addressing work-related problems. According to the theory, new knowledge "competes" with this common base. If the common base is strongly protected by a clan culture, new knowledge is often not imported. The results of this thesis, showing that clan orientation tends to decrease ACAP for certain categories of knowledge suggests that the "clan as carapace" argument (i.e., that a clan culture can act as a barrier to new knowledge), might indeed be a valid notion.

Another key finding was the fact that clan orientation demonstrated three different relationships with the various categories of ACAP. For some categories of knowledge, it had no effect. For Process and Tech ACAP, as discussed above, it had

a negative impact. In addition, there as also a small positive relationship noted with Service ACAP.

A possible explanation for the range of different relationships between clan orientation and ACAP could be related to the categories of knowledge used in this study. The sample was comprised of public sector organizations. Most public sector organizations tend to have processes that are clearly articulated and stored in explicit form. Similarly, knowledge about technology and how to use it tends to be available in explicit form.

In terms of knowledge about clients and services, organizations in this study delivered primarily business and technology services and thus operated as consultants to their clientele. In a consultative relationship, each client engagement tends to be slightly different because the services delivered depend on the unique needs of the service recipient. It is possible therefore, that knowledge about clients and services was not explicitly captured in most cases, but passed on by word of mouth.

This thesis had taken the position that type of knowledge (defined for the purposes of the study as explicit or tacit knowledge) was not to be specifically examined since applied knowledge in organizations combines both tacit and explicit components. It is possible, however, that certain categories of knowledge tend towards a higher

level of “tacitness” or “explicitness” depending on the organization’s standard operating procedures. As a result, clan orientation might promote sharing of tacit knowledge (i.e., client and service knowledge) to the exclusion of reliance on more explicit forms (process and technology knowledge). Indeed, the findings of this study support this argument in that most group members indicated that they captured new knowledge from their peers.

This issue of the ease of transferability of knowledge has been addressed by Kogut and Zander (1995) who demonstrated that knowledge that was amenable to codification (i.e., to being explicitly expressed) was more readily transferred. Similarly, Cohen and Levinthal (1990) demonstrated that companies working with “harder to capture” knowledge tended to invest more in ACAP. Although both of these studies investigated inter-organizational knowledge transfer, while this thesis is focused on intra-organizational ACAP, the studies show that some types of knowledge are more readily transferred than others. The results of this thesis suggests that type of knowledge is not the only consideration in determining ease of knowledge transfer, cultural orientation might play a role. Even through explicit knowledge might be more easily transferable in general, at the work group level, an organization’s culture might influence whether or not these explicit sources are used.

The findings of this thesis therefore, point out that the role played by clan orientation is fairly complex. On the one hand, clan orientation could promote knowledge absorption. On the other hand, it appears to impede ACAP for certain types of knowledge.

6.2 Absorptive Capacity

The most salient finding related to ACAP itself is that it does not appear to be a single construct. As discussed in the previous section, the four different categories of ACAP showed different relationships with organizational culture. In addition, in the multiple regression models created for the different categories of ACAP, the results indicated different relationships among the variables for the various categories. Level of manager and homogeneity of prior-related knowledge were significant predictors of Client and Service ACAP. Although level of manager was also a significant predictor of Process and Tech ACAP, clan orientation was found to be significant for these two categories, but homogeneity of prior-related knowledge was not.

The existing empirical literature does not address the issue of different categories of ACAP. Zahra and George's (2002) conceptual model however, suggests that ACAP exists in two forms: "Potential" ACAP and "Realized" ACAP . Potential ACAP refers to the capture and assimilation of new knowledge. Realized ACAP is the ability to

transform and apply this knowledge³⁵. Zahra and George (2002) argue that the processes that facilitate Potential ACAP in an organization might be different from those that promote Realized ACAP. Similarly, it might be argued that the factors that promote ACAP for one type of knowledge might not apply to other types of knowledge. These results suggest that, as Matusik and Heeley (2002) and Zahra and George (2002) point out, ACAP is a much more complex construct than previously thought.

Law, Wong and Mobley (1998) have attempted to shed light on the nature of multidimensional constructs. The authors provide a taxonomy of such constructs which includes three basic models: latent, aggregate and profile. Dimensions of latent constructs exist as underlying and unobservable aspects of the construct. Aggregate multidimensional constructs are those whose dimensions exist at the same level as the construct. The construct itself is formed by mathematically aggregating these dimensions. Profile multidimensional have dimensions that exist at the same level as the construct, but these dimensions are not mathematically aggregated to form the construct. Law, Wong and Mobley provide the example of personality tests as a profile construct where different aspects of personality exist but cannot be mathematically aggregated to form an overall personality "score".

³⁵ The original definition of ACAP is the ability of an organization to capture, assimilate and apply knowledge (Cohen and Levinthal, 1990). Zahra and George (2002) has separated the process into two distinct components: Potential (capture and assimilate) and Realized (transform and apply) ACAP.

The point of the taxonomy is to provide a model that allows for specification of the relationship between a multidimensional construct and its dimensions. Law, Wong and Mobley (1998) argue that until these relationships are articulated, the construct itself is not well defined, nor is it completely clear what one measures when undertaking research on such an ill-defined construct.

The exploratory results of this study suggest that ACAP may well be a profile multi-dimensional construct. That is, an organization might have different types of ACAP for different types of knowledge. Researchers who operationalize ACAP as a unidimensional construct might therefore generate inaccurate conclusions about how ACAP is developed unless the specific dimensions being studied are specified.

6.3 Prior-Related Knowledge

The findings of this thesis suggest that the level of prior-related knowledge does not influence ACAP, but homogeneity of prior-related knowledge does. The fact that the work group's level of prior-related knowledge did not influence ACAP was an unexpected finding. Cohen and Levinthal (1990), for example, argued that a base of knowledge is needed to enable the capture and assimilation of new knowledge. Similarly, the results of Gupta and Govindarajan's (2000) study with multinational firms indicated that subsidiaries staffed with expatriates, who knew more about the

parent organizations that staff in greenfield subsidiaries, were able to capture knowledge more readily.

The results of these 2 studies, however, could be interpreted more as an issue of homogeneity of prior-related knowledge rather than as one of an absolute level of prior-related knowledge. For example, in the study conducted by Gupta and Govindarajan (2000), employees from the parent organization probably had common knowledge about the organization that enabled them to work effectively as a group. Similarly, Cohen and Levinthal's (1990) study used R&D expenditure as a proxy for prior-related knowledge. No distinction was made as to whether these expenditures had an impact on the level or homogeneity of knowledge of groups in the organization. Accordingly, although the findings of this thesis do not appear to support the literature on the topic of prior-related knowledge, this literature does not make clear whether it is the level of knowledge, or the homogeneity of knowledge that is of importance in facilitating ACAP.

Cohen and Levinthal (1990) have argued that individuals need a certain base of knowledge in order to recognize and assimilate new knowledge. Similarly, at the group level, Grant (1996) suggests that common knowledge³⁶ is needed to allow members to share uncommon knowledge. The implication is that a base of knowledge is required if an individual is to recognize and assimilate new knowledge.

³⁶ Please note: different authors use different terms in referring to this construct: Grant (1996) uses "common knowledge", Crampton (2001) uses "mutual knowledge".

At the group level, however, if group members have a common base of knowledge, this new knowledge can be more easily distributed than if they do not. This finding suggests that in contrast to individual ACAP, ACAP at the group level depends to a greater extent on homogeneity of prior-related knowledge.

CHAPTER 7: Conclusions

The environment in which organizations operate is undergoing dramatic changes. Bettis and Hitt (1995) point to factors such as mass customization, faster pace of product and process innovation, and increasing technological change and diffusion as some of the key aspects of this new "competitive landscape". They further argue that increased knowledge intensity goes hand in hand with increased technological change. In addition, the knowledge base in many organizations is path-dependent, meaning that what the knowledge in an organization at any given time is based on the knowledge accumulated at a previous time. Accordingly, in the new operating environment, organizations will have to learn quickly, but also unlearn just as fast: a balancing act that requires the capability to import external knowledge. Bettis and Hitt (1995) argue that constructs such as ACAP, therefore, are important aspects of organizational functioning in this new environment.

In addressing similar issues, Nohria and Berkley (1994, p. 110) ask the question: ". . . in the post-bureaucratic world, with blurred organizational boundaries, ubiquitous technology, and empowered individuals, what counts as an organization?". The answer appears to be that small groups of employees working within a broader organizational context will likely be the norm (Bartlett and Ghoshal, 1998). These work groups, working in decentralized, flattened organizations, must be able to

absorb knowledge effectively in order to perform well. With this emerging reality of the organization in mind, this study has attempted to examine, using the construct of ACAP, some of the core elements that enable knowledge absorption at the group level. A number of significant conclusions may be drawn from the findings of this study.

Relative to the objectives of this thesis, the most critical finding is that the middle management layer in an organization appears to be an important contributor to the ability of work groups in knowledge-intensive environments to import and utilize new knowledge. However, not all middle managers practice the types of behaviours that encourage knowledge absorption; only those at higher levels in the hierarchy appear to do so. Thus the findings suggest that the middle managers who are able to provide information on strategic directions of the organization will tend to have an impact on the ability work groups to absorb knowledge.

A second important finding related to the role of middle managers is that knowledge integration behaviours—behaviours that build relationships among group members, did not appear to have an impact on ACAP. Nevertheless, the data demonstrated that group members relied heavily on peers as a source of knowledge. The conclusion is that work groups engaged in knowledge work, who have been together for some period of time, likely have well-developed mechanisms to promote intra-group knowledge sharing. Accordingly, the findings of this thesis

suggest that middle managers in knowledge intensive organizations should focus their attention on clarifying strategic context for their work groups in order to facilitate knowledge absorption.

In addition, an organization's culture does appear to have an influence on knowledge absorption. The relationship between culture and knowledge absorption however, is fairly complex: some cultures could have both a negative and positive influence on absorption of knowledge.

Finally, the thesis suggests that the putative relationship between prior-related knowledge and the ability of an organization to assimilate and utilize new knowledge is more complex than the current literature indicates. Different types of capability likely exist for specific types of knowledge. Thus, efforts at knowledge management within organizations need to carefully consider the types of knowledge needed, and whether or not a base level of knowledge, as well as the required homogeneity of knowledge exists to make full use of knowledge management systems.

From a theoretical perspective, this thesis supports the reconceptualization of ACAP proposed by Zahra and George (2002), which suggests that it is a complex construct that requires careful examination to fully understand the organizational processes which enable it. From a practical perspective, the findings suggest that managers in contemporary organizations need to carefully assess the types of knowledge that is

important to organizational success and align the organization's culture and group processes accordingly.

7.0 Theoretical Implications

It has been observed that, despite many years of study on the topic of knowledge in a variety of disciplines, the literature still has not produced a workable knowledge-based theory of the firm (Spender, 1996; Grant, 1996; Schulz, 2003). This state of affairs is partially due to the fact that so many different disciplines examine knowledge utilization in organizations that there is little in common among the various theoretical models.

Verkasalo and Lapalanien (1998) identified three schools of thought related to knowledge utilization in organizations: the core competence school, the knowledge creation school, and the knowledge base school. From an academic perspective, the core competence school is identified with the strategy and industrial economics literature. The knowledge creation school is more closely related to organizational theory, and the knowledge base school is associated with the information systems discipline³⁷. Within these disciplines, although all address the issue of knowledge in organizations, the theoretical frameworks and underlying models and analytical approaches are substantially different.

³⁷ Note: the organizational learning literature is a potential fourth stream of research, but it seems to be a component of the three previously mentioned disciplines.

Cohen and Levinthal's (1989, 1990) concept of ACAP has provided a tangible means of integrating research in the various fields. Unfortunately, since 1990, empirical studies involving ACAP have used many different conceptualizations of the construct. Matusik and Heeley's (2001) multi-level model provided a coherent multi-disciplinary framework in establishing relationships between the firm-level view promoted by researchers such as Cohen and Levinthal (1990) and Tsai (2002), and the more micro-organizational views of Gupta and Govindarajan (2000) and Szulanski (2000).

Figure 14: Contributions of this thesis to the development of the ACAP theoretical framework

Finally, Zahra and George (2002) reconceptualized ACAP as a dynamic capability that relied in a multiplicity of influences at various levels in the organization. As such, their model allows for different disciplinary approaches within a common framework. This thesis sought to contribute to this rapprochement in the development of a theoretical framework of knowledge utilization in organizations by examining ACAP at the group level in organizations, and by exploring the role of middle managers at this level. Moreover, it sought to more fully develop the multi-level framework introduced by Matusik and Heeley (2002).

Figure 14 provides a diagram outlining the state of the theoretical framework related to ACAP and the insights this thesis has provided which include:

- demonstrating that managers are important to ACAP and specifically, higher-level middle managers influence ACAP through context-building behaviours;
- indicating that ACAP might not in fact, be a single construct, rather, it could be a “profile” multidimensional construct;
- supporting the notion that organizational culture does influence ACAP, but suggesting that it has a range of different influences depending on the type of knowledge involved.
- introducing the notion that homogeneity of prior-related knowledge might be more critical to the ACAP of work groups than the level of prior-related knowledge.

The revised theoretical model developed in this thesis, which provides a rationale for these insights is outlined in Figure 15. The dependent variable in this thesis, ACAP, is shown to include 4 different categories of knowledge. Level of manager is

depicted as a moderating variable determining the extent to which managers practice context-building behaviours.

Figure 15: A Revised Multi-Level Theoretical Model of ACAP

Context Building Behaviours are, in turn, shown to influence ACAP. Finally, homogeneity of prior-related knowledge and clan orientation are shown as influencing ACAP for certain types of knowledge. This theoretical model leads to 5 main conclusions to be derived from this thesis.

First, not all levels of middle management have an impact on ACAP of work groups. In this thesis, higher-level managers tend to practice more context-building behaviours, likely because they are closer to the senior management cadre and thus are more exposed to strategic issues. The conclusion then, is that middle managers who are knowledgeable about the organization's strategic directions can likely influence the ACAP of work groups. Middle managers who do not understand the organization's strategic imperatives will not have much of an influence on ACAP.

Second, a finding corollary to the observation that higher-level middle managers are likely to influence ACAP through context-building behaviours, is that knowledge integration behaviours appear to have little impact on the development of ACAP. A possible explanation for this finding is that the work groups in this thesis were comprised largely of knowledge workers working in relatively mature groups. As such, they likely had their own knowledge integration processes in place and might be in fact, functioning as self-organizing Communities of Practice. This argument is partially supported by the data showing that most of the study participants obtained knowledge from peers. The conclusion then, is that not all work groups require knowledge integration behaviours from middle managers in order to develop ACAP. For mature groups (i.e., groups who have been together for some time) engaged in knowledge work, the findings of this study suggest that knowledge integration behaviours have little impact on ACAP.

A third finding is that homogeneity of prior-related knowledge (i.e., the degree of commonality of knowledge among group members) appears to be an important factor in developing ACAP at the work group level. The level of prior-related knowledge however (i.e., the knowledge base of the group as represented by the average of prior-related knowledge scores) did not appear to have an impact. The conclusion is that although prior-related knowledge is thought to be a key component of ACAP, it can be addressed as two very different constructs. As Cohen and Levinthal (1990) and Yeunt et al., (1999) point out, the impact of homogeneity of knowledge might depend, to some degree, on the type of work being done by the group and the environment in which they operate.

A fourth key finding is that clan orientation was found to have a range of different relationships with ACAP for different types of knowledge. This implies that organizational culture can both impede and facilitate ACAP depending on the type of knowledge required by work groups.

Finally, in terms of ACAP itself, this thesis suggests that it is not a single construct. It might be, according to the taxonomy of Law, Wong and Mobley (1998) a "profile" multidimensional construct. This means that an organization might have different levels of ACAP for different types of knowledge. It also suggests that different configurations of organizational factors such as culture, group dynamics and managerial practices might be required for each of the dimensions of ACAP. In sum,

the new theoretical model suggested by the data in this thesis is consistent with Matusk and Heeley's (2001) multi-level approach, and supports Zahra and George (2002) reconceptualization of ACAP as a multi-disciplinary, complex construct influenced by many different factors in an organization. The findings of the thesis however, suggest that ACAP might exist as a profile multidimensional construct, which has specific implications for the type of research required to better understand its underlying dimensions (Law, Wong and Mobley, 1998).

7.1 Practical Implications

From a practical perspective, the study suggests that a more detailed understanding of the impact of different levels of middle management is required. Previous studies have tended to address middle management as a singular group of managers. Based on the results of this study, it seems reasonable to conclude that, as far as knowledge absorption is concerned, managers who understand and can communicate the strategic imperatives of the organization are likely to have an influence on ACAP. Furthermore, the thesis demonstrates the knowledge integration behaviours do not appear to influence ACAP.

This is an important finding given research suggesting that the further one moves down the hierarchy in organizations, the less aware people are of strategic imperatives of the organization (Hambrick, 1981). Furthermore, Kifidu and Petridis

(1997) demonstrated that many middle managers performed mostly coordination tasks because their roles were formally confined to relatively small spheres of authority. Huy (2001) and Thakur (1998) also found similar results. Long chains of command might isolate lower level middle managers from information on strategic directions thus rendering them less capable of passing this information on to their work groups. The implication of this study is that senior managers need to ensure that all levels of middle management are involved in understanding strategic directions. Alternatively, flattening the chain of command might bring middle managers into more contact with strategic aspects of the organization.

This research also suggests that organizations that wish to increase ACAP might explore other ways to connect work groups to the strategic context of the organization. The use of communications technology might facilitate this connection. Versakalo and Lapannanien (1998) for example, demonstrated that by using information technology to distribute business plans, the information reached a larger number of people faster than those business plans distributed by word-of-mouth. Consideration could be given then, to augmenting the middle manager role as knowledge engineer with other tools that alert group members to strategic imperatives of the organization.

Group characteristics are also important from a practical perspective. The fact that peers were the main source of knowledge for group members suggests that

managers need to pay more attention to providing time and space for peer-to-peer interaction. In addition, the reliance of group members on managers as a source of knowledge³⁸ underlines the importance of ensuring that middle managers fully understand the strategic directions of the organization. The emergence of self-study as a popular means of knowledge absorption suggests that organizations will need to closely examine the role of informal sources of learning.

Related to the issue of group characteristics is the finding that groups with higher levels of common knowledge also demonstrated higher ACAP. This suggests that managers should examine ways of building common knowledge within the team. This might include for example, ensuring that team members attend training programs as a group, or implementing processes for developing group-based learning plans.

Finally, the fact that clan cultural orientation was negatively related to ACAP for certain types of knowledge indicates a need to consider carefully the values and beliefs of the group related to the integration of new knowledge from outside sources. These findings imply that managers should be more cognizant of the types of knowledge required by their work groups. In addition, organizations with clan cultures might need to take steps to encourage the search for knowledge from outside of the organization.

³⁸ Note: the data indicated that managers were the second most popular source of knowledge, with self-study third.

7.2 Contributions of this Thesis

This thesis has helped to advance the emerging theoretical framework of ACAP as a fundamental means of developing a knowledge-based theory of the firm in three principal ways. First, from a methodological perspective, it introduced direct measures of prior-related knowledge and of ACAP, took a longitudinal approach, and used multi-level data gathering and analytical methods. Second, the study focused on the dynamics of work groups as opposed to the firm-level or organizational level approaches noted in previous studies. Third, this study examined a previously neglected factor in the development of ACAP: the middle manager. Each of these contributions will be discussed in more detail below.

Previous studies have used a variety of indices of ACAP. The most popular approach at the firm level is R&D expenditures. Other studies relied on proxies for ACAP that amount to different ways of measuring prior-related knowledge. For example, Cohen and Levinthal (1990), indicate that R&D expenditure is really a proxy for investment in base knowledge within the firm that allows it to capture external knowledge. Gupta and Govindarajan (2000) measured the percentage of people in subsidiaries who were from the parent company. Szulanski (2000) used surveys to determine people's readiness to absorb data. In contrast, this thesis sought to measure directly, through the use of self-assessments, how much the knowledge of group

members had changed over time. Although the self-assessment methodology used might not be the most objective means of measurement, the measurement of ACAP as a reflection of how much knowledge was absorbed is a more direct approach than that used in previous studies.

In addition, the use of a longitudinal methodology lends itself to better control than a purely retrospective approach. In previous studies, there was little control over the tenure of group members or the impact of their affiliation within specific groups in the organization. In this study, these factors were controlled for by establishing a specific length of time during which the study was conducted and by using the group members themselves as their own controls (through the 2 waves of data collection matching of the Time 1 and Time 2 responses).

The use of multi-level analytical methods advances both the accuracy of analysis and the theoretical elegance of the ACAP model. A number of authors have argued that most organizational behaviour phenomena are influenced by factors at multiple levels (Goldstein, 1987; Draper, 1995; House, Rousseau, Thomas-Hunt, 1995) but few studies have embraced the methodology of hierarchical linear analysis to clearly identify the influence of these different levels. These methodological contributions should help to establish a framework for continuing exploration of the multi-level nature of ACAP.

This study also sought to advance the theoretical model of ACAP by addressing the group level in organizations. In so doing, it brings into focus the fact that current theories about group dynamics such as group size, cohesiveness, and member homogeneity could apply to the ACAP theoretical model. For example, the clan orientation of groups could be construed as an issue of relationships among team members, a topic addressed by group cohesiveness studies.

Similarly, homogeneity of prior-related knowledge is a direct analogue to group member homogeneity studies. Whereas previous work in these areas related to group performance in task accomplishment, this thesis provides a view from the perspective of group performance in knowledge absorption. If it is true that the ability to capture and apply knowledge is an important element in modern organizations, organizational theory should then begin to examine these theories and models from the perspective of knowledge utilization as well as from the perspective of task accomplishment. In this regard, this study provides important information in terms of culture, size and homogeneity of prior-related knowledge as means of stimulating further exploration. The research on Communities of Practice, examining the impact of work groups on shared learning and ultimately, higher performance (Storck and Lesser, 2001; Wenger, McDermott and Snyder, 2002), is a research stream that seems to fit well with the view that work groups have a strong influence on knowledge utilization in organizations.

Finally, the assessment of how middle managers influence knowledge absorption in organizations has been the subject of only one other recent study (Janczak, 1999). In his Ph.D thesis, Janczak used a case-study approach with a sample of private sector organizations. In his conclusions, he recommended additional research on middle management roles in knowledge absorption using different research methodologies. This thesis serves to fill this need in that it used public sector organizations as a sample whereas Janczak's work focused on the private sector. In addition, it uses a quantitative methodology as opposed to Janczak's case study approach. The two studies found similar results: namely that middle managers are not a homogenous group (Janczak, 1999) and that they do influence knowledge utilization in organizations. This thesis was able to specify which level of middle manager influenced ACAP, and the types of behaviours they tend to display to do so. The fact that these two studies, using different methodologies in different industry sectors by and large drew similar conclusions, suggests that the impact of middle managers on ACAP is an area that calls for further investigation.

7.3 Limitations of the Study

This study has contributed to the development of a theoretical framework for knowledge utilization in organizations. A number of limitations are inherent to the study however, that might affect generalizability of the findings.

First, the attrition rate in this study led to the final sample size being lower than expected. Although the effect size analysis indicated that the sample would still provide adequate power to detect an effect, the loss of 5 groups meant that the analysis with higher-level managers could not be conducted using HLM. Therefore, although the OLS analysis suggests that the hypothesis that middle management practices influencing ACAP should be accepted, it is difficult to say with certainty if this finding would hold when intra-class correlations are considered.

Second, in order to limit the attrition rate, the study was conducted with a sample of work groups from public sector organizations. Although there is no reason to believe that the model of ACAP developed in this thesis would not apply equally well to the private sector, all of the findings of this study might not be generalizable to private sector organizations.

Third, because this thesis was a field study, development of objective measures of knowledge was not possible. As noted previously, while this was not a primary concern (a review of studies on self-assessment measures of knowledge shows that they are likely to be accurate and, the practice of averaging scores from individual questions, and then again averaging these scores over a large number of respondents tends to improve the reliability of these types of measures) in an ideal world, specific knowledge tests, such as those used in educational settings, would help to avoid any issues that might arise with self-assessments.

Fourth, organizational culture is a fairly complex phenomenon. The fact that the study found mixed results for the impact of clan culture on ACAP might suggest that either clan culture is not the best measure of a cultural atmosphere conducive to knowledge absorption. It might also suggest that the measure of culture used in this thesis did not clearly identify the key cultural factors that influence ACAP.

Finally, this thesis was conducted with work groups as they existed within the participating organizations. Because these groups had been together for a while, it is possible that they had reached a level of competence such that the level of prior-related knowledge would not show an effect on ACAP. Additional research using groups at different stages of development might be useful to fully explore whether the influence of prior-related knowledge varies according to the development stage of the work group.

7.4 Future Research

In terms of future research, a number of recommendations follow from the results of this study. First, it would be important to conduct research that involves a wider range of middle managers at higher levels in the hierarchy, and possible lower-level senior managers. A mix of qualitative studies such as that conducted by Janczak (1999), and empirical research that examines precisely what middle managers do,

such as that conducted by Kifidu and Petridis (1997) would provide important information to build an understanding of how different levels of middle managers influence knowledge absorption. Indeed, a key finding of this thesis is that future studies on this topic need to control for level of middle manager involved.

Second, this thesis was designed as field research, which introduced limitations in terms of the types of measures that could be used. Research that used more objective measures of knowledge, perhaps in an experimental setting or in other field environments that lend themselves to such measures would help to extend the findings of this thesis.

Third, the role of organizational culture related to different knowledge categories and different types of knowledge would be a rich avenue for research into knowledge utilization in organizations. This thesis has suggested that the construct of ACAP needs to be expanded to explicitly model type of knowledge as a core component. Additional research that examines in more detail the various dimensions of ACAP and the factors within the organization that influence each would help to enrich the understanding of knowledge absorption in organizations.

Fourth, this study was focused primarily on identifying whether middle managers had an influence on ACAP. As such, other individual level factors such as motivation to learn, incentives for learning, and personal workload were not examined. There

was some indication in the data that workload is a core barrier to ACAP. Accordingly, a deeper examination of barriers to ACAP, building perhaps on the work of Szulanski's (2000) "stickiness factors" might help to shed light on organizational factors that can be detrimental to knowledge absorption.

Finally, this study has shown that research on ACAP needs to take into account factors at different levels in the organization. Continued multi-level studies, such as the approach taken by Matusik and Heeley (2002), coupled with the analytical power of hierarchical analysis as demonstrated in this thesis, would help to better illustrate the relationships between and among these factors.

Appendices: Data Collection Tools and Statistical Output

Appendix A

Organizational Culture Assessment Instrument (Cameron and Quinn, 1999)

1. Dominant Characteristics			
A	The organization is a very personal place. It is like an extended family. People seem to share a lot of themselves		
B	The organization is a very dynamic and entrepreneurial place. People are willing to take risks and stick their necks out.		
C	The organization is very results-oriented. A major concern is with getting the job done. People are very competitive and achievement oriented.		
D	The organization is a very controlled and structured place. Formal procedures generally govern what people do.		
Total		100	
2. Organizational Leadership			
A	The leadership in the organization is generally considered to exemplify mentoring, facilitating, or nurturing.		
B	The leadership in the organization is generally considered to exemplify entrepreneurship, innovating, or risk taking.		
C	The leadership in the organization is generally considered to exemplify a no-nonsense, aggressive, results-oriented focus.		
D	The leadership in the organization is generally considered to exemplify coordinating, organizing or smooth-running efficiency.		
Total		100	
3. Management of Employees			
A	The management style in the organization is characterized by teamwork, consensus, and participation.		
B	The management style in the organization is characterized by individual risk-taking, innovation, freedom, and uniqueness.		
C	The management style in the organization is characterized by hard-driving competitiveness, high demands, and achievement.		
D	The management style in the organization is characterized by security of employment, conformity, predictability, and stability in relationships.		
Total		100	
4. Organization Glue			
A	The glue that holds the organization together is loyalty and mutual trust. Commitment to his organization runs high.		
B	The glue that holds the organization together is commitment to innovation and development. There is an emphasis on being on the cutting edge.		
C	The glue that holds this organization together is the emphasis on achievement and goal accomplishment. Aggressiveness and winning are common themes.		
D	The glue that holds this organization together is formal rules and policies. Maintaining a smooth-running organization is important.		
Total		100	
5. Strategic Emphases			

A	The organization emphasizes human development. High trust, openness, and participation persist.		
B	The organization emphasizes acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.		
C	The organization emphasizes competitive actions and achievement. Hitting stretch targets and winning in the marketplace are dominant.		
D	The organization emphasizes permanence and stability. Efficiency, control and smooth operations are important.		
	Total	100	
6.Criteria of Success			
A	The organization defines success on the basis of the development of human resources, teamwork, employee commitment, and concern for people.		
B	The organization defines success on the basis of having the most unique or newest products. It is a product leader and innovator.		
C	The organization defines success on the basis of winning in the marketplace and outpacing competition. Competitive market leadership is key.		
D	The organization defines success on the basis of efficiency. Dependable delivery, smooth scheduling, and low-cost production are key.		
	Total	100	

Appendix B
Knowledge Assessment Inventory
(for assessment of Prior-Related Knowledge)

Please assess your own knowledge on the following topics. The rating scale is as follows:

Rating		
1	Beginner	I have limited knowledge of this topic. I would not be comfortable talking with my colleagues about it in any real depth.
2	Intermediate	I understand basic facts and how these evolved. I am able to converse with colleagues on a number of key issues.
3	Advanced	I have a thorough understanding of all facts and concepts related to this topic. I can converse easily on a wide range of issues and can solve problems related to this topic area.
4	Expert	I have extensive experience in the topic area. Can coach and counsel others. Capable of writing papers and/or making presentations on the topic. Can anticipate evolution of the field and forecast long run implications.

	Knowledge Category	1 Beginner	2 Intermediate	3 Advanced	4 Expert
1	Knowledge of Client				
2	Knowledge of Products and Services				
3	Knowledge of Processes				
4	Knowledge of Technology				

Appendix C

Assessment of Middle Management Practices and Work Complexity

Instructions

The objective of this tool is to gather your perceptions of middle management practices. There are no "right or wrong" answers, different organizations tend to support different types of practices.

Please respond by placing a check mark (✓) in the appropriate cell based on your impression of middle management practices in this organization.

The data will be combined with data from other groups in the organization to create a composite score and will be used to see how management practices vary from organization to organization.

Middle Management Practices	1 Not very often	2 Sometimes	3 Frequently	4 Very often	5 Continually
<i>Context Building Behaviours</i>					
Develops support and acceptance for the organization's mission statement.					
Helps employees understand how the mission of this organization is to be achieved.					
Helps to clarify the organization's vision, mission, and strategic imperatives.					
Provides feedback that helps to identify potential problems and opportunities.					
<i>Knowledge Integration Behaviours</i>					
Distributes information on how the organization is performing.					
Encourages work groups to make decisions about problems and opportunities.					
Encourages team members to act on new information received.					
Helps to develop relationships within the work groups.					
Provides opportunities for self-assessment with respect to goal accomplishment.					

Complexity of your Work

Please rate the degree of difficulty and challenge in your work by circling the appropriate number on the rating scale below. This data will be used to see if task complexity has an impact on knowledge transfer.

Difficulty

1 2 3 4 5 6 7 8 9
easy difficult

Challenge

[illegible]

Appendix D

Measurement of Absorptive Capacity

Referring to the knowledge domains you identified in the initial meeting, please indicate the extent of change in your knowledge in this area and the source of information received. In addition, please provide an assessment of how applicable the information is to your work.

To fill in the data, please place a check mark (✓) in the cell corresponding to how much you think your knowledge of the specific domain identified in Column A has increased over the past 5-6 months.

	Knowledge Categories	No Change	Increased a little	Moderate Increase	Increased a lot	Sources of Information (see legend below)	Applicability to my work (1=not very applicable, 5=highly applicable)
1	Knowledge of Clients						
2	Knowledge of Products and Services						
3	Knowledge of Processes						
4	Knowledge of Technology						

Legend for Sources of Information*

1. Formal Training programs
2. Information gathered from Intranet
3. Information gathered from Internet
4. Self-study
5. Information gathered from direct conversation with colleagues
6. Information gathered through direct conversation with managers
7. Clients

Other (please identify) _____

Appendix E

Structured Interview Outline

1. Please describe the current structure of your organization and the level of the middle manager to whom you report.
2. What is the most common means of information sharing used in this organization?
3. What barriers did you encounter?

Appendix F1

Hypothesis 1 B: "Context Building Behaviours practices by middle management will have a positive impact on the ACAP of work group members"

Level-1 Model

$$Y = B0 + B1*(CBBSS) + R$$

Level-2 Model

$$B0 = G00 + U0$$

$$B1 = G10 + U1$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	Approx. d.f.	P-value
For INTRCPT1, B0					
INTRCPT2, G00	2.446733	0.061524	39.768	27	0.000
For CBBSS slope, B1					
INTRCPT2, G10	0.003019	0.041649	0.072	27	0.943

Final estimation of variance components:

Random Effect	Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0	0.24501	0.06003	27	60.99399	0.000
CBBSS slope, U1	0.04803	0.00231	27	23.15673	>.500
level-1, R	0.54680	0.29899			

Appendix F2

Hypothesis 1C: "Knowledge Integration practices by middle management will have a positive impact on the ACAP of work group members"

Level-1 Model

$$Y = B0 + B1*(KIBSS) + R$$

Level-2 Model

$$B0 = G00 + U0$$

$$B1 = G10 + U1$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

		Standard		T-ratio	d.f.	Approx. P-value
Fixed Effect		Coefficient	Error			
For INTRCPT1, B0						
INTRCPT2, G00		2.446828	0.061551	39.753	27	0.000
For KIBSS slope, B1						
INTRCPT2, G10		0.014278	0.039156	0.365	27	0.718

Final estimation of variance components:

Random Effect		Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0		0.24545	0.06025	27	61.05942	0.000
KIBSS slope, U1		0.04875	0.00238	27	21.68128	>.500
level-1, R		0.54650	0.29866			

Appendix F3

Hypothesis 2: "Organizational culture will moderate the relationship between middle management practices and ACAP. Specifically, the stronger the clan orientation, the more influence management practices will have on ACAP".

Level-1 Model

$$Y = B0 + B1*(CBBSS) + B2*(KIBSS) + R$$

Level-2 Model

$$B0 = G00 + U0$$

$$B1 = G10 + G11*(CLANN) + U1$$

$$B2 = G20 + G21*(CLANN) + U2$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value
For INTRCPT1, B0					
INTRCPT2, G00	2.446739	0.061594	39.724	27	0.000
For CBBSS slope, B1					
INTRCPT2, G10	-0.012082	0.056754	-0.213	26	0.833
CLANN, G11	-0.002445	0.007383	-0.331	26	0.743
For KIBSS slope, B2					
INTRCPT2, G20	0.018689	0.052502	0.356	26	0.724
CLANN, G21	0.001771	0.005210	0.340	26	0.736

Final estimation of variance components:

Random Effect	Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0	0.24832	0.06166	27	61.30052	0.000
CBBSS slope, U1	0.11515	0.01326	26	20.86057	>.500
KIBSS slope, U2	0.11503	0.01323	26	19.13348	>.500
level-1, R	0.54543	0.29749			

Appendix F4

Hypothesis 3: "Managerial practices will influence ACAP more in work groups with higher levels of homogeneity of prior-related knowledge".

and Hypothesis 4: "Managerial practices will influence ACAP more in work groups with higher levels of prior-related knowledge".

Level-1 Model

$$Y = B0 + B1*(CBBSS) + B2*(KIBSS) + R$$

Level-2 Model

$$B0 = G00 + U0$$

$$B1 = G10 + G11*(SDALL) + U1$$

$$B2 = G20 + G21*(PRKALL) + U2$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value
For INTRCPT1, B0					
INTRCPT2, G00	2.446244	0.065585	37.299	25	0.000
For CBBSS slope, B1					
INTRCPT2, G10	-0.025147	0.055161	-0.456	24	0.652
SDALL, G11	0.196250	0.176660	1.111	24	0.278
For KIBSS slope, B2					
INTRCPT2, G20	0.022201	0.051518	0.431	24	0.670
PRKALL, G21	0.035391	0.087606	0.404	24	0.689

Final estimation of variance components:

Random Effect	Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0	0.25783	0.06648	25	57.88074	0.000
CBBSS slope, U1	0.10703	0.01145	24	19.47575	>.500
KIBSS slope, U2	0.11963	0.01431	24	15.98901	>.500
level-1, R	0.55755	0.31086			

Appendix F5

Cross Level Interactions Homogeneity of Variance with Context Building and Knowledge Integration Behaviours

Level-1 Model

$$Y = B0 + B1*(CBBSS) + B2*(KIBSS) + R$$

Level-2 Model

$$B0 = G00 + U0$$

$$B1 = G10 + G11*(PRKALL) + U1$$

$$B2 = G20 + G21*(SDALL) + U2$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value
For INTRCPT1, B0					
INTRCPT2, G00	2.446776	0.065609	37.293	25	0.000
For CBBSS slope, B1					
INTRCPT2, G10	-0.018486	0.058683	-0.315	24	0.755
PRKALL, G11	0.075402	0.087245	0.864	24	0.396
For KIBSS slope, B2					
INTRCPT2, G20	0.017629	0.053330	0.331	24	0.744
SDALL, G21	-0.050613	0.189747	-0.267	24	0.792

Final estimation of variance components:

Random Effect	Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0	0.25737	0.06624	25	57.83644	0.000
CBBSS slope, U1	0.12046	0.01451	24	20.04118	>.500
KIBSS slope, U2	0.11555	0.01335	24	15.99799	>.500
level-1, R	0.55774	0.31108			

Appendix F6

Level of Manager as a Predictor of ACAP

Level-1 Model

$$Y = B0 + R$$

Level-2 Model

$$B0 = G00 + G01*(MGRLV) + U0$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value
For INTRCPT1, B0					
INTRCPT2, G00	2.445819	0.055847	43.795	26	0.000
MGRLV, G01	-0.513481	0.083867	-6.123	26	0.000

Final estimation of variance components:

Random Effect		Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, level-1,	U0	0.20873	0.04357	26	49.64409	0.004
	R	0.54686	0.29906			

Appendix F7

Clan as predictor of ACAP

Level-1 Model

$$Y = B0 + R$$

Level-2 Model

$$B0 = G00 + G01*(CLANN) + U0$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value
For INTRCPT1, B0					
INTRCPT2, G00	2.445879	0.057315	42.675	26	0.000
CLANN, G01	0.016343	0.007809	2.093	26	0.046

Final estimation of variance components:

Random Effect	Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0	0.22263	0.04956	26	53.05584	0.002
level-1, R	0.54724	0.29947			

Appendix F8

Size of Group at Time 1 as Predictor of ACAP

Level-1 Model

$$Y = B0 + R$$

Level-2 Model

$$B0 = G00 + G01*(SIZEB) + U0$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

		Standard		Approx.		
Fixed Effect		Coefficient	Error	T-ratio	d.f.	P-value

For	INTRCPT1, B0					
	INTRCPT2, G00	2.439545	0.059778	40.810	26	0.000
	SIZEB, G01	0.036429	0.018904	1.927	26	0.065

Final estimation of variance components:

		Standard	Variance	df	Chi-square	P-value
Random Effect		Deviation	Component			

INTRCPT1,	U0	0.23393	0.05472	26	55.65141	0.001
level-1,	R	0.54651	0.29867			

Appendix F9

Homogeneity of Prior-Related Knowledge as a Predictor of ACAP

Level-1 Model

$$Y = B0 + R$$

Level-2 Model

$$B0 = G00 + G01*(SDALL) + U0$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value

For INTRCPT1, B0					
INTRCPT2, G00	2.441644	0.059031	41.362	26	0.000
SDALL, G01	-0.560645	0.226968	-2.470	26	0.021

Final estimation of variance components:

Random Effect		Standard Deviation	Variance Component	df	Chi-square	P-value

INTRCPT1, level-1,	U0	0.22961	0.05272	26	54.90714	0.001
	R	0.54658	0.29875			

Appendix F10

Task Complexity as a Predictor of ACAP

Level-1 Model

$$Y = B0 + R$$

Level-2 Model

$$B0 = G00 + G01*(TSKCM) + U0$$

The outcome variable is ACAPALL: Final estimation of fixed effects
(with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value
For INTRCPT1, B0					
INTRCPT2, G00	2.445787	0.061127	40.012	26	0.000
TSKCM, G01	-0.111602	0.140767	-0.793	26	0.435

Final estimation of variance components:

Random Effect	Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0	0.24735	0.06118	26	59.50328	0.000
level-1, R	0.54659	0.29876			

Appendix F11

ANOVA test of Context Building vs Knowledge Integration Behaviours: Level 2 vs Level 3 Managers (SPSS Output)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CBBSS	Between Groups	3.380	1	3.380	4.478	.036
	Within Groups	133.616	177	.755		
	Total	136.996	178			
KIBSS	Between Groups	.249	1	.249	.321	.572
	Within Groups	137.151	177	.775		
	Total	137.400	178			

Test of differences among Context-Building Behaviours: Level 2 vs Level 3 Managers

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SPPRT	Between Groups	2.340	1	2.340	2.044	.155
	Within Groups	202.655	177	1.145		
	Total	204.994	178			
MSSON	Between Groups	1.804	1	1.804	1.848	.176
	Within Groups	172.815	177	.976		
	Total	174.619	178			
CLARF	Between Groups	7.783	1	7.783	7.451	.007
	Within Groups	184.874	177	1.044		
	Total	192.656	178			
FEEDB	Between Groups	2.862	1	2.862	2.130	.146
	Within Groups	237.857	177	1.344		
	Total	240.719	178			

Appendix F12

OLS Regression: CBBs and ACAP with groups reporting to higher-level managers only (SPSS output)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.653	.314		5.271	.000
CBBSS	.223	.097	.366	2.294	.028

a. Dependent Variable: ACAPALL

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