Incremental and radical innovations in research libraries: An exploratory examination regarding the effects of ambidexterity, organizational structure, leadership, and contextual factors

Rutgers University has made this article freely available. Please share how this access benefits you. Your story matters. [https://rucore.libraries.rutgers.edu/rutgers-lib/40599/story/]

Citation to Publisher
Version: No citation available.

Citation to this Version: Jantz, Ronald C.. Incremental and radical innovations in research libraries: An exploratory examination regarding the effects of ambidexterity, organizational structure, leadership, and contextual factors, 2013. Retrieved from doi:10.7282/T3ZP44PT.

Terms of Use: Copyright for scholarly resources published in RUcore is retained by the copyright holder. By virtue of its appearance in this open access medium, you are free to use this resource, with proper attribution, in educational and other non-commercial settings. Other uses, such as reproduction or republication, may require the permission of the copyright holder.

Article begins on next page

SOAR is a service of RUcore, the Rutgers University Community Repository
RUcore is developed and maintained by Rutgers University Libraries
INCREMENTAL AND RADICAL INNOVATIONS IN RESEARCH LIBRARIES: AN EXPLORATORY EXAMINATION REGARDING THE EFFECTS OF AMBIDEXTERTY, ORGANIZATIONAL STRUCTURE, LEADERSHIP AND CONTEXTUAL FACTORS

By

RONALD C. JANTZ

A Dissertation submitted to the

Graduate School-New Brunswick
Rutgers, The State University of New Jersey

in partial fulfillment of the requirements

For the degree of

Doctor of Philosophy

Graduate Program in Communication, Information and Library Studies

Written under the direction of

Dr. Daniel O’Connor

and approved by

________________________
________________________
________________________
________________________

New Brunswick, New Jersey

May, 2013
ABSRACT OF THE DISSERTATION

Incremental and Radical Innovations in Research Libraries: An Exploratory Examination

Regarding the Effects of Ambidexterity, Organizational Structure, Leadership, and Contextual Factors

By

RONALD C. JANTZ

Dissertation Director:

Professor Daniel O’Connor

This study examines the effects of ambidexterity, organizational structure, and leadership on innovation in research libraries. There is much published literature suggesting the research or academic library must change, quickly and dramatically. These changes will likely take the form of new services, new products and new administrative practices – all of which are potential innovations. Much of the research literature on organizational innovation focuses on the for-profit sector of our economy. Based on organizational learning theories, institutional theory, and the diffusion of innovations, this study develops a comprehensive framework for studying innovation in institutional, nonprofit organizations and, more specifically, the research library. As such, this framework addresses the complex organizational path that an idea will take from inception to realization as a high quality library service.

The study extends certain innovation theories and examines factors that are unique to the institutional nonprofit, suggesting that ambidexterity and a more integrated leadership team are fundamental for the library to survive and thrive in the turbulence of
the new century. A core concept that is examined in this study is the distinction between radical innovations resulting in major organizational change and the more routine, incremental innovations. It is expected that the results of this study will not only contribute to the relatively sparse literature on innovation in the nonprofit sector, but will also have significant practical implications for leaders who want to create the 21st century research library.
ACKNOWLEDGEMENTS

First and foremost, I want to thank the leaders of the fifty-one research libraries who agreed to participate in this study of innovation. Many in research libraries are plagued with “survey fatigue” and I know the first impulse in a busy library is to say “no”, especially when 3 or 4 members of the leadership team were required to fill out the innovation survey. My spirits were frequently buoyed when these library leaders not only filled out the survey but also wished me luck. Many university librarians voiced interest in the results and some even discussed the implications of survey questions in their staff meetings. Obviously, I would not have had a dissertation without the data provided by these library leaders.

As in most significant endeavors, the individual effort is assisted by many along the way and so it is with my study of innovation. The encouragement, support, and active engagement of my university librarian, Marianne Gaunt, and my associate university librarian, Grace Agnew, were instrumental, not only in suggesting areas to pursue, but also enabling me to complete the PhD while also working as a librarian at Rutgers University Libraries.

I am indebted to many librarians and colleagues who assisted me throughout these dissertation endeavors. An eleven-member panel of librarians and library scholars provided the evaluation of some 40 library innovations to determine which ones could be considered radical or incremental. In addition, numerous librarians, library staff, and PhD students helped me pretest and debug a survey consisting of 102 questions.

During my seven year pursuit of the PhD, I was assisted in numerous ways by faculty at the School of Communication and Information (SC&I). Especially noteworthy,
my advisor, Professor Daniel O’Connor, provided much needed guidance regarding statistical methods while also striking, in my mind, a nice advisory balance regarding numerous issues of content and quality. Our mutual interest in research libraries led to many interesting and thought-provoking discussions. Professor Marija Dalbello pointed me to some key theoretical frameworks and helped me sort out qualitative and quantitative methodological issues. Additionally, I would not have data for the study if it were not for the online survey launched with software hosted by SC&I. I would like to acknowledge and thank the SC&I system administrators for their rapid response to questions relating to the successful operation of my survey.

The literature on innovation is vast and difficult for a student to negotiate. Professor Fariborz Damanpour of the Rutgers Business School introduced me to the innovation literature and the unique aspects of organizational innovation. I wanted to also take this opportunity to thank Professor Rebecca Warner of the University of New Hampshire. Of the many books on applied statistics that I have examined in the past several years, her text on bivariate and multivariate techniques is, without a doubt, the best in explaining the practical, theoretical, and intuitive concepts that are fundamental to regression analysis.

On a personal note, I want to thank my wife, Leona, for her support and love throughout my studies. The pursuit of the PhD has been a seven year sojourn. We have postponed vacations and other pursuits in order for me to have time to undertake this venture. Your understanding and acceptance of an interrupted life is greatly appreciated.
# Table of Contents

Abstract ......................................................................................................................... ii  
Acknowledgements ....................................................................................................... iv  
List of Tables ................................................................................................................ ix  
List of Figures ............................................................................................................... x  
List of Appendices ....................................................................................................... xi  

**Chapter One - Introduction and Problem Statement** .............................................. 1  

*Introduction* ......................................................................................................... 1  
*Problem Statement* ............................................................................................... 5  
*Assumptions* ......................................................................................................... 11  

**Chapter Two - Theoretical Framework** ................................................................. 13  

*The Stages of Innovation* ....................................................................................... 13  
*The Institutional Context* .................................................................................... 14  
*The Conceptual Model of the Innovation Process and Definitions* ....................... 17  

**Chapter Three - Literature Review** ................................................................. 24  

*Organizational Learning Theories* ...................................................................... 24  
*The Learning Organization and Ambidexterity* ....................................................... 25  
*Empirical Support for Ambidexterity* .................................................................. 28  
*Organizational Structure and Innovation* .............................................................. 31  
*Innovation and Quality Processes* ......................................................................... 32  
*Innovation and the External Environment* ............................................................. 33  
*Upper Echelon Theory and Leadership Demographics* ......................................... 36  
*Empirical Support for Leadership Demographics* ............................................... 37  
*The Leadership Team and Behavioral Integration* ................................................. 40  
*Empirical Support for Behavioral Integration* ...................................................... 41
Innovation in Libraries .................................................................................................42

Chapter Four - Research Model, Research Questions and Hypotheses .................46

Research Questions .................................................................................................49

Innovation Performance – the Dependent Variable ..................................................49

Research Hypotheses ...............................................................................................53

The Leadership Team and Behavioral Integration .................................................53

Organizational Structure .........................................................................................55

The External Environment – Munificence and Dynamism ....................................57

Learning Strategy and an Ambidextrous Orientation ............................................61

A Mediation Effect ..................................................................................................64

Hypotheses for Demographics and Enabler Variables .........................................65

Demographics of the Senior Team .........................................................................66

Enabler Variables – Decision Awareness, Organizational Profile, & Singular Leader ..................................................................................................................69

Controls ..................................................................................................................74

Chapter Five - Methodology ...................................................................................78

Population and Sample ..........................................................................................78

Survey Methodology ..............................................................................................82

Assessing Library Innovations – Cluster Analysis .................................................83

Measures ..................................................................................................................89

Major Constructs and Dependent Variable ..........................................................89

Measures – Leadership Demographics and Enabler Variables .............................95

Measures – Control Variables ................................................................................96

Chapter Six - Analysis ............................................................................................98

Zero-order Correlations ........................................................................................98
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression Analysis</td>
<td>102</td>
</tr>
<tr>
<td>Results</td>
<td>104</td>
</tr>
<tr>
<td>Binary Logistic Regression Analysis</td>
<td>109</td>
</tr>
<tr>
<td>Mediation Analysis</td>
<td>116</td>
</tr>
<tr>
<td>Chapter Seven - Discussion</td>
<td>119</td>
</tr>
<tr>
<td>Overview</td>
<td>119</td>
</tr>
<tr>
<td>Discussion</td>
<td>119</td>
</tr>
<tr>
<td>Unexpected Results</td>
<td>132</td>
</tr>
<tr>
<td>A Review of the Research Questions</td>
<td>137</td>
</tr>
<tr>
<td>Chapter Eight - Implications for Practice, Future Research, and Limitations</td>
<td>139</td>
</tr>
<tr>
<td>Implications for Practice</td>
<td>139</td>
</tr>
<tr>
<td>Future Research</td>
<td>148</td>
</tr>
<tr>
<td>Limitations</td>
<td>151</td>
</tr>
<tr>
<td>Chapter Nine - Summary and Concluding Remarks</td>
<td>154</td>
</tr>
<tr>
<td>References</td>
<td>157</td>
</tr>
<tr>
<td>Appendices</td>
<td>170</td>
</tr>
</tbody>
</table>
List of Tables

Table 1 Varying Results in the Study of the Size-Innovation Relationship ......................75
Table 2 Research Questions and Hypotheses Mapped to the Survey Instrument ..................77
Table 3 Size and Institutional Characteristics of Research Libraries ................................80
Table 4 Leadership Team (TMT) Demographics ................................................................82
Table 5 Cluster Centers – Three Clusters, Five Variables ..............................................87
Table 6 Number of Innovations in Each Cluster ..................................................................87
Table 7 Cluster Centers – Three Clusters, Three Variables ...............................................88
Table 8 Innovations Implemented by Research Libraries ..................................................94
Table 9 Zero-order Correlations of Predictors with Innovation Performance .....................101
Table 10 Model Summary of R² and R² Changes ...............................................................105
Table 11 t-values for the Five Best Individual Predictors ....................................................107
Table 12 t-Values for Selected Independent Variables ......................................................108
Table 13 Classification Table for Innovative and Non-Innovative Research Libraries ......110
Table 14 Binary Logistic Model to Predict Innovation .......................................................111
Table 15 Predicted Probabilities for Innovative and Non-Innovative Libraries ..................112
Table 16 Small Library Innovators .....................................................................................121
Table 17 Distribution of Innovative Libraries and TMT Age ..............................................133
Table 18 Changes in Professional and Support Staff (FTE) from 2004 to 2009 .................136
Table 19 A Summary of the Research Questions and Hypotheses .....................................138
Table 20 Cluster Membership for Each Innovation .............................................................138
Table 21 The Final Innovations Used in the Survey ............................................................183
Table 22 Means and Standard Deviations for all Variables ...............................................185
Table 23 Correlations of All Variables .................................................................................186
Table 24 Correlations with Radical Innovation Performance ............................................187
List of Figures

Figure 1 Stages in Rogers’ Diffusion of Innovation Model .................................................. 14
Figure 2 Conceptual Model of the Innovation Process .......................................................... 23
Figure 3 The Hypothesized Model ........................................................................................ 52
Figure 4 Geographical Distribution of Research Library Participants ..................................... 81
Figure 5 Predicted Probabilities for Non-Innovative Libraries ............................................. 113
Figure 6 Predicted Probabilities for Innovative Libraries ...................................................... 114
Figure 7 Un-standardized Path Coefficients for the BI/AO/IP Mediation Analysis ............118
Figure 8 Standardized Path Coefficients for the BI/AO/IP Mediation Analysis .................118
List of Appendices

Appendix A Innovations in Research Libraries - 2007 to 2011 .............................................. 170
Appendix B Panel to Assess Innovations in Research Libraries ............................................... 173
Appendix C Survey for the Research Library Top Management Team ..................................... 175
Appendix D Cluster Membership for Each Innovation .............................................................. 180
Appendix E The 32 Final Innovations ...................................................................................... 183
Appendix F Means and Standard Deviations ............................................................................ 185
Appendix G Correlations of All Variables .................................................................................. 186
Appendix H Correlations with Radical Innovation Performance .............................................. 187
Chapter One

Introduction and Problem Statement

Introduction

In this study, a specific type of organizational change – an innovation – is examined. Broadly speaking, an innovation is an idea, practice, or object that is perceived as new by the unit of adoption – the organization (Rogers, 2003, p. 12). A fundamental question for innovation research is to explain how innovations occur. The specific organization to be examined in this study is a unique institutional, nonprofit – the university research library. Why study innovation in research libraries? This question cannot be answered without first considering research and the university. Up to 50% of all U.S. economic growth over the past 50 years is thought to be the result of investments in research and development (Sonka & Chicoine, 2004). Universities in the United States are considered by many to be preeminent because they produce a very high proportion of this research and the associated fundamental knowledge (Cole, 2009, p. 5). At a time of increased scrutiny of higher education, a recent report\(^1\) illustrates how the U.S. graduate education system benefits the United States and the world. U.S. graduate schools have had far reaching accomplishments in the sciences, business, government, education and the arts, positively affecting millions of people. Over the past ten years, 62 percent of Nobel Prize winners in chemistry, physics, medicine, and economics have received their graduate degrees in the United States. The report illustrates the value of graduate education to both the U.S. economy and our quality of life. Of the approximately 600

\(^1\) See the Executive Summary from the Council of Graduate Schools at [http://www.cgsnet.org/portals/0/pdf/GR_GradEd-PubGood_excerpt.pdf](http://www.cgsnet.org/portals/0/pdf/GR_GradEd-PubGood_excerpt.pdf)
universities that offer master’s degrees, only about 125 contribute significantly to the
growth of knowledge (Cole, 2009, p. 6). It is the research libraries that are associated
with these primary research institutions that are the subject of this proposed study. A
fundamental premise of this undertaking is that a more innovative library is better able to
contribute to scholarship and the advancement of knowledge in the research university.

In the late 19th and early 20th centuries, library visionaries such as Charles Cutter
and John Cotton Dana projected an optimistic view of the library, suggesting radical
innovations such as collecting non-book materials and the installation of book lifts and
“various little railroads” to retrieve books (Musman, 1993, pp. 197-199). These early
practitioners presented an optimistic view of growth and opportunities for the library,
however in today’s more turbulent environment conflicting perceptions are emerging.
Daniel Greenstein (2009), vice provost for academic planning and programs in the
University of California System, has a somewhat different view of the possibilities for the
library: “The university library of the future will be sparsely staffed, highly decentralized,
and have a physical plant consisting of little more than special collections and study
areas.” His perspective suggests that the research library may be in a downward spiral
that will culminate in irrelevance for the university.

In contrast to the relatively stable period of the 20th century, our society today is
seemingly more complex with challenges emanating from many different dimensions –
social, economical, political, and technological. Change has always been a factor in
organizational life and most would agree that change in the library is needed.
Organizations change in different ways; however the rate of change and the resulting
success can vary significantly. Innovation is about change in complex organizations, but
what kind of change is needed and what are the factors that bring about change? Perhaps small, incremental changes are more suited to a research library in contrast to major, discontinuous change. Instituting and managing change in complex organizations is difficult. Today, library leaders are faced with a major challenge in which the continuation of the status quo may result in external factors forcing fundamental and even disruptive change in their institutions. Machiavelli (1940, p. 21) best summarizes the dilemma and the resistance to change: “It must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all those who profit by the old order . . .”

The focus in this research is on those nonprofit organizations that have an institutional and professional framework. The institutional framework is one that is more formal and binding with regulations and well established traditions. This class of nonprofits includes education (universities, colleges, university libraries, and high schools), health (hospitals), and certain social services organizations. Schumpeter, one of the earliest and most original thinkers regarding innovation posited three major factors that govern the innovation process (Fagerberg, 2005, p. 9): the fundamental uncertainty of all innovation projects, the prevalence of organizational resistance to change, and the need to move quickly to reap economic rewards. Of these factors, the first two are most relevant for the institutional nonprofit. Uncertainty manifests itself in concerns regarding the ends or outcomes of a new project as well as the means or how the project will be implemented. For research libraries, change can disrupt the stability of the organization.

---

2 Hereafter, the term “nonprofits” will be used to designate the institutional, nonprofit as a class of organizations.
and can impact social relationships, informal power networks, and the delivery of quality service. Local pride in the organization can act in resistance to change where a “deaf ear is turned to new knowledge”. A proposed innovation can introduce new vocabulary and unfamiliar jargon, resulting in a “communication differential” and ultimately an obstacle to change (Zaltman, et al., 1984, pp. 86-87). The third factor, economic benefits, arises out of Schumpeter’s perspective as an economist and cannot be readily applied to institutional nonprofits. The nonprofit does not typically act directly for economic benefits. Rather, these institutions will seek to advance the public good, a goal that is laudatory but also very difficult to quantify. However, although quite different from the economic view, competition is increasingly a concern for libraries. Research universities compete for students, a goal that the library shares. The research library also competes for resources within the institution and, externally, with for-profit organizations that are seeking to provide library services.

Schumpeter’s factors are important to consider, however the research library is a unique professional organization, embedded in a much larger institutional environment – a setting that presents its own special challenges. To understand these special challenges, this study takes on an exploratory dimension with the expectation that some of the innovation theories applied to the for-profit sector will not readily apply to research libraries. George Keller (1983), as cited by Budd (2012, p. 71), aptly describes the paradox of American universities and, by association, the research library:

American colleges and universities occupy a special, hazardous zone in society, between the competitive, profit-making business sector and the government owned and run state agencies. . . . They constitute one of the largest industries in
the nation but are among the least businesslike and well-managed of all organizations.

If our universities and research libraries are poorly managed, it might be that they are operating under different criteria which may be optimal for these institutional nonprofits. Given these paradoxes, the institutional nonprofit may well represent a new sector for innovation studies.

**Problem Statement**

What are the emerging challenges for research libraries? Given the political, financial, and technological challenges, the library will need to pursue innovative, and perhaps radical, approaches in order to meet the demands of its parent institution. Otherwise, the library will likely ossify, decay, or be dramatically altered by forces external to the library. As noted by Harris and Hannah (1996), architects of great skill will be needed to address the information structure of the future; otherwise this structure will be imposed by default. Many library scholars and practitioners (Alire & Evans, 2010, p. 329, Atkinson, 2001; Fowler, 1998; Harris & Hannah, 1996; Neal, 2007; Stoffle et al., 1996; Wordsworth et al., 1989) have articulated the need for change suggesting that the research library will be radically altered in the first decades of the new century. There are many potentially conflicting user needs. Users of existing library capabilities demand improved access, more information resources, and higher quality services. Future users will require new service configurations, support of radically different technologies, and the launching of fundamentally new services. It is difficult to predict or foresee how the research community will address these challenges to create the 21st century library. Traditional services such as the reference desk or print book access
appear to be in significantly less demand as evidenced in multi-year trends. Emerging new services such as the institutional repository (Jantz & Wilson, 2008) are having difficulty gaining traction, especially with faculty and researchers within the institution. Some 40 years ago, Jesse Shera (1972, p. 191) articulated the primary function of the library: “the central and unifying concept of the library has been its dedication to assembling, preserving, and making available for use the records of human experience . . .” (author’s italics). Given the technology-dominated information environment, the role of libraries in these three fundamentals has been significantly reduced.

Amidst this confusion of visions and goals, one can put forth a credible argument that the forces acting against major change are perhaps stronger in the university library than in other institutional nonprofits. Some of these forces are inherited from the parent institution. Bass (1985, pp. 159-160) summarizes the condition in the modern university as one embedded in a state bureaucracy, complicated by union contracts, faculty norms, and traditions. The decision framework in these institutions has been characterized as an organized anarchy consisting of inconsistent and ill-defined preferences, uncertain technology, and an environment of fluid and often uncertain participation by organizational members (Cohen et al., 1972). This uncertainty and the related external administrative and financial controls result in delegating considerable power to the leader of the library and thus creating excessively centralized structures (Musman, 1982). For the library, the external forces, the professional objectives to provide quality service to clients, and a preoccupation with rules and processes often leads to a conservative approach to change. The resulting bureaucratized environment restricts the autonomy of

---

the individual and the free flow of ideas – an essential antecedent of innovation. Much of the early innovation literature (Damanpour, 1996b; Hage & Aiken, 1970, pp. 38-44) clearly demonstrates that the more bureaucratic organization is less innovative. In an environment of centralized management and external controls, it is difficult for the organization to generate new ideas and to initiate the implementation of these ideas.

The deleterious effects of library norms and traditions are also evident in librarian demographics. Wilder (1999, p. 1) notes that librarians, particularly academic librarians, are older than other professionals in all but a few occupations. For the profession, about 75% of librarians are 45 years or older and the trend appears to be in the direction of increasing age with significant ageing occurring after 1990. It is expected that the effects of age and tenure will be most noticeable in attempting to introduce major change in the library. In a study of 725 U.S. local government agencies, Damanpour and Schneider (2009) hypothesized that both a manager’s age and tenure will have a significant relationship with innovation adoption. In noting the competing aspects of young and old, these researchers suggest the middle age ranges will be most significant for innovation without the negative aspects of inexperience of the younger manager or the overly socialized older manager. Although the age effects were not significant, the hypothesis for tenure was supported in Damanpour’s study.

In discussing the new public management framework (Anheier, 2009) proposes that nonprofits should put more emphasis on private-sector management practices, with fewer middle managers, and the explicit use of formal standards and performance measures. The use of business practices and performance indicators presents significant challenges within the nonprofit sector. In the for-profit sector, the literature on the
relationship between innovation and performance has been dominated by the economic perspective and is replete with studies that relate various factors (structure, leadership, the external environment) to performance outcomes, usually measured with economic indicators such as return on investment or profit/loss. However, for the research library, there are no useful or credible quantitative indicators of organizational performance, making it very difficult to detect any improvement. As a result, libraries rely on either volume measures or anecdotal evidence to indicate that they are performing well. Although perception of satisfactory performance can contribute to organizational stability and continuity (Hambrick, 1994, p. 193), these same perceptions may induce complacency and a commitment to the status quo, factors that operate against innovation. One of the most troubling indicators for the research library is annual expenditures as a percent of the institution’s expenditures. Budd (1998, pp. 196-198) cites a trend that started in the mid-1970s in which the academic library’s expenditures began to shrink as a part of the parent institution’s educational and general expenditures. The data on 1000 four year institutions show a decline in this percentage in a decade (1976-1985) from 5.05% to 3.73%. Allen and Dickie (2007) report on a survey in which the budgets of 88 ARL libraries, measured as a percentage of the university’s education and general budget, fell steadily in a decade (1982 to 1992) from 3.91% to 3.32 %. For a sample of 17 ARL libraries, the average library expenditure as a percentage of university expenditures continued to decline from 2.8% to about 2.0 % for the period 2000 to 2009 (Association of Research Libraries, 2012)⁴. One interpretation of these trends is that a reduction in

demand for library services is occurring, likely a result of ever more effective access to information on the Internet.

It must also be acknowledged that the continuing budget crisis, both at state and federal levels, will not be ameliorated any time soon. At this writing, Congress is threatening to cut off funding for granting agencies such as the Institute of Museum and Library Services. The challenge for libraries is to offer unique, value-added services at reduced costs. Martell (2000) eloquently implores librarians to “to create a range of services unthinkable in the twentieth century, but mandatory in the twenty-first century, if we are to provide society with the value added services it will need from its professionals.” It should be noted that any library service that has the potential for generating revenue will be ultimately undertaken by for-profit organizations. However, there are important niches that can be leveraged for the future. For example, much of science research data is not shared or reused. This data is developed with grant funds (i.e. paid for by the public) and has tremendous potential to stimulate knowledge growth and innovation in the U.S. economy. Institutional repositories, developed and managed by research libraries, can take on this challenge by preserving and providing access to research data. A multi-library collaboration using open-source platforms for archiving, preserving, and sharing data is a tremendous opportunity that will require innovation in both technical and administrative spheres.

Technological innovations can be highly beneficial to libraries while also representing a competitive threat. Existing services can be radically and quickly altered through the use of rapidly evolving information and communication technologies and the impact of computer science innovations. We have recently seen what the IBM Watson
computer can do using conventional databases from Wikipedia, a digital encyclopedia, and a computer system with 6000 cores and 15 TB of storage. One could easily imagine Watson answering many of the undergraduate questions in a research library. Natural language processing and artificial intelligence capabilities have the potential to displace many of the functions of research librarians including bibliographic instruction. If computers are answering the questions of undergraduates and bibliographic instruction is accomplished through online tutorials, much of the undergraduate problem is covered with little assistance from professional librarians.

Beyond the boundaries of the institution, external forces can induce a variety of changes in the organization. Although there is considerable resistance to change, innovation theorists believe that a more turbulent external environment will act for change. In a less stable and less predictable environment, it is believed that leaders will respond to the uncertainty by creating new organizational structures and by bringing in new members with different knowledge sets in order to cope with the uncertainty. Although there are some theories that portray leaders as having little control over organizational outcomes (Hannan & Freeman, 1984), this study follows the approach of many scholars who believe that the leadership team has a significant impact on many dimensions of the organization. In a case study of nonprofits, Light (1998, p. 19) indicates that some scholars see leadership as the sole factor in success. Clearly, the multidimensional problem space illustrates the contextual complexity in which the research library finds itself. This study objective is to identify and explore the factors that will help leadership address this complexity and, in the process, create a more innovative library.
Assumptions

Innovativeness. In general, it is assumed that innovativeness is a desirable trait for social organizations and, in recent decades, this trait has become more important for institutional nonprofits such as research libraries. The preponderance of innovation research in the manufacturing sector has made this same assumption, however it must be acknowledged that there are significant differences between the for-profit and nonprofit sectors. Within the more general area of innovation studies, there are relatively few findings that challenge the assumption that innovation is good. In a recent meta-analysis of 42 studies of small to medium sized firms, Rosenbusch and colleagues (2011) ask “Is innovation always beneficial”? Their analysis generally shows that innovation has a positive effect on the performance of these types of firms, noting, however, that there is considerable variation in results depending on the organizational context and the type of innovation. In a case study of nonprofits, Light (1998, p. xv) has captured the essential difference between the for-profit seeking economic gain and the nonprofit: “. . . in the public sector, innovation must be about doing something worthwhile.” The assumption and claim in this study is that the research library must innovate to survive and prosper into the future. University librarians in a small sample of major institutions appear to unanimously support this claim (Jantz, 2012a). This assumption is based primarily on the problems summarized in the previous section and the pressing need for library leaders to develop creative ways to address these problems.

The Incremental-Radical Continuum. A second major assumption is that the university library must achieve a more balanced innovation portfolio. The traditional environment of the library has been stable and predictable, an organizational context that
is highly bureaucratized and leads largely to incremental innovations. These incremental innovations emanate from the client interface and are focused on improving the quality and reliability of the existing services. In today’s modern university, these traditional services are less in demand, given the rapid advances in the technological environment. A more balanced innovation portfolio that consists of both incremental and radical innovations can lead to significant new services that are offered to the university community. As Nadler and Tushman (1990) have postulated, a continued focus on incremental innovation in the face of environmental turbulence is a recipe for failure.

*The Library and the University.* A third assumption posits that a more innovative library will help support scholarship and the creation of new knowledge in the university. This assumption is perhaps the most controversial in that the performance of the library and the university are very difficult to measure. In the for-profit sector, there are many studies that relate various aspects of innovativeness to quantitative indicators such as profit/loss and return on investment, however there are no comparable measures in the university environment. Ultimately, this assumption will have to be supported in longitudinal studies that examine the impact of library innovation over the course of many years. Although investments in uncertain exploratory projects will incur risk and likely more project failures, the benefits can result in profoundly new and more relevant services that enable the library to thrive as a valued partner in the research university of the 21st century. Obviously, it is important to understand how innovation affects the library’s performance outcomes. This study takes a first step in this direction by uncovering the relationships in a complex environment that lead to an innovative research library.
Chapter Two
Theoretical Framework

The Stages of Innovation

This study assumes that leadership shapes and manages the organization in an environment where strategic choices will be partially constrained by contextual factors such as the size of the organization and the funding sources. When the leadership of an organization makes decisions about introducing a change, their choices occur over time in a series of stages as represented in Figure 1 – the stages of innovation diffusion. There are multiple sub-stages for each of these three major stages (Duncan, 1976). For example, a first step in the initiation stage is organizational awareness of the possibility for an innovation. Leaders might pursue an innovation as a new opportunity or to address an existing problem. If leaders have a positive attitude toward change, then initiation of an innovation becomes possible. Assuming that the leaders have an awareness of a possible innovation, the second sub-stage of initiation is that of attitude-formation (ibid, 1976). This is a critical stage involving the leader, leadership team, and the strategy of the organization. To move ahead with a decision, the leadership team will need to form a positive view of the innovation potential. In the subsequent adoption stage, there is much information gathering and communication within the leadership team in order to decide to proceed to the implementation stage. The implementation stage typically has two sub-stages. In the initial implementation, the innovation is put on a trial basis and evaluated to determine if it is practical for a long-term commitment. The second sub-stage of implementation involves a formal commitment in which the organization establishes appropriate processes, policies and possibly makes structural changes to support the
innovation. Full implementation would result when a majority of the potential clients have successfully used the innovation.

**Figure 1 – Stages in Rogers’ Diffusion of Innovation Model**

Adapted from Rogers’ (2003, p. 170) and Duncan (1976)

Innovation enablers can include a host of factors including new knowledge, the external environment, and the organizational structure. Creativity and new ideas are important antecedents of organizational innovation; however these ideas cannot mature into potential innovative projects without a supportive organizational structure and culture. Events in the external environment can precipitate changes in the strategy and structure of the organization in which leaders take action to cope with the uncertainty in the environment. A successful outcome in each of the stages of Figure 1 requires leadership support, considerable flexibility, and may even require different organizational structures.

**The Institutional Context**

The great bulk of organizational research has focused on the for-profit sector where the goals are primarily to seek profitability or to gain a competitive edge. In contrast, the nonprofit seeks to advance the public good, a goal that is much more difficult to quantify. For a nonprofit, the primary goal is to fulfill the institutional mission rather than seek profitability or shareholder wealth (McDonald, 2007).
This study focuses on a class of nonprofits – the institutional nonprofit – and the research library as a special member of this class. In striving to become more innovative, nonprofits encounter unique challenges such as dependence on external funding, establishing credible success criteria, and dealing with ethical issues (Jaskyte, 2011). In the institutional environment, the nonprofit appears to compete more for social fitness rather than economic efficiency (Powell, 1991, p. 184). One of the most promising theories that helps us understand how the research library behavior differs from other non-profits and the for-profit sector emanates from the work of DiMaggio and Powell (1983) and DiMaggio and Anheier (1990).

In their theory of institutional isomorphisms, DiMaggio and Powell (1983) contend that the engine of bureaucratization has moved from the competitive marketplace to the state and the professions. Once a set of organizations emerges as a field, a paradox results in which rational actors work to make their organizations similar. These researchers argue that structural change is driven less by competition; rather bureaucratization makes organizations more similar without making them more efficient. They define three isomorphic processes that are leading to this result. These three mechanisms of institutional isomorphic change are coercive – resulting from both formal and informal pressures exerted on organizations upon which they are dependent, mimetic – resulting from standard responses to uncertainty, and normative – a force associated with professionalism.

In the context of nonprofits such as research libraries, we might expect a coercive force to emanate from state government or a regulatory agency and the associated political and budget control. When an organization faces uncertainty such as that
introduced by the environment and technological advances, a mimetic force can cause imitation where the organization adopts services or products that appear to be successful in other similar institutions. Perhaps the strongest normative force operating on a research library is professionalism which resides in formal education and professional networks. According to DiMaggio and Powell, two aspects of professionalism result in isomorphic tendencies: 1) the vesting of formal education and legitimation in a cognitive knowledge base produced by specialists and 2) the growth and elaboration of professional networks that span organizations. In a particular relevant assertion, these researchers note that “many professional career tracks are so closely guarded, both at the entry level and throughout the career progression, that individuals who make it to the top are virtually indistinguishable”.

In developing hypotheses regarding environmental uncertainty and bureaucratic structures, DiMaggio and Powell assert that these isomorphic forces often lead organizations to resemble each other in structure, culture, and output. Within an institutional context, this hypothesis suggests that the more uncertain the relationship between means and ends, the greater the extent to which an organization will model itself after organizations it perceives to be successful. DiMaggio and Powell also hypothesize that “the greater the reliance on academic credentials in choosing managerial and staff personnel, the greater the extent to which an organization will become like other organizations in its field.” This theory of isomorphic forces is fundamental to the premises underlying organizational innovation in research libraries. The research library has had over 100 years to bureaucratize itself through the norms of the profession and the various professional library organizations. According to these isomorphic forces, the
principal actors, the dominant coalitions, and the leaders of these organizations construct an environment around themselves that restricts their ability to change. Ultimately, this constructed environment exerts a powerful force against innovation – reducing variation and the opportunities to introduce innovative services.

**The Conceptual Model of the Innovation Process and Definitions**

The previous section has established the institutional framework for this study and has characterized the institutional context, the stages of innovation diffusion, and the role of leaders. Figure 2 presents an innovation process model that includes the stages in the diffusion process (Rogers, 2003, p. 11) and the four major construct groups that are a focus of this study - senior leadership, innovation antecedents, organizational structure, and organizational learning. The objective of this model is to highlight the combined effects of these constructs and the environmental context on the process of organizational innovation. The following definitions are offered before proceeding with an explanation of the innovation process.

**Innovations – Technical and Administrative.** In this study, innovation is defined as the introduction into the organization of a new product, a new service, a new technology, or a new administrative practice; or a significant improvement to an existing product, service, technology, or administrative practice (Damanpour & Gopalakrishnan, 1998). In a study of public libraries, Damanpour (1987) emphasizes the importance of distinguishing between types of innovations, noting that different effects arise from both organizational factors and the stages of innovation. The most fundamental typology distinguishes between administrative and technical innovations. Administrative innovations focus on the internal mechanisms of the organization and the social system
(e.g. recruitment of personnel, allocation of resources, and the reward system) whereas a technical innovation focuses externally on the client and end user. This study will focus exclusively on technical or service innovations for several reasons. From a methodological perspective, administrative innovations are internal to the organization and much more difficult to identify. From prior research (Daft, 1978, Damanpour, 1996b), it is also evident that administrative innovations are introduced primarily by those members within the administrative core of the organization. Although there are differing findings (Damanpour & Evan, 1984), this study assumes that administrative innovations will frequently follow technical innovations in time. For example, an organization may only realize that they need a new unit (an administrative innovation) after actually implementing the technical innovation. Thus, the technical innovation can provide an early and more quantifiable indicator of an innovative organization.

Organizational Structure (Complexity, Centralization, Formalization). According to Zaltman et al. (1984, p. 106), an organization is “a social system created for attaining some specific goals through the collective efforts of its members. Its most salient characteristic is the structure that specifies its operation.” Throughout the past several decades of innovation research, scholars have studied various aspects of organizational complexity.

Organizational complexity is typically operationalized in terms of functional diversity (the variety and number of different units) or role specialization – the variety of different job specialties. Most research has shown that complexity is positively related to organizational innovation. In contrast to complexity, bureaucratic control is generally considered to be negatively associated with innovation (Hage & Aiken, 1970; Kimberly
Two major dimensions of bureaucratic control are considered—centralization and formalization (Damanpour, 1996a). Centralization, or top-down decision making, restricts members from access to information and participating in the work of the organization, leading to lack of personal autonomy and commitment. Formalization refers to a rule-based organization where enforcement of rules restricts creativity and the generation of new ideas. Most of the organizational research indicates that both centralization and formalization are negatively associated with innovation.

**Innovation Characteristics.** The most important characteristic for this study deals with the extent of change which varies along a continuum from incremental to radical. According to Zaltman, et al. (1984, p. 24), a radical innovation is always “to some extent disruptive of the status quo” and involves changes in the organization’s subsystems, values, incentives and power. Radical innovations involve new knowledge that is used to create totally new products and services or to make fundamental changes in an existing product or service. In contrast, an incremental innovation uses existing knowledge to create minor improvements in a product or service. Radical innovations represent a clear departure from existing practice whereas incremental innovations are more routine and support existing practice. Research has been quite consistent in demonstrating that radical innovations are riskier than incremental innovations and they have more profound organizational effects, albeit with the promise of greater returns (Gatignon, et al., 2002). Although the incremental and radical concepts represent a continuum, this study will view these concepts as endpoints or polar opposites on a continuum.  

---

5 Although the term “radical” has some pejorative connotations, it will continue to be used in lieu of perhaps more appropriate but more awkward phrases such as “non-incremental” and “discontinuous” innovations.
As an example of an incremental innovation, a research library might introduce a device that enables students to check out their own books rather than relying on an attendant at the circulation desk. This service is new to the organization but it also supports existing practice and would be considered an incremental innovation. The innovation consists of a product, the device for checkout, and a process - the associated policies and practices – in order that a student can conveniently use the device. A radical innovation might be one in which the library has chosen to provide a new service to faculty for publishing e-journals. This new service is not an extension of existing practice and could very well lead to organizational changes such as a scholarly publishing unit or collaboration with the university press.

In addition to the radical-incremental continuum, there are other innovation characteristics to consider. According to Rogers (2003, p. 15), an innovation has five perceived attributes which explain different rates of adoption: a) relative advantage – the degree to which an innovation is perceived as better than the idea it replaces, b) compatibility – the degree to which an innovation is perceived as being consistent with the organization’s values and culture, c) complexity – the degree to which an innovation is perceived as difficult to understand and use, d) trialability – the degree to which an innovation lends itself to experimenting and prototyping and e) observability – the degree to which the results of an innovation are visible to others. In a meta-analysis, Tornatzky and Klein (1982) found that relative advantage and compatibility are positively associated with innovation while complexity is negatively related to innovation.

Ambidexterity. In this study, the concept of ambidexterity is included in the organizational learning construct of Figure 2. Tushman and O’Reilly (1996) have defined
ambidexterity as the “ability to simultaneously pursue both incremental and discontinuous innovation and change.” In the context of the proposed research, ambidexterity in research libraries is further refined as an organization’s ability to simultaneously undertake the exploitation of existing capabilities while also pursuing exploratory activities that can lead to major new services and products. Jansen et al. (2009) aptly define some of the important characteristics of an ambidextrous orientation as including “the routines and processes by which organizations mobilize, coordinate, and integrate dispersed exploratory and exploitative efforts, and allocate, reallocate, combine and recombine resources and assets across differentiated units.”

The Innovation Process. In Figure 2, the external environment is shown as impacting leadership. Although the turbulence in the external environment can have many subtle effects, this study considers the leader's perception of the environment as most significant. A leader who does not perceive a turbulent environment will not likely take action, no matter how much turbulence actually exists. As shown in Figure 2, two major aspects of leadership are considered – the demographics of leaders and the integration of the leadership team. It is in the early stages of the model – recognizing the performance gap and initiation – where the most decision complexity resides and where leaders must consider strategy, the external environment, the uncertainty of the project, and its ultimate benefits. An integrated senior team should be able to deal with this multi-faceted environment more effectively. As we shall see in the literature review, decision complexity is further complicated by certain demographics including the age of the leadership team. If a new idea and a recognized opportunity are compatible with the strategy and culture of the organization, a proposed innovation can proceed from the idea
stage (stage 1) to the adoption stage (stage 2). It is in this stage that the perceived attributes of the innovation can have the most impact. For example, if an innovation project appears to be extremely complex to implement, the leaders may decide not to proceed. Uncertainty regarding the various outcomes, especially of radical innovations, might lead to an early implementation stage in which prototyping is undertaken to gather more information. These uncertainties can also lead to a prolonged decision process and possibly delayed decisions about the next steps. As indicated in the definitions related to structure, the extent of complexity, centralization, formalization, and organizational size will affect virtually every stage in the diffusion process. If the innovation reaches the implementation stage (stage 3), the organization must focus on process, schedules, and delivery of a high quality product. Although not shown in Figure 2, both incremental and radical innovations can flow through the stages of innovation. Organizational learning theorists have suggested that the successful organization must be able to simultaneously exploit existing services while also exploring and developing totally new services. This organizational ambidexterity can ultimately produce both incremental and radical innovations.

Although the model in Figure 2 has a linear flow, the actual process obviously includes much communication feedback, churn, and even organizational chaos. Innovation activities can be planned and highly structured, however it is difficult to predict more than the next few steps. The leadership of the organization will impact all stages of the process and is considered a primary enabler of an innovative capability. However, it is expected that all major constructs of Figure 2 will interact in complex ways to result in a highly innovative research library.
Figure 2 – Conceptual Model of the Innovation Process

- External Environment (Trigger Events)
  - (Uncertainty, competition for resources, community expectations, fiscal crises)
- Senior Leadership
  - Demographics - age, tenure, education
  - Team Integration - information sharing, trust, etc.
- Recognized Need or Opportunity
- Initiation (Stage 1)
  - New ideas
- Adoption (Stage 2)
  - Decision to adopt
- Implementation (Stage 3)
- Innovation Performance
- Organizational Structure
  - Size, complexity, centralization, formalization
- Creativity, New Knowledge, Professionalism
- Innovation Antecedents
- Mission, Strategy, Ambidexterity
- Organizational Learning

Stages of the Innovation Process
Major Constructs
Chapter Three

Literature Review

A major objective of this study is to understand how the various constructs as shown in Figure 2 affect innovation. This section reviews the innovation literature that summarizes the theoretical and empirical evidence for how these factors can lead to improved organizational outcomes and a more innovative institution. The final segment of this review covers the relatively sparse literature on innovation in libraries.

Organizational Learning Theories

In their literature review, Raisch and Birkenshaw (2008) integrate the various research streams and develop a model that addresses antecedents, moderators, and outcomes resulting in organizational ambidexterity. Important research streams include organizational learning, organizational adaptation, strategic management, and organizational design. Regarding organizational learning, researchers (March, 1991; March & Levinthal, 1993) have identified two fundamentally different processes – exploration and exploitation – that can lead to either radical or incremental innovations respectively. March (1991) notes that “the essence of exploitation is the refinement of existing competences, technologies, and paradigms” while “the essence of exploration is experimentation with new alternatives.” Within the organization, these processes compete for resources and leaders must establish an appropriate balance in order to insure both short-term success and long-term survival. Gupta and Smith (2006) have further refined these concepts by investigating whether exploration and exploitation lie on opposite ends of a continuum or whether they are two different orthogonal aspects of organizational behavior. These researchers posit that exploration and exploitation will be
mutually exclusive in a single domain (e.g. an individual or a unit within an organization). However, in an organization with multiple units, one unit may proceed with exploration while another unit proceeds simultaneously with exploitation.

There appears to be near consensus on the need for balance between exploration and exploitation; however there is considerably less clarity regarding how to achieve this balance (Andriopoulos & Lewis, 2009; Atuahene-Gima, 2005; Raisch et al., 2009; Simsek, 2009; Tushman & O’Reilly, 1996). Corso and Pellegrini (2007) review the literature relating to achieving a balance between exploratory and exploitative processes. Their summary indicates that balance has to be achieved on both the incremental-radical and exploitative-exploratory dimensions. March (1991) points out that too much exploration to the exclusion of exploitation will likely result in an organization that is unable to reap the benefits of its experimental activities. Conversely, too much exploitation focuses on near term success and limits the development of new knowledge, reducing the opportunities for growth and to thrive over the long term. Andriopoulos and Lewis (2009) state that innovation tensions can trap the organization into a one-sided focus. Organizations develop mindsets that inculcate one type of learning while neglecting a more varied approach to learning. There is considerable empirical evidence suggesting that too little of either exploration or exploitation can ultimately lead to diminished organizational performance (Greve, 2007; He & Wong, 2004).

**The Learning Organization and Ambidexterity**

The concept of ambidexterity originates in the capability of a person to use both hands with equal ease and has become a useful metaphor in organization research. A major factor affecting innovation is the ability for an organization to continuously
improve existing services while simultaneously exploring and developing major new capabilities. Organizational scholars (O’Reilly & Tushman, 2004; O’Reilly & Tushman, 2008; Tushman & O’Reilly III, 1996) have identified the ability to manage both evolutionary and revolutionary change as an ambidextrous orientation in an organization. Ambidexterity not only requires the organization to achieve a balance between exploratory and exploitative actions, but also to sustain a balance over time in order to become a truly innovative organization. Fundamentally, ambidexterity is grounded in an explicit strategy to pursue evolutionary and revolutionary innovation streams simultaneously. According to March (1991), finding a balance is particularly difficult because of the inherent organizational conflicts that emerge from exploration and exploitation. The simple idea underlying ambidexterity is that the demands of an organization’s task environment are always, to some extent, in conflict (Gibson & Birkinshaw, 2004).

While some researchers have thought that ambidexterity presented a conundrum that could not be reconciled, others have suggested that ambidexterity is essential for an organization to survive and thrive. There are at least two basic approaches that organizational leaders can use to achieve this simultaneity or ambidexterity: 1) a single, flexible structure that lies somewhere between the more classic organic and mechanistic structures and 2) conducting both exploration and exploitation in different units within the same organization. Simsek et al. (2009) have developed a more refined typology that delineates four arch-types of ambidexterity which vary along two dimensions – structural and temporal. An organization that is harmonic ambidextrous will pursue exploration and exploitation concurrently within the same unit. This approach requires the creation
of processes that empower individuals to make their own decisions about work priorities (Gibson & Birkinshaw, 2004). The harmonic orientation suggests that the leadership team will create a supportive context that enables members to deal with the inevitable conflicts that will emerge. Creating a culture where conflict is expected and considered to be normal requires considerable up front investment and agreement by the leadership team.

Another arch-type is that of partitional ambidexterity where dual organizational structures are needed to both initiate and implement innovations (Duncan, 1976). The partitional approach (Simsek et al., 2009) requires the creation of largely independent organizational units with their own strategies, structures and cultures. Here again, leadership is required in order to create an environment where knowledge and learning are shared across units.

Duncan (1976) has provided one of the earliest theoretical conceptualizations of ambidexterity. This researcher views the innovation process as consisting of two major stages: initiation and implementation. Each of these stages has sub-stages which closely resemble Rogers’s diffusion process (Figure 1). Using the Hage and Aiken (1967) formulations for organizational structure, Duncan argues that higher complexity, lower formalization, and lower centralization are needed in the initiation stage while the opposite is needed for effective implementation. The most critical factors for leaders who are considering structural changes are the switching rules, specifically the more radical changes desired, the more the organization should use different structures for initiation and implementation. For example, a flexible organizational structure can spawn task forces and brainstorming sessions that are needed in the initiation stage to generate new
ideas. A more rule-based organization is needed for implementation in order to adhere to quality guidelines, processes, and schedules. Similarly, Daft’s study (1978) suggests that low formalization, decentralization, and high complexity support the initiation and adoption of technical innovations. Somewhat in conflict with Daft’s study is the extensive meta-analysis by Damanpour and Aravind (2012, p. 509) which suggests that the formalization of procedures and the centralization of decision making is not necessarily negative. In fact, these factors may be essential to initiate and implement the more radical innovations.

**Empirical Support for Ambidexterity**

In an empirical study of different types of industries (finance, manufacturing, transportation), Grover, Purvis, and Segars (2007) used three dominant theoretical frames that represent models for becoming ambidextrous – the punctuated equilibrium, semi-structures, and ambidexterity. The important finding of this study was that organizational configurations for doing incremental innovation (i.e. more mechanistic) and creating radical innovations (i.e. more organic) do, in fact, exist simultaneously in organizations. Mechanistic organizations with hierarchical structures and precise rights and rules are better suited for stable environments and incremental innovation. Organic structures with decentralized decision making appear to work better for radical innovation and volatile environments. He and Wong (2004) further support the ambidexterity hypothesis by connecting innovation strategy to sales growth rate. These researchers report the following: 1) the interaction between explorative and exploitative innovation strategies is positively related to sales growth rate and 2) the relative balance – absolute difference - between explorative and exploitative innovation strategies is negatively related to sales.
growth rate. Gibson and Birkinshaw (2004) developed the concept of contextual
ambidexterity which is the organizational behavioral capacity to simultaneously
demonstrate alignment and adaptability across a business unit. In contrast to structural
ambidexterity, the contextual approach does not assume separate units to support
adaption and alignment activities. Rather, contextual ambidexterity “encourages
individuals to make their own judgments as to how to divide their time between the
conflicting demands for alignment and adaptability”. Gibson and Birkinshaw found that
ambidexterity thus defined is positively related to performance and organizational context
(stretch, discipline, support, and trust) is positively related to ambidexterity. Further, it
was found that ambidexterity mediates the relationship between contextual factors and
performance. In an interesting approach, Un (2010) related management practices to
achieving balance between incremental and radical innovations. Un defined predictors of
organization-level practices and team-based practices. This researcher found that the
organizational-based approach offers more psychological safety and therefore supports
radical innovations more effectively while the focus on team practices is better for
achieving incremental innovations. Jansen et al. (2009) further support the importance of
the senior team in order to create an ambidextrous organization. These researchers found
that structural differentiation acts on ambidexterity through informal senior team and
formal organizational integration mechanisms. These researchers posit that structural
differentiation is an important but insufficient attribute for achieving ambidexterity.
Achieving ambidexterity will also require the resolution of conflicting tensions in senior
teams and the integration of knowledge across diverse units within the organization.
Much of the more recent literature provides compelling arguments that organizations should strive for innovating incrementally on existing products while simultaneously developing new knowledge and exploring new opportunities (Tushman & O’Reilly III, 1996; O’Reilly III & Tushman, 2004). In a case study of 15 business units in nine different industries, O’Reilly and Tushman (2004) examined 35 attempts at radical, breakthrough innovations. Their organizational typology included the following categorizations: 1) functional, completely integrated into the existing structure, 2) cross-functional teams, 3) unsupported teams that were set up outside the established management hierarchy sometimes referred to as “skunkworks”, and 4) ambidextrous organizations where the breakthrough efforts were organized as separate units but were integrated into the senior management hierarchy. The criteria for success included the successful implementation of the innovation while maintaining or improving overall business performance. In this context, over 90% of ambidextrous organizations achieved their goals. The factors governing this success are twofold. The ambidextrous structure allows cross-fertilization while preventing cross-contamination. Secondly, the exploratory R&D units can share important resources from the traditional units such as financial resources, talent and expertise. More recent research has continued to explore and define the concept of ambidexterity. Cao et al. (2009) unpack the ambidexterity construct into two dimensions – balance and magnitude. Balance suggests that the firm carries out both exploration and exploitation activities without undue emphasis on either. Magnitude represents how much of each activity is ongoing in the organization. These researchers found synergistic effects between balance and magnitude. Most relevant for the university library was the finding that balance becomes even more important in an
organization that is resource-constrained. As a result, libraries that are becoming increasingly resource-constrained may want to focus more on how they manage the tradeoffs between exploratory and exploitative activities.

There are important lessons from these reported findings that will inform the research model for this study. First, ambidextrous organizations need leaders and senior teams who can also be ambidextrous and who are able to communicate a clear and compelling vision to members of the organization. Members of the library must understand and internalize the strategy that both exploration and exploitation are important and must be balanced within the organization. Secondly, and most important for practice, leaders must learn how to manage the inevitable conflicts, tensions, and paradoxes that are created by an ambidextrous orientation.

Organizational Structure and Innovation

Given these cited empirical findings, it would appear that two distinctly different organizational structures are needed in each of the two stages - initiation of the innovation and implementation of the innovation. In an attempt to account for different innovation approaches, Ettlie, Bridges, and O’Keefe (1984) have developed a model that focuses on organizational strategy and a structure that leads to both radical and incremental innovations. In their study of the food processing industry, findings suggest that radical innovation is supported by an aggressive technology policy, a centralized decision process, informal structures, and a concentration of technical specialists whereas incremental innovations emerge from large, complex, decentralized organizations. In contrast to many of the innovation studies, Ettlie found that large size appears to negatively affect radical innovations in that more formal structures are required to
manage large organizations. Ettlie and colleagues suggest that the more traditional organizations might offset the size influence by partitioning structurally for radical and incremental innovation – an early hint at an ambidextrous organization. Highlighting bureaucratic effects, Jansen et al. (2006) found that centralization negatively affects exploratory innovation whereas formalization positively affects exploitative innovation. The multidimensional complexity of organizational innovation can be seen in these studies where there are different views of the types of organizations that are required in the initiation and implementation stages. Organizational size, a concept that has caused much variation in research results, appears to further complicate the understanding of what structures are best to achieve ambidexterity (Damanpour, 1992; Germain, 1996). If major change and radical innovations are desired, these studies seem to suggest a more complex, informal, decentralized organization is required in the initiation stage and a centralized process for decision making is required in the adoption stage. To manage the complexities of a radical implementation, a further shift to a more formal, less complex organization would be required in the implementation stage. These shifting structural requirements highlight the importance of flexibility in the organizational structure and the inherent challenge to the leadership of the organization to create optimal organizational structures.

**Innovation and Quality Processes**

The research indicates that a preoccupation with process, as is typically found in research libraries, is likely to act in resistance to the implementation of more radical change. Benner and Tushman (2003, p. 242) focused more critically on the mechanistic organization in their conceptual study of exploitation, exploration, and process
management. These researchers use process management, including total quality management (TQM), as a way to view an organization as a system of inter-linked processes. In developing a model and testable propositions, Benner and Tushman argue that process management techniques stabilize and rationalize organizational routines with a focus on efficiency and customer satisfaction. Process management influences technological innovation in three ways: 1) process-focused activities stabilize resource allocation, 2) these techniques tighten internal communication linkages and restrict the types of changes that are recognized, and 3) process management also extends to innovation and design processes. As these techniques are diffused throughout the organization, exploitative activities are favored at the expense of exploration. Several relevant propositions follow from these perspectives: increases in process management (PM) practices promote incremental innovation, increases in PM practices decrease radical innovation, and increases in PM practices decrease innovation for new customers. Significantly for research libraries, these authors conclude that process management practices must be buffered from exploratory activities and that ambidextrous organizations can provide the complex contexts for these inconsistencies. In support of the Benner and Tushman propositions, Staw and Epstein (2000) found that while TQM initiatives were associated with higher CEO compensation, there was no association with firm performance.

**Innovation and the External Environment**

Although there is considerable literature on innovation and public institutions, Noordegraaf and Stewart (2000) suggest that more attention should be given to the environment in which the institution is embedded. Outside of the borders of the
university, there are external pressures that are creating environmental uncertainty that
affect the university and the university library. These pressures originate, in part, from
the political and economic environment and the emergence of for-profit firms that offer
competing services. In studying environmental impact on innovation, Damanpour and
Gopalakrishnan (1998) locate educational institutions in a stable, predictable environment
which leads primarily to mechanistic organizations that are characterized by a focus on
rules and incremental innovations. These researchers have developed a model that relates
environmental change, organizational structure, and innovation. The two primary
dimensions of the environmental model are stability – the extent to which events in the
environment occur frequently – and predictability – the extent to which events occur in a
pattern that can be discerned in advance. Four environmental conditions result: 1)
stable/predictable, 2) stable/unpredictable, 3) unstable/predictable, and 4)
unstable/unpredictable. For much of the 20th century, research libraries resided in a
stable, predictable environment. However, the external environment of the 21st century
appears to be much more unstable, a situation that is likely to lead to more radical
innovation.

Dess and Beard’s model (1984) defines three components of the external
environment – munificence, complexity, and dynamism. Boyne and Meier (2009) clarify
the concept of dynamism for this study by explaining that the crucial element of
dynamism is not the frequency or magnitude of change which can usually be anticipated
but the unpredictability or uncertainty of the environment. There is strong support
indicating that environmental uncertainty favors radical innovation. Damanpour (1996a)
found that the effect of environmental uncertainty is significant for the size-innovation
relationship and helps explain variance beyond control variables. In studying logistics innovation adoption, Germain (1996) found that organizational size and environmental uncertainty predict expensive, radical innovations but not incremental innovation. Damanpour (1996b) found that the relationship between bureaucratic control and innovation is less negative under conditions of high environmental uncertainty. In a study of the financial services sector, Jansen et al. (2006) conclude that exploratory innovation is more effective in dynamic environments. In contrast to most of the previous studies, Koberg et al. (2003) found that environmental dynamism positively affects both incremental and radical innovations, although the affect is more positive for radical innovations.

For the for-profit sector, considerable attention has been focused on the effects of environmental uncertainty on the performance of the firm. Since performance and innovation are related, these research results are worth noting. In a conceptual paper (Simsek, 2009) proposes that both environmental dynamism and complexity will positively affect the ambidexterity-performance relationship. Anderson and Tushman (2001) found that uncertainty is significantly more lethal than lack of munificence or complexity, resulting in higher exit rates for commercial firms. In studying public service firms, Boyne and Meier (2009) indicated that environmental turbulence can have a negative effect on performance and that managers can mitigate these effects from the environment by maintaining structural stability. Andrews (2009) used both objective and subjective measures of environmental dynamism and reported that both measures were negatively related to achievements in public organizations.
The preceding sections of this literature review have discussed the impact of the external environment, organizational structures, and organizational learning on innovation and performance. The next part of this review delves more deeply into organizational behavioral concepts that can affect both the ambidextrous orientation and the ability to innovate.

**Upper Echelon Theory and Leadership Demographics**

The many studies of the effects of group composition indicate that the characteristics of the top management group have a significant impact on organizational outcomes. Researchers have suggested that leadership is one of the most influential predictors of innovation (Carmeli & Schaubroeck, 2006; Rosing et al., 2011). Hambrick and Mason (1984) developed a model of how upper echelon characteristics are reflected in organizational outcomes, suggesting that managerial characteristics will partially predict organizational performance levels. They argue that complex decisions, such as those regarding the strategy of the organization, are difficult to make based solely on technical and economic factors. For these more complex decisions, leaders are inclined to make decisions based on behavioral factors. In the proposed upper echelon model, these researchers claim that observable managerial characteristics such as age and educational level can be considered indicators of cognitive characteristics such as knowledge about future events and related alternatives (Hambrick, 1994; Hambrick & Mason, 1984).

In advocating a different theoretical approach, Edmondson et al. (2003) argue that the TMT\(^6\) demographic composition is relatively stable and does not account for specific

\(^6\) The top management team (TMT) is the relatively small group of influential leaders and managers at the top of the organization (Hambrick, 1995).
situations. This lack of refinement or precision has led to conflicting empirical results due, in part, to the imperfect proxies inherent in the theoretical approach. Situational leadership research suggests that leaders need to adjust their styles based on specific circumstances. In a specific situation, a leader may choose either a highly directive or a highly participative decision process. Finkelstein and Hambrick (1992) have examined managerial discretion as a possible bridge between disparate theoretical approaches. Managerial discretion refers to the latitude of action available to top executives. These researchers hypothesize that where discretion is high, upper echelon theory is likely to have stronger explanatory power.

**Empirical Support for Leadership Demographics**

Koberg et al. (2003) demonstrate the importance of managerial autonomy in a study showing that the freedom to experiment was more positively related to radical innovation than to incremental innovation. In a large empirical study of three industries (aerospace, electronics, and telecommunications), Koberg et al. (ibid) used complexity theory as a theoretical framework and found that CEO age was negatively associated with incremental innovation (i.e. higher age, less incremental innovation), a result that was contrary to their hypothesis. The effect might be explained in their research protocol which aggregated both administrative (rules, work procedures, work schedules, etc) and technical innovations together. It is suspected that their hypothesis would have been supported if they had limited the study to technical innovations. Especially significant for the proposed study herein, these researchers note that managerial variables such as tenure in position and tenure with the company were significant predictors of incremental
innovation. The Koberg study also reported partial support for CEO age being negatively related to radical innovation.

Bantel and Jackson (1989) examined the characteristics of top management teams in banks including average age, average tenure\(^7\) in the firm, education level, and heterogeneity with respect to age, tenure, educational background, and functional background. Results indicated that more innovative banks are managed by more educated teams who are diverse with respect to their functional areas of expertise. These relationships remained significant when controlling for organizational size and team size.

Finkelstein and Hambrick (1990) studied executive-team tenure in a sample of 100 organizations in the computer, chemical, and natural-gas distribution industries. These researchers found that tenure has a significant impact on strategy and performance, with long-tenured managerial teams following more persistent strategies that conformed to the norms in the industry. Wiersema and Bantel (1992) report firms that are most likely to undergo strategic corporate change had TMTs characterized by lower average age, shorter organizational tenure, and higher educational level. Daellenbach et al. (1999) report studies of opposite effects in which years of experience in the industry are positively related to innovation. However, the hypothesis of a positive relationship was not supported in Daellenbach’s study.

It is also useful to examine the dispersion or heterogeneity of certain characteristics within the TMT (Bantel & Jackson, 1989; Hambrick, 1994). Regarding heterogeneity, Wiersema and Bantel (1992) note that higher organizational tenure heterogeneity and higher educational specialization heterogeneity are positively related to

\(^7\) It should be noted that this study will focus on organizational tenure, the number of years a team member has with the specific organization. A related concept is “team tenure” – the number of years one has been a member of a specific team.
strategic change, however this demographic diversity can only be positive only up to a point. At very high levels of diversity, conflict and power struggles are likely to occur. The importance of the team and strategy has also been amply demonstrated. Researchers have argued that teamwork at the top of the organization can result in a knowledge strategy that generates new ideas and multiple alternatives – important antecedents of innovation (Edmondson et al., 2003; Nadler, 1996). Wagner et al. (1984) found that the proportion of the top-management group that turned over was inversely related to the firm's financial performance and positively related to the coefficient of variation of the distance among managers. At the individual level of analysis, managers who were older were located in firms that performed worse. In these firms, turnover was higher in groups where managers were more dissimilar in terms of age.

Organizational theorists have demonstrated early and persistent support for the upper echelon perspective in studies regarding the positive effect of elites’ attitude toward change and innovation (Daft, 1978; Damanpour & Aravind, 2012; Hage & Dewar, 1973). In reporting on four decades of research, Damanpour and Aravind (2012, pp. 502-503) indicate that manager’s positive attitude toward change remains a salient determinant of innovation across two separate waves of meta-analyses, suggesting that “a favorable attitude toward change in managers is essential for creating a climate conducive to innovation . . .”. However, it was also noted that managerial age and education were not significant determinants in the post-1990 meta-analysis. In a study of drug and alcohol treatment centers and technological innovation, Davis (2003) reports that education is, in fact, positively related to the awareness stage of innovation.
In summary, the demographics of library leaders are likely to have a significant impact on innovation. Although the above studies cannot be generalized to research libraries, the ageing profession and tenure in the position may have significant negative impacts on radical innovation and are worthy of further study. However, it must also be acknowledged that leaders can be flexible and are able to adjust their management styles based on the specific situation.

The Leadership Team and Behavioral Integration

In most organizations, decisions do not emanate unilaterally from the singular leader at the apex of the organization. Rather, leaders and managers – the top management team (TMT) - are constantly communicating and making tradeoffs between meeting current needs and developing capabilities for the future. Building on upper echelon theory, Hambrick (1994, 1995) proposed the concept of behavioral integration in the top management team and linked the concept to organizational outcomes. The leadership of an organization is called upon to make decisions in a complex environment of information overload which is often ambiguous and contradictory and frequently subject to multiple interpretations. According to Hambrick, a more integrated team can navigate the complexities of decision making more effectively. However, for many organizations, the concept of a leadership “team” is a misnomer. The group that is nominally the TMT may have little interaction, rarely meets as a team and group members may have their own agendas. Even in this less integrated team, the leaders and managers of the organization, with their respective styles, motives, biases, and experience, can be expected to significantly affect organizational outcomes.
Behavioral integration is a meta-construct that involves group processes such as collaboration that were previously represented by separate constructs. Behavioral integration should not be confused with social integration or inter-dependence. The meta-construct also does not imply consensus and, in fact, behaviorally integrated teams may have considerable disagreement – a situation which can create more content-rich discussions (Hambrick, 1994). Hambrick theorized that behavioral integration consisted of three important factors: 1) level of collaborative behavior, 2) quantity and quality of information exchange, and 3) emphasis on joint decision making. Simsek et al. (2005) extended Hambrick’s model of behavioral integration by developing a measure of the construct and demonstrating empirical support. The proposed study herein adopts Hambrick’s focus on the TMT rather than focusing on the singular leader of the organization. The premise of this study is that a more behaviorally integrated TMT will be better able to deal with the inherent conflicts that emerge in the various stages of the innovation diffusion process.

**Empirical Support for Behavioral Integration**

Carmeli and Schaubroeck (2006) note a behaviorally integrated TMT is characterized by intense interaction that produces open information exchange and collaboratively-based decisions. These decisions are typically more complex than those encountered in other work groups. These researchers examined the impact of behavioral integration on organizational decline using a sample of 116 TMTs from various industries. It was found that behavioral integration was negatively related to organizational decline (i.e. more behavioral integration results in less decline) and was positively related to the perceived quality of strategic decisions. In addition, their in-
depth case studies indicate that it is reasonable to impute causality to these hypothesized relationships. In a survey of teams from 96 service organizations, Carmeli (2008) found that TMT behavioral integration is positively associated with both human resource performance and economic performance. A component of behavioral integration is the exchange of information in the leadership team. Damanpour and Aravind (2012, p. 503) report internal communication and “a climate conducive to the dispersion of ideas across the organization” were positively related to innovation in two waves of meta-analyses. Marion (2012, p. 468) and Kazanjian et al. (2012) discuss the role of leadership in collective creativity, a process that can lead to the dispersion of ideas throughout an organization. Uhl-Bien (2007) coined the phrase “enabling leadership” where the formal leaders of the organization are particularly well-suited to stimulate creativity because of their networks, access to resources, and authority. A more behaviorally integrated leadership team may be able to carry out this enabling leadership, resulting in an organization generating more ideas which lead to improved innovative performance.

**Innovation in Libraries**

Reynolds and Whitlatch (1985) note there is no comprehensive theory that can be used to study innovation in libraries. Although there is much published literature on the need for innovation, there still does not appear to be any substantial theoretical approaches to studying innovation in research libraries. The conceptual model of Figure 2 provides a starting point for studying innovation in research libraries.

As indicated in Figure 2, the structure of an organization can affect virtually all stages of the innovation process. Budd (1998, p. 166) asserts that the most common form

---

*It should be noted that this segment of the review has been partially reported in a related study on organizational innovation in research libraries (Jantz, 2011a).*
of organizational structure in research libraries is the hierarchical bureaucracy which includes the primary functional areas of public services and technical services. This organizational form provides the structure and control that is desired by library managers.

Musman (1982) characterizes the library technical services function as consisting of work activities that are geared to specific processes and well-defined tasks, an environment that is not likely to result in innovative or novel ideas. On the other hand, the public services organization can be considered more of a professional bureaucracy where processes are more decentralized and members operate with considerable autonomy. In a public services organization, incremental or routine innovations emanate from practice, the liaison role, and the client interface.

Based on Hage and Aiken’s theory (1970, 1967) of organizational complexity, Howard’s dissertation (1977) presents an analysis of how the impact of organizational structure can affect the rate of innovation in research libraries. In reviewing the research of Hage and Aiken, Howard (1977) reports that a key variable that stimulates creativity is organizational complexity and the critical component of organizational complexity is diversification of knowledge. Diversification of knowledge can be characterized by the number of occupational job titles. For the sample of institutions, Howard selected four research libraries grouped by demographic similarities into two pairs. For this small sample, Howard’s study showed mixed results in both the complexity-innovation and centralization-innovation relationships.

Fowler (1998) studied organizational learning and innovation by focusing on a single academic library in which use of the Internet was considered the innovation outcome. In this study fourteen variables were identified that might have an impact on
innovation. Of these variables, professional reading and the number of published articles were significant positive factors affecting innovation whereas organizational structure was not significant.

In a mixed mode analysis of 140 academic libraries within institutions that grant Master’s and Bachelor’s degrees, White (2001) found that the size of the organization is positively related to innovation in the area of digital reference services. Damanpour and Childers (1985) studied public libraries by relating size to innovation. They found that library size, as defined by budget, was positively related to innovation, however, the rate of adoption among small to medium sized libraries was rising faster than in large libraries. These researchers also found that the rate of innovation adoption was increasing from the 1975-79 period to the 1980-84 period. In a subsequent study of 75 public libraries, Damanpour (1987) found that specialization, functional differentiation, professionalism, size, and slack resources were better predictors of technical innovations than administrative innovations.

What this literature review demonstrates is that multiple factors (leadership, organizational structures, quality processes, and the external environment) that comprise the research library context can act either for or against major change and radical innovations. The research findings provide insight as to why libraries continue on their track of incremental innovations and are finding it difficult to implement major change. What one garners from much of the literature on organizational learning and the TMT is that leadership must find a balance in which both exploratory and exploitative activities are supported. There is a creative tension that can arise from pursuing both exploratory and exploitative initiatives. Depending on the organization’s strategy, too much
exploration can lead to chaos whereas too much exploitation results in sacrificing the future. One might ask if continuing to produce small, incremental changes might be an effective strategy for libraries. The observation is a key question for this proposed study. Daniel Greenstein, as quoted earlier, provides a partial answer in suggesting that a continuation on the current track will result in the slow dismantling of the research library over the next ten years. This study now turns to the formal research model, the research questions and related hypotheses.
Chapter Four

Research Model, Research Questions, and Hypotheses

From the literature review and the author’s research, a model is formulated in which the effects of both the external environment and organizational factors on the innovativeness of the research library are taken into account. Innovativeness in research libraries is hypothesized to be the consequence of four major factors: the leadership team, the external environment, the organizational structure, and the learning strategy of the organization. In addition to the major factors, several additional predictor variables have been included in this study because of support in the established literature or because these variables might have causal effects within the unique environment of the research library. The rationale for selecting these factors and variables is briefly outlined before proceeding to a more in-depth discussion of the research model and the research questions.

The Leadership Team and Behavioral Integration. Organizational theorists (DiMaggio & Powell, 1983) have coined the phrase “the iron cage” as a metaphor for the environment in which the institutional nonprofit finds itself. The iron cage results from the standards, traditions, and norms of the library profession that restrict major change in the organization. Innovation in any organization represents a challenging managerial responsibility and the obstacles to successfully innovate are many and complex. What motivates the leaders to break out of this iron cage and pursue what are likely to be risky ventures?

9 The phrases “predictor variable” and “independent variable” will be used interchangeably in this study.
To create and sustain an innovative culture, the singular leader will need the support and active engagement of the senior leadership team. Although this team can be the source of new ideas, one of its most important functions is to champion innovation and facilitate navigation through the stages of the innovation process (Figure 1). The innovation literature is replete with examples of innovation obstacles – fear of change, unfamiliar jargon, and local power structures – all of which can contribute to innovation failures. The senior team will need to counter these negative forces by exchanging information, collaborating, and participating in joint decision making. Beyond these initiatives, the senior team will also have to provide the resources for implementing the innovation and encourage teamwork throughout the implementation process. Behavioral integration is the concept that will be used to characterize the degree of collaboration and information exchange within the library leadership team.

Organizational Structure. The research library has typically been seen as a hierarchical organization with considerable authority and decision-making power vested in the singular leader. This centralized authority can restrict the free flow of ideas. To successfully innovate, it seems that two types of organizational structures are needed. The organization needs to be loose and less hierarchical to generate new ideas and move these ideas into the decision process. However, to effectively implement new ideas, the organization must focus on schedules, quality, and reliability - processes which require a somewhat narrower focus. Thus the organizational structure to carry out the implementation may be quite different from that of the idea initiation structure. In this study, structural differentiation – the subdivision of library tasks into different units of the library - is an important factor that is expected to impact innovative capability.
The External Environment. The research library is emerging from a long period of stability and finding itself in a more dynamic external environment where budgets are less predictable and technological breakthroughs can quickly render a service obsolete. Although this dynamism may be viewed as negative, it can also be the source of new ideas and a stimulus for change in the library. Leaders who are in touch with these changes are likely to take action which can lead to major new changes in the library. In this study, two dimensions of the external environment will be examined – environmental munificence and environmental dynamism. Munificence is typically interpreted as the availability of abundant human and financial resources while dynamism refers to change and the uncertainty in the external environment (Boyne & Meier, 2000; Dess & Beard, 1984).

Learning Strategy and an Ambidextrous Orientation. While pursuing new ventures, the library will obviously want to support and even enhance existing services. Organizational learning theorists have characterized the organization’s ability to simultaneously explore new services while supporting and exploiting existing services as an ambidextrous orientation. In this study, the ambidextrous orientation is modeled by capturing leadership views of the exploratory and exploitative capabilities of their organization.

These brief rationales provide an introduction to the research model and the four major factors that are expected to affect innovation in the research library – integration of the senior leadership team, structural differentiation of the organization, the external environment, and the learning strategy of the organization.
Research Questions

From the extant literature, earlier research by the author (Jantz, 2012a, Jantz, 2012b), and observations within research libraries, the following research questions have been formulated:

1. What effect does the behavioral integration of the senior team have on the innovation performance of the research library?
2. How does a more structurally differentiated organization affect the innovation performance of the research library?
3. How do the factors of munificence and dynamism in the external environment affect the innovation performance of the research library?
4. What is the effect of an ambidextrous orientation on the innovation performance of the research library?
5. Does an ambidextrous orientation mediate the relationship between senior team integration and innovation performance?
6. How do contextual factors of the research library affect innovation performance?

Innovation Performance – the Dependent Variable

This study is exploratory in nature and will examine how the major and contextual factors affect innovation performance. As a research objective, we want to understand the total innovation performance of the library by examining the capability to implement both incremental and radical innovations. In this study, innovation performance is constructed as a combination of radical and incremental innovations, focusing exclusively on service or technical innovations directed at the end user. Administrative innovations are not addressed in this study. Innovation performance is
considered to be best when both radical and incremental innovations are carried out in an organization and when there is a balance between these two types of innovations.

_Total Innovation Performance._ A metric constructed from a single dimension is inadequate to represent the complex processes involved in organizational innovation (Ravichandran, 2000). In this study, the innovation performance construct – the dependent variable - is defined as consisting of three dimensions that relate to the library’s innovative capabilities. These dimensions are aggregated to form the innovation performance construct. First, the innovation adoption decision reflects the ability of the organization to make a decision to proceed with implementation. This aspect, sometimes referred to as _innovation magnitude_ (Gopalakrishnan, 2000), represents the breadth and depth of innovation and is compiled from the organization’s decisions regarding the implementation of selected innovations (Appendix E). However, the innovation adoption decision only partially reflects the organization’s ability to innovate.

After the decision to adopt is made, the organization must marshal resources to implement the innovation. Walker’s configuration framework for service organizations helps us understand why this issue is important for research libraries. Walker (2008) suggests that public organizations may make innovation decisions in search of legitimacy. An innovation decision may be made to manipulate appearances with little effort invested to actually implement the innovation. Innovation must therefore be more than just an idea or a decision; the innovation must be implemented and have significant user impact. In a research library with few reliable performance indicators, there typically are no significant negative repercussions in not following through on a decision. It is possible that a decision is made to adopt an innovation; however the implementation
is never undertaken because of resource constraints, political controversy, or other blocking factors. For the second component of the innovation performance construct, rather than using a simple yes/no approach, the decision to adopt is augmented by the extent of implementation of the innovation and represents the organization’s effort that is directed to realizing the innovation.

The third dimension of innovation performance addresses the impact of the library’s learning strategy and the ability to simultaneously conduct both exploratory and exploitative activities that can result in both incremental and radical innovations (He & Wong, 2004). The traditional culture and bureaucratic structures of the library can resist the implementation of more radical innovations. Research libraries typically create predominantly incremental innovations that emanate from practice and the client interface (Salge & Vera, 2009; Sidhu, Volberda, & Commandeur, 2004). In a seminal article, March (1991) has stressed the importance of balance that is critical for the firm to survive and prosper. Piao (2010) has examined balance from a temporal perspective and concludes that a firm can extend its longevity with a moderate amount of overlap between exploratory and exploitative activities.

In this study, the total innovation performance construct captures the notion of balance and penalizes the library that is implementing either predominantly incremental or radical innovations. The ideal outcome is a balance where the library excels at implementing both radical and incremental innovations.

With this background, the hypothesized model for this research proposal is illustrated in Figure 3.
In Figure 3, the four major constructs – senior team integration, structural differentiation, the external environment, and an ambidextrous orientation – are expected to have a significant impact on innovation performance. In addition, it is expected that the relationship between team integration and innovation performance will be mediated by an ambidextrous orientation. Beyond these major constructs, there are several classes of variables that are also expected to have an impact on innovation in the research library. The demographics of the leadership team – age, time in the profession, and level of education – are likely to impact the innovation adoption decision. In addition, a class of contextual or enabler variables\textsuperscript{10} such as decision awareness and the staff/professional profile may have an impact on innovation performance. Controls in the model include organizational size and the type of institution (public or private).

\textsuperscript{10} The term “enabler” is taken from an in-depth study of innovation in high schools (Daft & Becker, 1978, p. 54)
Research Hypotheses

The research model and the hypotheses for the major factors, leadership demographics, and enabler variables are developed in more detail in the following sections.

The Leadership Team and Behavioral Integration. A primary thesis of this study is that the senior leadership of the research library – the top management team (TMT)\(^{11}\) – has a major impact on innovation. Leadership is also seen as a major factor in contributing to organizational creativity – an important antecedent of innovation (Alencar, 2012, p. 100). Few researchers will disagree that the leadership team in an organization can have a profound effect on innovation and performance. As Tushman et al. have indicated (2002), the strategy emanating from senior leadership and the resulting organizational design are powerful levers that enable an organization to pursue dramatically different types of activities. To successfully innovate, TMT collaboration and active engagement is needed to create supportive structures, strategies, and an innovative organizational culture (Andriopoulos & Lewis, 2009).

Hambrick (1994) developed the concept of behavioral integration which consists of three important factors: 1) level of collaborative behavior, 2) quantity and quality of information exchange, and 3) emphasis on joint decision making. The position in this paper is that behavioral integration of the TMT is especially important for research libraries to become more innovative. These libraries have traditionally focused primarily on incremental innovations that improve efficiency and quality; radical innovations that

\(^{11}\) The phrase “top management team” has been adopted by organization theorists to refer to the relatively small group of the most influential executives at the apex of the organization (Hambrick, 1994, p. 173). In university libraries, this group typically consists of the university librarian, associate university librarians and directors. The terms “TMT” and “leadership team” are used interchangeably in this study.
deviate from the norms and traditions of the profession are relatively rare. A behaviorally integrated team has the confidence and trust to have open debates on unpopular issues and risky proposals, resulting in a greater likelihood of achieving agreement and concerted action on controversial projects. Siegel and Hambrick (1996) have shown that the more behaviorally integrated team makes better use of knowledge alternatives. Through increased quality and quantity of information, more ideas are available for discussion and joint agreement. The collaborative aspect of the behavioral construct suggests that team members will be more willing to discuss unique, non-traditional ideas. The flow of new ideas, the willingness to discuss controversial ideas, and the collaborative aspects of the team will lead to more radical innovation proposals flowing into the decision process. In contrast, members of the less behaviorally integrated team are likely to withdraw into their own domains where they have undisputed control. This behavior is typical of the classical manager in which rules and processes become dominant and which lead to support of the status quo and, at best, more incremental innovations.

The primary way that the TMT influences organizational outcomes results from their role in developing and articulating organizational strategy and creating the resultant organizational structures and innovative culture. However, perhaps unique to those organizations that are embedded in an institutional environment, the TMT not only has a role in overcoming the institutional resistance cited previously but must also help guide the prospective innovation through the bureaucratic structures that have resulted from the many years of professional development, library traditions, and embedded power networks. Similar to small and medium-sized firms, libraries have fewer hierarchical
levels and most of the leaders in the team will have both strategic and operational roles (Lubatkin et al., 2006). The collaborative aspect of the behaviorally integrated team becomes important in facilitating the operational implementation of innovative projects through the various units of the organization. The engagement of the senior team in facilitating innovation projects will also provide psychological protection for organizational members who might otherwise be reluctant to work on controversial projects (Un, 2010). All of these team characteristics can lead to decisions and implementation of more radical innovations and a more balanced portfolio. These perspectives lead to the following hypothesis:

**H1:** The extent of senior team integration in the research library is positively associated with innovation performance. More integration of the senior team will lead to improved innovation performance.\(^{12}\)

*Organizational Structure.* Organizational structure is important for innovation in so far as it is designed to facilitate the generation of new ideas and the successful implementation of these ideas. Duncan (1976) has identified the persistent dilemma for innovative organizations – “different organizational structures appear to be appropriate for the initiation and implementation stages of the innovation process.” In the initiation stage, a looser organization with less formalism and hierarchy will allow for the free flow of ideas that can become innovations. However, in the implementation stage, more

---

\(^{12}\) Although the logic of statistical inference requires that the null hypothesis be stated as having no effect, the hypothesized effect will be used in the following discussion to more clearly demonstrate the theoretical framework and results from the literature review. The null hypothesis will be stated in the analysis of Chapter 6.
emphasis on process is needed to meet the schedule, quality, and reliability requirements of the new product or service. Dess, Lumpkin, and McGee (1999) have argued to overcome the impediments of hierarchy-driven organizational models firms must embrace a barrier-free organization to facilitate the knowledge growth that is needed to create new services. However, Jansen et al. (2009) posit that different structures can help an organization maintain multiple inconsistent and conflicting demands. The structure and culture of these units will likely differ from that of the more traditional library unit. Jansen and colleagues state that structural differentiation can help organizations simultaneously conduct both exploratory and exploitative activities and deal more effectively with the resulting organizational tension. Effectively conducting dissimilar activities can be achieved by creating different organizational structures for exploration and exploitation, similar to the classic R&D organization. Damanpour and Gopalakrishnan (1998) supported this perspective by noting that organizations in unstable environments will need specialized units to introduce more radical innovations. Earlier studies (Hage & Aiken, 1970; Kimberly & Evanisko, 1981) have shown that organizational complexity characterized by the variety and number of different units is positively related to innovation. However, as reported by Daft and Becker (1978, p. 140), there is considerable research suggesting that similarity supports cross-fertilization and information exchange – activities that can lead to more innovation. On the other hand, differentiation can act as a barrier resulting in unfamiliar vocabulary and different knowledge bases that impede communication.

The structural conundrum is evident in these research studies. To stimulate knowledge growth and the free flow of ideas, it appears that separate structures are
needed which are somewhat buffered from the organizational units that conduct the day-to-day business of the library. Budd (2012, pp. 104-109) has traced the evolution of academic libraries noting that the bifurcation into public and technical services units was motivated in the early 20th century by a focus on efficient management. The resulting bureaucratic organization created a uniformity based on rules and regulations – management processes that limit creativity. According to Budd, in spite of considerable discussion and espousal of different structures, most research libraries have retained a classical organization structure that focuses on public services, technical services, and collections. What appears to be important is not just the structural differentiation, but what types of structures are emerging in the research library and how well these structures are integrated (Nord & Tucker, 1987, pp. 14-15). Although there is some evidence that libraries are creating R&D units (Jantz, 2012a), leaders would also need to create a different type of culture by articulating how these R&D units can complement existing services and develop new knowledge to enhance innovative capabilities. In today’s library, it is expected that the classical structures and centralized authority persist and continue to represent barriers to the free flow of ideas across units. The extant research and these observations lead to the following hypothesis:

**H2:** A more structurally differentiated research library will be negatively related to innovation performance.

*The External Environment – Munificence and Dynamism.* Environmental munificence is the scarcity or abundance of critical resources needed by firms
Castrogiovanni, 1991; Dess & Beard, 1984). In a nonprofit organization, managers typically have little or no direct control in determining the amount of financial resources to be allocated to the organization. When resources are abundant, it is relatively easy to invest in new and more risky projects without adversely affecting existing products and services. As one measure of munificence, Daft and Becker (1978, p. 53) report that affluence, defined as education expenditures per student, is highly correlated with innovation in high schools. In a study of 21 school districts, researchers (Koberg, 1987; Koberg & Ungson, 1987) found that resource scarcity was associated with more frequent changes in procedural, personnel, structural and strategic processes. It is noteworthy that the types of changes in the Koberg study included the elimination of teacher positions and the reduction in expenditures on textbook repairs and out-of-district travel. These types of changes can reduce variation and the inflow of new knowledge into the organization, factors that typically work against technical innovations. In an examination of public organizations, Andrews (2009) found that environmental munificence, using both objective and subjective measures, was positively related to performance.

In studying effects of munificence on for-profit firms, economists typically model the change of munificence over a period of years (Anderson & Tushman, 2001). In this study, environmental munificence will be based on the increase in library expenditures from the year 2000 through 2009\footnote{Data available at the Association of Research Libraries website - http://www.arl.org/stats/annualsurveys/arlstats/}. Non-inflation related increases could result from obtaining a larger percentage of the parent institution’s budget or from other sources such as grants. In any event, if the library has experienced increases over this 10 year period,
it is assumed that they are experiencing a more munificent environment, resulting in the following hypothesis:

**H3a:** Environmental munificence is positively related to innovation performance. A larger increase in expenditures will result in improved innovation performance.

*Dynamism and Uncertainty.* Frequent and major change in the economic, technological, and political environment of the research library can create considerable uncertainty. These major changes are typically referred to as environmental dynamism. The crucial element of dynamism is turbulence or the unpredictability of change (Boyne & Meier, 2009). Since uncertainty is a key element of dynamism, this study will focus on the concept of environmental uncertainty. Coping with change and uncertainty is the essence of the administrative challenge for library leaders.

Turbulence and uncertainty in the external environment can cause leaders to take action to cope with this uncertainty. These actions can result in changing the organizational structure or hiring people with different knowledge and skills, actions which can ultimately benefit innovation outcomes. However, as Anderson and Tushman (2001) explain, uncertainty can be quite hazardous for an organization. For example, a library may try to adapt to a major new technological advancement, only to find that this technology is quickly rendered obsolete. Similarly, responding to unpredictable environments can create internal political turbulence.

It is the premise of this study that research libraries are finding themselves in a more unstable and less predictable environment. The source of the instability typically emanates from the political environment, budget and financial pressures, and the rapid
evolution in the technological infrastructure. Past research indicates that environmental uncertainty affects all types of innovations. In a meta-analysis of 21 studies, Damanpour (1996a) found that structural complexity is more positively related to innovation in organizations that are operating under high environmental uncertainty in contrast to those operating under low uncertainty. Germain (1996) examined logistics innovation which involves the organizational-wide flow of goods and information. University libraries are good candidates for this type of innovation in that they store and process millions of books and thousands of digital files while managing a diverse set of information regarding user accounts and bar-coded materials. Although Germain’s study focused on manufacturing organizations, his conclusions are noteworthy, indicating that size and environmental uncertainty were definite predictors of radical innovations. Sidhu et al. (2004) have shown that a more dynamic environment will result in an organization conducting more exploratory activities. Using an objective measure, Boyne and Meier (2009) examined public organizations and found that turbulence in the environment has a negative effect on performance. Performance in this Boyne’s study was based on student test scores and represents a related, but quite different, concept from innovation.

As Kanter (1983, p. 280-281) has indicated, the environment does not really create change automatically or directly, rather it is the perceptions of the environment and related actions by key actors that result in change. In accordance with Milliken (1987), environmental uncertainty is defined here as an individual’s perceived inability to predict something accurately. Accordingly, this study uses the view that leaders’ perceptions, as opposed to an objective measure, are most relevant in a library. A sample question asks respondents if they can accurately predict the actions of peer library institutions
Leaders that view the environment as benign and stable, regardless of more objective measures, are not likely to take the actions necessary to introduce innovations into their organization. In contrast, an environmentally sensitive leadership team will be more responsive to changing conditions in the external environment and more likely to support innovative initiatives. These observations lead to the following hypothesis:

**H3b:** Uncertainty in the external environment, as perceived by library leaders, is positively related to innovation performance in the research library. More uncertainty will lead to improved innovation performance.

*Learning Strategy and the Ambidextrous Orientation.* Organizational scholars (Andriopoulos & Lewis, 2009; O’Reilly & Tushman, 2004; Tushman & O’Reilly III, 1996) have identified the ability to manage both evolutionary and revolutionary change as a strategy that results in what they refer to as an ambidextrous orientation. Ambidexterity\(^\text{14}\) not only requires the organization to achieve a balance between exploratory and exploitative actions, but also to sustain a balance over time in order to become a truly innovative organization. There are multiple paths that lead to an ambidextrous organization. If leaders pursue an ambidextrous orientation, the organization may take on a variety of characteristics that will result in ambidexterity. Innovative activities may be pursued within a single unit or, alternatively, exploratory efforts can be buffered from the daily activities required to support existing services by

\(^{14}\) The phrase “ambidextrous orientation” and the term ambidexterity will be used interchangeably in this study.
creating separate units for these activities. Grover et al. (2007) found that an
amidextrous approach – using two structures simultaneously - is being used by many
telecommunications firms to achieve balance. From a temporal perspective, an
organization may have long periods of relatively stable incremental improvement where
these stable periods are occasionally punctuated by the development of a major new
capability (Gersick, 1991; Hannan & Freeman, 1984; Piao, 2010). O’Reilly and
Tushman (2008) suggest that leaders do not need to make these temporal tradeoffs by
focusing on either exploitation or exploration. Rather, these researchers view
amidexterity as a capability embedded in senior leadership’s learning that enables them
to reconfigure the organization to adapt to specific circumstances, thus simultaneously
supporting both exploratory and exploitative learning.

The model in this study explores the senior team’s strategy and perspectives
regarding the organization’s ability to seek greater efficiency and improvements in
existing services while simultaneously experimenting and developing new knowledge
and new services. A key question relates to balance, i.e. the ability to do both exploratory
and exploitative work but not to put undue emphasis on either activity. Kim and Rhee
(2009) support the importance of balance, noting that frequent and less dramatic change;
similar to what is found in the research library environment today, demands a balance
between exploration and exploitation. These relatively small, but frequent, changes will
ultimately constitute a major change in the environment. As an example of how changes
can accumulate, incremental changes resulting from the Internet and mobile technology
can now be seen as having a major impact on research libraries.
An ambidextrous strategy acknowledges the importance of developing new services while also improving the quality and reliability of existing services (He & Wong, 2004; Tushman et al., 2002). In this study, the ambidextrous orientation of the research library is defined as a property of the organization, as perceived by the leadership team, which encourages both exploratory and exploitative activities. This strategy can lead to different implementations of the ambidextrous orientation. For example, leaders may pursue a single unit approach where an organizational context is created which encourages individuals to use their own judgment to divide their time between diverse activities that will lead to different types of innovations. In this ambidextrous organization, these diverse activities are valued and rewarded and failures are recognized as opportunities for learning. Alternatively, separate structures might be established either to buffer exploitative and exploratory activities or to provide a more supportive context in the initiation and implementation stages. In this structural separation, leaders must actively manage the sharing between units and assist in resolving the inevitable conflicts that will arise.

The measure of an ambidextrous orientation is based on the approach used by Lubatkin et al. (2006) who adapted Benner and Tushman’s conceptualization (2003) and which captures both dimensions of exploration and exploitation. It is expected that the more ambidextrous orientation will result in more balanced investments in different types of innovations, leading to the following hypothesis:

**H4:** An ambidextrous orientation is positively related to the innovation performance of the research library.
A Mediation Effect. As illustrated in Figure 3, it is expected that an ambidextrous orientation will mediate the relationship between behavioral integration of the senior team and innovation performance. Intuitively, a more integrated team is likely to develop before an organization can deal with the conflicts that arise from ambidexterity, suggesting that the behaviorally integrated team precedes ambidexterity in time.

The responsibility for creating an ambidextrous orientation lies largely with the senior leadership team (Simsek et al., 2009). It is expected that the attributes of behavioral integration – senior team collaboration, quantity and quality of information exchange, and emphasis on joint decision making – will impact innovation performance through the development of an ambidextrous orientation. Similar to what Gibson and Birkinshaw (2004) have proposed, the expectation in this study is that an ambidextrous orientation will be developed through the various interactions of a behaviorally integrated team. It is expected that ambidexterity will develop over a period of years through the positive interactions of a more integrated TMT. Or, in other words, a team that is reasonably well integrated will not immediately demonstrate an ambidextrous orientation. To develop ambidexterity, the collaborative orientation of the TMT can result in experimentation and prototyping of new ideas which can not only provide a better understanding of a new service but also demonstrate how these ideas can be integrated into the existing suite of services. Researchers (Jansen et al., 2009) have demonstrated that senior team integration can contribute to balanced resource allocation and will also enhance cross-fertilization across exploratory and exploitative activities. This more balanced approach can lead to an ambidextrous orientation. As noted by Lubatkin et al. (2006), “the TMT’s level of behavioral integration directly influences how its members
deal with contradictory knowledge processes . . . such that greater integration enhances the likelihood of jointly pursuing . . .” both exploratory and exploitative activities. These observations lead to the following hypotheses:

**H4a:** An ambidextrous orientation mediates the relationship between behavioral integration of the senior team and innovation performance.

It should be noted that the mediating affects of the ambidextrous orientation represent a competing hypothesis. According to the mediating concept, when controlling for the direct effects of behavioral integration on ambidextrous orientation and the effects of ambidextrous orientation on innovation performance, the effect of behavioral integration on innovation performance is no longer significant (Baron & Kenny, 1986). However, when an ambidextrous orientation has not been developed, it is expected that behavioral integration will still have some impact on innovation performance. Therefore hypothesis **H4a** somewhat contradicts the hypothesis of **H4**; this study will test for both possibilities.

**Hypotheses for Demographics and Enabler Variables**

The hypothesized model of Figure 3 represents the major factors that are expected to affect innovation in research libraries. It must be acknowledged that innovation research in the nonprofit sector is still in its early stages and researchers are just beginning to understand which variables are most strongly associated with innovation. As Light (1998, p. 12) has suggested, one who studies nonprofits must search for the preferred states of organizational being. Axtell et al. (2000) note a major limitation of
innovation studies. Apart from a few exceptions, “studies tend not to include a wide range of individual, group, and organizational characteristics.” At this juncture, unexpected findings may be important and can provide insight into an improved research model. To complement the major factors in the theoretical model of Figure 3 and provide insight into the larger social context of the library, three additional classes of variables, with hypotheses, are introduced here – demographics of the senior team, enabler variables, and controls.

Demographics and Education of the Senior Team. The demographics of the senior team can be characterized in terms of the quantity of a characteristic within the group. For example, average organizational tenure has been correlated with innovativeness. Hambrick and Mason (1984) note that much research has been conducted regarding the tenure of a senior team member in an organization. In previous studies (Bantel & Jackson, 1989; Damanpour & Schneider, 2009; Koberg, Detienne, & Heppard, 2003), researchers have hypothesized that the demographics of leaders such as age and educational level can have a direct effect on innovation. Organizational tenure may be one of the more important of the demographic variables affecting organizational outcomes (Pfeffer, 1983). Those leaders who spend their entire careers in one organization or one industry type may find it difficult to embrace nontraditional opportunities to innovate. The resulting limitations can result in a restricted knowledge base and continued support of the status quo. The original insight is reported by Katz (1982) who notes that increased tenure results in stability and a commitment to the status quo, conditions that can limit the team’s response to innovative ideas. A team with new members and relatively low team tenure will experience tension and uncertainty as they
learn to work together. Although it is expected that a team will become more integrated as they spend time together, a point is reached where group-think begins to occur (Hambrick, 1995). These longer-tenured teams develop norms of interaction over time that become mechanical and content free.

Researchers have found that the average tenure of the TMT “is strongly and consistently associated with strategic persistence, or absence of change” (Hambrick, 1994, p. 185). Empirical results continue to demonstrate this trend even after controlling for industry type (Bantel & Jackson, 1989; Wiersema & Bantel, 1992). Finkelstein and Hambrick (1990) found that the average tenure of the TMT showed a tendency for long-tenured groups to engage in risk-averse behavior, resulting in a commitment to persistent, unchanging strategies and conformity to industry averages. In studying organizations that develop community resources for schools, Jaskyte (2011) hypothesized that the tenure of the executive director is positively related to technological innovation and negatively related to administrative innovation. In reported findings, Jaskyte found that the relationship to technological innovation was negative and not significant. A basic rationale for these reported effects is that a longer tenured team member is likely to have a more pronounced psychological commitment to the status quo.

A concept related to organizational tenure is that of chronological age. According to upper echelon theory, the age of an individual leader can have a significant impact on how a leader will make decisions. Wiersema and Bantel (1992) report that flexibility decreases and resistance to change increases as people age. For older executives, financial and career security become very important and can lead to the avoidance of risky decisions. In studying corporate strategic change, these researchers found that
chronological age was negatively associated with corporate change. In accordance with these earlier studies (Bantel & Jackson, 1989; Wiersema & Bantel, 1992), it is expected that older managers may lack the conviction to institute major change, resulting in fewer radical innovations.

What can be gleaned from these studies is that a younger team or shorter tenured team may not have the confidence or experience to initiate a risky project, whereas the leadership teams in the mid-ranges of both age and tenure are likely to possess the confidence and the maturity to introduce more radical change into their organizations. However, the team with many members nearing retirement will likely become risk-averse. These observations lead to the following hypotheses:

**H5a:** The senior team’s average age will have an inverted U-shaped relationship with innovation performance.

**H5b:** The senior team’s average tenure in the profession will have an inverted U-shaped relationship with innovation performance.

According to Hambrick (1984), a consistent research finding indicates that the level of education of senior team members is positively associated with a receptivity to innovation. Other researchers report similar findings (Kimberly & Evanisko, 1981; Rogers & Shoemaker, 1971), although the Kimberly & Evanisko results held only for technical innovations. In an examination of strategic change in corporations, Wiersema and Bantel (1992) report that the level of education was positively associated with strategic change. Levels of education can obviously offset the limited knowledge base
that results from long duration in a single profession. Educational heterogeneity also has an impact on change in organizations. Not only does the level of education contribute to innovation, but also cognitive diversity becomes a valuable resource, resulting in different points of view and a larger set of alternative potential solutions (Bantel & Jackson, 1989). Within the context of libraries, innovation is increasingly the result of technological advancements. In this study, we examined educational diversity as it relates to science degrees held by the senior team. Library leaders with diverse academic backgrounds and with degrees in science, engineering, and computer science are likely to be more supportive of innovations originating in these disciplines. The hypotheses are as follows:

**H6a:** The senior team’s level of education will be positively related to innovation performance.

**H6b:** The senior team’s science educational diversity will be positively related to innovation performance.

*Enabler Variables – Decision Awareness, the Organizational Profile, and the Singular Leader.* The social environment of the research library is complex and the objective in this study is to examine as much of this environment as possible. In addition to the major constructs of Figure 3, there are certain enabler variables that are expected to impact innovation performance.

*Decision Awareness – An Enabler.* Much of the literature discusses the obstacles in an organization that can quickly cause an innovation to fail. These obstacles are due to
resistance to change, informal power networks, and the bureaucracy of the organization. For an innovation to succeed, the leadership team must be aware of the adoption decision and support the innovation throughout the diffusion process. If a team member is not aware of the decision to adopt, it is unlikely that this individual will support the specific innovation in question. In this study, the relationship of the decision awareness of the leadership team to innovation performance is examined. Although related to the major factor of behavioral integration, decision awareness puts additional emphasis on the decision process and the communication of decisions throughout the organization. The variable for decision awareness is constructed from responses to survey questions regarding the team member’s understanding of whether or not a decision has been made to adopt an innovation. It is expected that a higher degree of decision awareness in the TMT will result in more leadership support of an innovation, leading to the expectation that this construct will be positively related to innovation performance.

**H7:** The decision awareness of the senior team will be positively related to innovation performance.

*Organizational Profile (Staff/Professional Ratio) – An Enabler.* The ratio of library support staff to professional staff may have an impact on innovation performance. This ratio is related to the unique circumstances within research libraries and the knowledge and skills of the support staff and professional librarians. Recent library innovations have been made possible through the transfer and reuse of various information technologies. Evidence of this impact can be seen in the now ubiquitous and
popular new services including live chat software for reference, enabling the library website on smart phones, dynamic mapping guides for the book stacks, and lending of laptops and iPads. Research libraries are taking advantage of open source software platforms to provide totally new services or to reduce the expense of commercial software. The rapidly evolving technology environment is creating a demand for technology-savy support staff. In contrast, public services librarians usually bring with them a specific disciplinary knowledge in the humanities, social sciences, or science. Technical services librarians are trained in cataloging and technical services. Although these skills and the associated knowledge are still very important, IT-related skills are in demand to create and support technology-related innovations. Many professional librarians have not typically developed the in-depth technical know-how that is required to implement major technical innovations. Regazzi (2012) notes that there has been a growth in academic library positions not requiring an MLS and a migration of librarian responsibilities to support staff. In fact, non-librarian professionals are the fastest growing group of staff in libraries associated with doctoral granting institutions (ibid). As a result of these trends, library managers are confronted with difficult decisions regarding the conversion of professional librarian positions to staff positions with IT skills.

Since many of the innovations in libraries are technology based, it is expected that libraries will be trading off professional positions for staff positions, thereby increasing their staff/professional ratio. In this study, the staff/professional profile is constructed as a ratio by examining the trend over the period 2004 – 2009, providing an indicator for average increase or decline for the period. It is expected that the libraries with more IT
skills are better able to not only augment existing services with technology enhancements but to also launch technology based initiatives into major new areas such as journal publishing and creating institutional repositories. These observations lead to the following hypothesis:

**H8:** The staff/professional profile in research libraries will be negatively related to innovation performance. An increase in professional versus staff positions will result in reduced innovation performance.

*The Singular Leader – An Enabler.* The hypothesis regarding behavioural integration puts considerable emphasis on the collaboration of the senior team. Past research has demonstrated that innovation adoption is also affected by the individual leader’s values and attitudes (Moon & deLeon, 2001; Rivera, Streib, & Willoughby, 2000). The Moon and deLeon research investigated U.S. municipal governments with a focus on “reinventing government”, a process which has challenges similar to transforming the research library. Findings from this research indicated that the chief administrator’s reinvention values are positively associated with the adoption of reinvention programs. Researchers have examined the pro-innovation attitude of leaders in nonprofit organizations and found that this attitude in the singular leader is positively associated with innovation adoption (Daft & Becker, 1978; Damanpour & Schneider, 2009).

Similarly, it is expected that a university librarian’s attitude with respect to major change and innovation will impact innovation performance. The centralized structure of
the research library and the traditions of the institutional nonprofit place considerable power and authority in the hands of the singular leader. Thus, it is reasonable to expect that the university librarian\textsuperscript{15} as an individual will have a significant impact on the innovation performance of the library. The leader’s opinions about which innovations to pursue will have more weight in the decision process while the singular leader’s social skills will be important to promote innovative ideas throughout the organization and to provide a supportive environment (Axtell et al., 2000). In this study, the leader’s positive view of the institution’s ability to create innovative products will be expected to permeate through the organization, empowering members to be more innovative and stimulating related practices such as brainstorming sessions and increased conference attendance. These perspectives and the supporting research lead to the following hypothesis:

**H9:** The singular leader’s view of the organization’s creativity will be positively related to innovation performance in the research library. A more positive view of the library’s creative abilities will result in increased innovation performance.

It is acknowledged that hypothesis **H9** is somewhat in conflict with **H1** (behavioral integration). In fact, there may be two models in the research library that lead to innovation – one dominated by the singular leader and the other orchestrated by a more integrated team. In the regression analysis of Chapter 6, the individual contributions of both factors will be examined.

\textsuperscript{15} The phrase “university librarian” will be used as the designation for the singular leader in the research library although other labels are common such as director or dean of libraries.
Controls

Organizational Size. The concept of organizational size represents a significant research issue. There is much literature that reports on the size-innovation relationship. Damanpour (1992) points out that there is little consensus among researchers regarding the magnitude or the direction of the size-innovation relationship. It is generally thought that bureaucratic inertia increases with the size of the organization, resulting in less innovative activity. Although limited by bureaucratic obstacles, the large firm typically has slack resources and can more easily assume the risk of major innovation projects. On the other hand, the small firm is thought to be more flexible and can respond more quickly to external forces. In an extensive meta-analysis, Camisón-Zornoza et al. (2004) note that organizational size is more positively related to innovation in service firms than in industrial firms, however there is still much variability in results. In an empirical study covering a period of three decades, Damanpour (1996a) states that some of the most important predictors of organizational innovation are structural complexity and organizational size, however he also points out that correlations have varied significantly, ranging from -0.09 to 0.71 for the structural complexity-innovation relationship and -0.04 to 0.76 for the size-innovation relationship. Table 1 summarizes several studies on the size-innovation relationship in nonprofit organizations. Although the results show the size-innovation relationship to be generally positive, the comments suggest that using different innovation models might have produced different results. The comments in the table are not intended to reflect on the quality or the credibility of the cited studies. The intent is to demonstrate the variability in the size-innovation relationship and possible causes for the variability.
### Table 1

**Varying Results in the Study of the Size-Innovation Relationship**

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of Organization</th>
<th>Results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daft, R. &amp; Becker, S. (1978). <em>Innovation in Organizations</em></td>
<td>13 high school districts in Illinois.</td>
<td>District size and slack resources were not related to college oriented innovations (pp. 81-82)</td>
<td>The radical-incremental continuum was not considered.</td>
</tr>
<tr>
<td>Walker, R. 2008. An empirical evaluation of innovation types and organizational and environmental characteristics: Towards a configuration approach. <em>Journal of Public Administration Research and Theory</em>, 18(4): 591-615.</td>
<td>English local governments</td>
<td>Size is positively related to innovation.</td>
<td>Innovation types were considered but the radical-incremental continuum was not addressed.</td>
</tr>
</tbody>
</table>

As Downs and Mohr (1976) have indicated, size may be a proxy for other conditions such as slack resources. A small organization with lots of slack resources may
be quite innovative. In service organizations, size is generally measured by the number of employees in contrast to a manufacturing organization where a volume measure is typically used. Interestingly, if one ranks research libraries by total expenditures and total expenditure per student, the “size” rankings turn out quite different. Some of the smaller institutions when ranked by total expenditures turn out to rank with much larger organizations when expense per student is used (Jantz, 2012a). Given the variability in these findings, organizational size will be treated as a control variable in order to eliminate what might be an overriding effect on the major factors in the research model.

Type of Institution (Public/Private) – A Control. In this study, the sample of ARL libraries contains libraries that are members of either public or private institutions. Since governance and funding is quite different for these institutions, the type of institution will be included in the model as a dichotomous control variable.16

The following table summarizes the research questions, the hypotheses, and illustrates how the questions relate to the survey instrument in Appendix C.

---

Table 2

Research Questions and Hypotheses Mapped to the Survey Instrument

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Hypotheses</th>
<th>Construct</th>
<th>Questions in Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1. What effect does the integration of the senior team have on the innovation performance of the research library?</td>
<td>H1. The extent of integration of the research library top management team (TMT) is positively associated with innovation performance (^\text{17}).</td>
<td>Behavioral Integration</td>
<td>Variable is constructed from Appendix C – Section A, questions 1 – 9.</td>
</tr>
<tr>
<td>RQ2. How does a more structurally differentiated organization affect the innovation performance of the research library?</td>
<td>H2: A more structurally differentiated research library will result in reduced innovation performance.</td>
<td>Structural Differentiation</td>
<td>Variable is constructed from Appendix C – Section B, questions 10 – 14.</td>
</tr>
<tr>
<td>RQ3. How does uncertainty in the external environment, as perceived by leaders, affect the innovation performance of the research library?</td>
<td>H3a: Munificence is positively related to innovation performance in the research library. (^\text{17}).</td>
<td>Environment Munificence</td>
<td>Variable is constructed from ARL statistics.</td>
</tr>
<tr>
<td></td>
<td>H3b: Uncertainty in the external environment is positively related to innovation performance in the research library.</td>
<td>Environmental Uncertainty</td>
<td>Variable is constructed from Appendix C – Section C, questions 15 – 20.</td>
</tr>
<tr>
<td>RQ4. What is the effect of an ambidextrous orientation on the innovation performance of the research library?</td>
<td>H4. The extent of ambidexterity of the research library is positively associated with innovation performance.</td>
<td>Ambidextrous Orientation</td>
<td>Variable is constructed based on responses to questions regarding exploration and exploitation (Appendix C – Section D, questions 21 – 32).</td>
</tr>
<tr>
<td>RQ5. Does an ambidextrous orientation mediate the relationship between behavioral integration and innovation performance?</td>
<td>H4a. An ambidextrous orientation mediates the relationship between behavioral integration of the TMT and innovation performance.</td>
<td>To test the mediating hypothesis, both behavioral integration and the ambidextrous orientation are used as defined for RQ1 and RQ2.</td>
<td></td>
</tr>
<tr>
<td>RQ6. How do the demographics and enabler variables affect innovation performance of the research library?</td>
<td>The direct effects of demographics, enablers and controls are hypothesized in hypotheses H5a, H5b, H6a, H6b, H7, H8, &amp; H9.</td>
<td>Organization size Staff/Professional Ratio Decision Awareness Singular Leader Attitude Team Demographics -TMT Age -TMT Tenure - Educational level - Ed. Diversity (Science)</td>
<td>From ARL statistics. From survey responses From App. C-Section D Constructed from questions in App. C – Section F.</td>
</tr>
</tbody>
</table>

\(^\text{17}\) Note, that the dependent variable, innovation performance, is constructed from the question responses for each innovation, Appendix C – Section E.
Chapter Five

Methodology

Population and Sample. The Association of Research Libraries (ARL) is a nonprofit organization of 123 research libraries at comprehensive, research-intensive institutions in the U.S. and Canada that share similar research missions, aspirations, and achievements. From the population of 99 U.S. libraries, a sample of 51 libraries was created by contacting university librarians and obtaining approval for their leadership team to participate in the innovation study. These library leaders typically selected 3 or 4 members of the leadership team to participate in the innovation study. Average team size was 3.6 members including the university librarian.

Online surveys were sent to the university librarian and the library top management team for the sample of 51 research libraries. These library leaders answered survey questions regarding their attitudes toward change, the external environment, ambidexterity, the management team, organizational structure, demographics, and which innovations have been adopted by their institution (Appendix C). One of the libraries was dropped from the sample because of a survey software problem on the client’s workstation.

For the resulting sample of 50 libraries, potential non-response bias was assessed by determining if there was any significant difference in either the size of the library or the geographical region between participating and non-participating libraries. For size, an independent samples $t$ test was performed to assess whether the mean size of libraries participating in the innovation study differed significantly from the libraries that did not participate. The null hypothesis ($H_0$) for Levene’s test is the two populations –
participants and nonparticipants – have equal variance. Preliminary data screening
indicated that the variable size departed somewhat from normality but was not serious
enough to use a nonparametric test. The assumption of homogeneity of variance was
assessed using the Levene test, $F = 3.52$, $p = .064$; this indicated no significant violation
of the equal variance assumption. Therefore, the pooled variances version of the $t$ test
was used. The means of the size variable for participants and nonparticipants did not
differ significantly, $t (97) = 1.77$, $p = .08$, two-tailed. The mean for participants ($M =$
320.23, $SD = 181.05$) was about 54.44 larger than the mean for nonparticipants ($M =$
265.79, $SD = 122.55$). Therefore the null hypothesis is not rejected.

The Wilcoxon rank-sum test is a nonparametric alternative to the two sample $t$-
test. In this study, we want to test the hypothesis that the distribution of geographical
regions among the library participants is the same as the distribution in the
nonparticipating libraries. The null hypothesis ($H_0$) is that the mean ranks for the
participants and the nonparticipants are equal. The Wilcoxon Rank-Sum test indicated no
significant difference between these two groups, $W (n1 = 51, n2 = 48) = 2569.0$, $p =$
.826 (two tailed). Therefore the null hypothesis cannot be rejected. From both the
Levene and Wilcoxon tests, it can be reasonably assumed that there is no non-response
bias.
Table 3 depicts the size and institutional characteristics of the research libraries. The largest size category is in the 200 – 299 FTE range at 32%. The research libraries in this sample are predominantly part of public institutions (84.0 %) and mostly reside in urban-city environments (84.0%).

Table 3

*Size and Institutional Characteristics of Research Libraries (N=50)*

<table>
<thead>
<tr>
<th>Size (Total FTE)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 – 199</td>
<td>30.0</td>
</tr>
<tr>
<td>200 – 299</td>
<td>32.0</td>
</tr>
<tr>
<td>300 – 399</td>
<td>16.0</td>
</tr>
<tr>
<td>400 – 499</td>
<td>10.0</td>
</tr>
<tr>
<td>&gt;= 500</td>
<td>12.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institutional Characteristics</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Institution (Public/Private)</td>
<td>84.0/16.0</td>
</tr>
<tr>
<td>Region – Urban/City</td>
<td>84.0</td>
</tr>
<tr>
<td>Region - Suburb</td>
<td>10.0</td>
</tr>
<tr>
<td>Region - Town</td>
<td>6.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Figure 4 provides a bar chart showing the distribution of the research library participants across nine geographical regions.
Figure 4

Geographical Distribution of Research Library Participants (N=50)
Table 4 provides descriptive statistics for the library top management teams.

### Table 4

**Leadership Team (TMT) Demographics (N=50)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMT Age (years)</td>
<td>55.52</td>
<td>45.50</td>
<td>62.67</td>
<td>4.17</td>
</tr>
<tr>
<td>TMT Tenure in the Profession (years)</td>
<td>25.06</td>
<td>11.00</td>
<td>34.67</td>
<td>6.15</td>
</tr>
<tr>
<td>TMT Tenure in the Current Position (years)</td>
<td>7.33</td>
<td>1.20</td>
<td>20.25</td>
<td>4.40</td>
</tr>
<tr>
<td>TMT Level of Education</td>
<td>3.18</td>
<td>1.00</td>
<td>9.00</td>
<td>1.60</td>
</tr>
<tr>
<td>TMT Educational Diversity</td>
<td>1.98</td>
<td>1.00</td>
<td>4.25</td>
<td>0.63</td>
</tr>
</tbody>
</table>

*Survey Methodology.* Data for this study comes primarily from two sources – the online survey of the research library leadership team and statistics from the Association of Research Libraries. For the online survey, an invitation to participate in the innovation study was sent to the university librarians of the 99 U.S. research libraries. Of these libraries, 51 chose to participate, 28 declined and there was no response from 19 of the 20 remaining libraries. One library was excluded from participating in the study since members of this library participated in pretesting of the survey. For those participating in the innovation study, the university librarian was asked to name members of the leadership team who were familiar with the strategy and operational aspects of the library and who could participate in the innovation study. Online surveys were sent to the university librarian and the team members asking them to complete the survey within three weeks.
The survey questionnaire\textsuperscript{18} consisted of six major sections – integration of the leadership team, organizational structure, environmental uncertainty, exploration-exploitation, candidate innovations, and leadership demographics (Appendix C). The largest section dealt with candidate innovations in which two questions dealing with the decision to implement and the extent of implementation were posed for each of 32 innovations (Appendix C – Section E). The survey consisted of a total of 102 questions.

The survey was launched in April, 2012 and data collection was completed in November, 2012 with 183 surveys returned. The survey questionnaire was pretested by a mix of professional librarians who have experience as managers or members of the top management team (TMT) in a research library and LIS scholars. From this pretesting, it was estimated that respondents would require about 30 minutes to complete the survey.

SelectSurvey\textsuperscript{19} was the software used for the survey, developed by ClassApps – a private American company – and hosted by the Rutgers School of Communication and Information.

\textit{Assessing Library Innovations – Cluster Analysis}

This study focuses on technical innovations that are offered to library patrons in contrast to administrative innovations which deal with the social and administrative aspects of the institution (e.g. human resources, financial planning, and management practices). Architectural innovations are related to physical products – a category that does not readily apply to research libraries. The primary innovation characteristic of importance in this study is the incremental-radical continuum – a dimension that indicates

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{18} An html version of the survey can be viewed at http://www.scc.rutgers.edu/rjantz/innovation/innovation_survey.htm
\item \textsuperscript{19} For a description of SelectSurvey, see http://www.classapps.com/SelectSurveyNETOverview.asp
\end{itemize}
\end{footnotesize}
the magnitude of change for the library. Cluster analysis is used to classify innovations as either radical or incremental (Aldenderfer & Blashfield, 1984, Clatworthy et al., 2005).

In order to establish a reliable comparison between libraries, the process for identifying innovations will be “closed” (Damanpour & Childers, 1985). In contrast to allowing libraries to select what they consider to be innovative, the closed list approach provides a common basis for comparison and can therefore improve validity. The closed approach involves the preparation of a list of research library innovations. The library senior team will use this list to identify the innovations for which there have been a decision to adopt. An exhaustive literature review and examination of research library websites has been conducted to identify both radical and incremental innovations in university research libraries for the period 2007-2011 (Appendix A). A total of 40 innovations was identified. The relatively large number of innovations is important given earlier methodological studies indicating that a small number of innovations will not adequately portray adoption behavior in the organization under study.

The last decade of the 20th century produced significant technology advances including the Internet, the World Wide Web and major improvements in networking and storage technology. As a knowledge intensive institution, the research library has taken advantage of much of this information and communication technology. The selected time period of 2007-2011 therefore provides ample time for libraries to transfer technology from earlier periods and adapt information technology in innovative ways. An expert panel of library professionals and professors from library schools who focus on library studies was identified to evaluate the list of innovations to determine which are
radical or incremental (see panel survey questions – Appendix B)\textsuperscript{20}. Each question uses a nine-point scale, ranging from 1 (strongly disagree) to 9 (strongly agree). This more refined scale improves discrimination, enriches the possible data analyses and facilitates the calculation of co-variances. A more granular scale has also been shown to not have a negative impact on survey response rates (Coelho & Esteves, 2007). Using the results from the survey, a mean score is computed for each question related to a specific innovation. Using these scores, cluster analysis is used to identify groups of radical and incremental innovations (Aldenderfer & Blashfield, 1984; Kachigan, 1991, pp. 261-270).

Given the variability of innovation research findings, it is important to choose variables for cluster analysis within the context of explicit theory. Gatignon and colleagues (2002) have developed a comprehensive set of measures to assess innovation characteristics. These researchers found that an innovation can be uniquely described by distinguishing aspects such as product complexity (the number of its subsystems) and the innovation’s characteristics (incremental/radical, competence-enhancing, and competence-destroying). Results from this study show that an innovation can be evaluated distinctively on these various dimensions. Gatignon et al. (2002) generated a large number of items reflecting innovation types and characteristics, including nine potential variables for radicalness. Using expert evaluations and factor analysis, the Gatignon study resulted in the retention of five items for the radicalness scale. The Gatignon scale has been adapted for the study of library service innovations, resulting in five criteria that characterize library innovations (Appendix B).

\textsuperscript{20} Survey questions for assessing the radical dimension have been adapted from Gatignon, et al (2002).
In order to understand the extent of change in research libraries, this study examines which libraries have introduced both radical and incremental innovations. Since the objective is to develop two clusters, one each for incremental and radical innovations, the k-means cluster method is used. The k-means approach is an iterative method that uses a Euclidean distance metric to calculate cluster centroids and then places each case in the cluster with the nearest centroid. Intuitively, the incremental-radical designation represents a continuum in which some innovations will be more radical than others. The objective is to uncover those clusters that best represent the endpoints on this continuum. The approach used here is to generate three clusters, resulting in an incremental cluster, a radical cluster, and a third cluster in which respondents were uncertain whether the innovation was radical or incremental, termed the “middle-range” innovations.

A cluster analysis was run on the set of 40 innovations (Appendix A) with the number of clusters set to “3”, resulting in 10 radical innovations, 19 mid-range innovations, and 11 incremental innovations. The resulting cluster centers (z-scores) and the average center for each cluster are shown in Table 5. Errors reported by the ANOVA F-test indicated that the variables relating to librarian skills and the changes in the organization were not as helpful in discriminating between clusters as were the three questions relating to major improvements, innovation breakthroughs, and new knowledge.

21 IBM SPSS version 20 was used to do the cluster analysis and all of the regression analyses reported in Chapter 6.
The cluster analysis was run again using only the three most important variables – major improvement, breakthrough, and new knowledge. There was one minor change in the clusters in which one innovation moved from the mid-range to the incremental cluster, resulting in a final tally of 12 incremental innovations, 18 mid-range innovations and 10 radical innovations, and (Table 6).

### Table 5

*Cluster Centers – Three Clusters, Five Variables (N = 40)*

<table>
<thead>
<tr>
<th>The Innovation . . .</th>
<th>Clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radical</td>
</tr>
<tr>
<td>Is A Major Improvement</td>
<td>7.27</td>
</tr>
<tr>
<td>Is Considered A Breakthrough</td>
<td>6.35</td>
</tr>
<tr>
<td>Represents New Knowledge</td>
<td>6.29</td>
</tr>
<tr>
<td>Leads to Organizational Changes</td>
<td>6.40</td>
</tr>
<tr>
<td>Requires New Skills</td>
<td>6.87</td>
</tr>
<tr>
<td>Average Center</td>
<td>6.64</td>
</tr>
</tbody>
</table>

### Table 6

*Number of Innovations in Each Cluster (N = 40)*

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Number of Innovations in Each Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental Innovations</td>
<td>12</td>
</tr>
<tr>
<td>Middle-Range Innovations</td>
<td>18</td>
</tr>
<tr>
<td>Radical Innovations</td>
<td>10</td>
</tr>
<tr>
<td>Total Number of Innovations</td>
<td>40</td>
</tr>
</tbody>
</table>
The final cluster centers are shown in Table 7, indicating a monotonically decreasing score for each variable from radical to incremental. Appendix D identifies each innovation as radical, mid-range or incremental and shows the “distance” variable which indicates the proximity of each case to the centroid of its cluster group.

Table 7

Cluster Centers – Three Clusters, Three Variables (N = 40)

<table>
<thead>
<tr>
<th>The Innovation . . .</th>
<th>Clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radical</td>
</tr>
<tr>
<td>Is A Major Improvement</td>
<td>7.27</td>
</tr>
<tr>
<td>Is Considered A Breakthrough</td>
<td>6.35</td>
</tr>
<tr>
<td>Represents New Knowledge</td>
<td>6.29</td>
</tr>
<tr>
<td><strong>Average Center</strong></td>
<td>6.64</td>
</tr>
</tbody>
</table>

Several changes were made to the set of 40 innovations to arrive at the final set of 32 innovations used in this study. One radical innovation was eliminated (the creation of a publishing service in the library) because this innovation is more properly considered an administrative innovation. Only product or service innovations are considered in this study. From a methodological perspective, the mid-range innovations do not shed light on the radical-incremental continuum; however these innovations do provide insight into the total innovative capability of the library. Several of the mid-range innovations were similar (e.g. mobile access to the library OPAC and mobile access to the library website). To eliminate this redundancy and provide a more focused final survey, eleven mid-range innovations were selected from the list of 18. The final set of 32 innovations for this
study included 9 radical innovations, 11 mid-range innovations, and 12 incremental innovations (Appendix E).

**Measures**

*Major Constructs and Dependent Variable.* The major constructs for this study are defined as those independent variables that are expected to have the most impact on innovation performance as hypothesized in the model of Figure 3. To assess reliability of the major constructs, Cronbach’s alpha is reported for all scale items. Measures for demographics, enabler, and control variables are discussed in a subsequent section.

*Behavioral Integration.* Simsek and colleagues (2005) created a measure of behavioral integration that consists of three concepts: collaborative behavior, information exchange, and joint decision making (Hambrick, 1994, p. 189). Scale items were adapted from Mooney’s behavioral integration scale (2000), Eby and Dobbins (1997) leader-member exchange scale, and Seers (1989) quality of team member exchange scale. For this independent variable, a single, overall measure of behavioral integration is constructed from the resulting nine-item measure (Appendix C – Section A). The behavioral integration scale appeared to have good internal consistency, \( \alpha = 0.93 \).

*Organizational Structure.* Although a more differentiated structure can enable an organization to better manage conflicting demands (Jansen et al., 2009), the library classical structures are likely to restrict innovation.

Most university libraries have traditional structures for technical and public services. From the scale developed by Jansen et al., five questions were used to create a variable that characterizes the extent of structural differentiation. For example, one of the questions asks if the library has different units for exploratory and production activities.
Scale items have been adapted from Jansen et al. (Appendix C – Section B). The resulting scale captures the extent that leaders have partitioned their organization into separate units. For each of the scale items, a team score is computed as an average of the scores for each individual respondent. To develop an organizational score which represents the extent of structural differentiation, the mean team scores for the scale items are averaged, resulting in a final score for structural differentiation. The scale for structural differentiation had acceptable internal consistency, \( \alpha = 0.66 \).

**Environmental Uncertainty.** In accordance with Milliken (1987) and Waldman et al. (2001), *environmental uncertainty* will be captured as a perception by leaders of the university library. It is possible that a leader may not perceive a complex external environment as turbulent, resulting in the leader not taking action either to change the organization or to launch major projects. A six-item scale, adapted from Khandwalla (1976) and Koberg (1987) is used to measure environmental uncertainty. Four items were used from this scale that uniquely captures the respondent’s ability to predict various aspects of the external environment (Appendix C – Section C, questions 16 – 19). For each item, a team score is computed as an average of the scores for each individual respondent (Appendix C – Section C). To develop an organizational score which represents the team’s perception of the external environment, the mean team scores for each scale item are averaged, resulting in a final score for the research library. The scale for environmental uncertainty had acceptable internal consistency, \( \alpha = 0.71 \).

**Environmental Munificence.** In this study, *environmental munificence* is operationalized as a resource scarcity and measured by computing the percentage change
in the library’s expenditures for the period 2000 – 2009\(^{22}\). Let year 2000 expenditures = \(E_{00}\) and year 2009 expenditures = \(E_{09}\), then the formula to be used to compute the change over this period is the following:

\[
\text{Percentage Change} = \left( \frac{E_{09} - E_{00}}{E_{00}} \right) \times 100
\]

Although this indicator is usually positive, there were several ARL libraries that experienced a decline in expenditures for this period.

*Ambidextrous Orientation.* Lubatkin et al. (2006) extended He and Wong’s measures (2004) for exploratory and exploitative orientations, resulting in a six item scale for each concept. This scale has been adapted for research libraries. Sample questions for exploratory behavior include: 1) the library looks for technological ideas by thinking “outside the box”, 2) the library looks for creative ways to satisfy users’ needs, and 3) the library creates products or services that are innovative. Sample questions for exploitative behavior include: 1) the library commits to improve quality and lower costs, 2) the library continuously improves the reliability of its products and services, and 3) the library frequently conducts surveys to determine user satisfaction (Appendix C – Section D). The scale for exploration appeared to have good internal consistency, \(\alpha = 0.90\). The scale for exploitation appeared to have good internal consistency, \(\alpha = 0.87\).

Given the two dimensions of an ambidextrous orientation, various researchers have constructed measures by either subtracting, multiplying, or adding the scores for exploration and exploitation (Gibson & Birkenshaw, 2004; He & Wong, 2004; Jansen et al., 2009). In this exploratory study, both the additive and subtractive scores will be used. The theoretical rationale for this decision is that the additive score provides insight into

\(^{22}\) ARL statistics for library expenditures as a percentage of the institution’s expenditures is available at [http://www.arl.org/stats/annualsurveys/eg/index.shtml](http://www.arl.org/stats/annualsurveys/eg/index.shtml)
the commitment to both learning styles while the difference score highlights the balance between exploratory and exploitative behaviors. Cao, et al. (2009) assert that balance is more important for resource-constrained organizations, a situation that is likely to be found in research libraries. The objective here is to understand the leaders’ relative emphasis on these activities and whether or not their strategic approach does, in fact, lead to more balance between radical and incremental innovation implementation.

*Innovation Performance – the Dependent Variable.* In this study, innovation performance is constructed by taking into account the decisions to implement an innovation, the extent of implementation of the innovation, and the balance achieved between incremental and radical innovations. Innovation performance (IP) is considered to be best when there is extensive implementation of innovations and when there is a balance between radical and incremental innovations.

As reported previously, for nonprofits such as research libraries, it is important to capture not only the decision to adopt an innovation but also the extent of implementation. Regarding balance, many researchers (March, 1991; O’Reilly III & Tushman, 2004; Tushman & O’Reilly III, 1996) have emphasized the need to balance exploratory and exploitative activities with results that have been supported by empirical studies. From observations (Jantz, 2011a) and anecdotal evidence it is quite clear that the majority of research library innovations are incremental and are intended to support current products and services. Thus, the balance dimension of the IP variable is constructed to capture the concept of balance between incremental and radical innovations.
From a prepared list of radical and incremental innovations, the university library top management team indicated which of the innovations have been adopted by the library. This team was also asked to estimate the extent of implementation for each innovation (Appendix C – Section E). Respondents indicated on a nine point scale, anchored by “Not Implemented” and “Fully Implemented”, the extent to which the innovation has been implemented in their organization (Grover et al., 2007). As noted previously, the innovations are grouped into three classes – incremental, radical, and a mid-range class that lies in the middle of the continuum from incremental to radical. Scores for radical (R), incremental (I) and mid-range innovations (M) are computed for each institution by summing the implementation scores as determined from the leadership team responses. Anomalies are discarded when the TMT views are divergent regarding the decision to adopt or the extent of implementation. As an example, the score for radical innovations is determined by using the following formula: \( R = \sum (r_i \times t_i) \) (where \( r_i \) is the \( i^{th} \) radical innovation and equals 1 if a decision has been made to implement, otherwise it is zero, and \( i \) ranges from 1 to \( r \) – the total number of radical innovations that have been implemented). The value of \( t \) is the extent of implementation and is computed for each innovation from team responses to the questions in Appendix C – Section E. Similarly, scores are computed for incremental (I) and mid-range (M) innovations. Therefore total innovation (TI) takes into account both the decision to adopt and the extent of implementation and is computed as follows:

\[
TI = ((R+I+M)/\text{total score possible}) \times 100
\]

Innovation balance (B) improves as the difference between the number of radical and incremental innovations becomes less. Let \( x = \) the number of radical innovations for
which a decision has been made to implement and \( y \) = the number of incremental innovations for which a decision has been made to implement. Balance is therefore computed as a ratio using the following formula:

\[
B = \frac{\min(x,y)}{\max(x,y)}
\]

Final innovation performance (IP) is then determined by prorating total innovation by the balance ratio as follows:

**Innovation Performance (IP) = Balance (B)\*Total Innovation (TI)**

In addition to the adoption decision, innovation performance captures two distinct aspects of an innovative capability: the ability to not only initiate but also implement the innovation and the ability to achieve some degree of balance between incremental and radical innovations. The total innovation score provides an estimate of how much innovation is being conducted and balance provides an indication of the ability to carry out both radical and incremental innovations. Table 8 provides a summary of responses regarding the radical, mid-range, and incremental innovations that were implemented by the research libraries.

**Table 8**

*Innovations Implemented by Research Libraries (N=50)*

<table>
<thead>
<tr>
<th>Implementation of Radical, Mid-Range and Incremental Innovations</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radical</td>
<td>9</td>
<td>5.87</td>
<td>1.45</td>
</tr>
<tr>
<td>Mid-range</td>
<td>11</td>
<td>9.32</td>
<td>1.22</td>
</tr>
<tr>
<td>Incremental</td>
<td>12</td>
<td>8.00</td>
<td>1.41</td>
</tr>
</tbody>
</table>
Leadership Demographics and Enabler Variables. Leadership professional tenure is computed by taking the average of the number of years each TMT member has served as a professional librarian and computing one score for the TMT. Chronological age for the team is computed by taking the average of chronological age for each member of the team. The Herfindahl index is used to determine diversity in education or educational heterogeneity (Daellenbach et al., 1999). This index is defined as follows: 

\[ H = 1 - \sum p_i^2 \]  

where \( p \) is the proportion of group members in a category and \( i \) is the number of different categories (\( i \) varies from 1 to \( N \) – the total number of categories). \( H \) will vary from 0 to 1 where values closer to 1 indicate more educational diversity. In this study, \( H \) will be multiplied by 100 to provide a value between 0 and 100. Nine categories of educational level are defined for the library leadership team as follows: a) MLS only = 1, b) Master’s degree (no MLS) = 2, c) MLS plus another Master’s degree = 3, d) MLS plus significant work toward the PhD = 4, e) MLS, Master’s degree, plus significant work toward the PhD = 5, f) PhD only = 6, f) MLS and PhD = 7, g) PhD and Masters (non MLS) = 8 and h) PhD, MLS, and Masters = 9. For educational level, these same categories are used with values ranging from 1 (MLS only) to 9 (PhD, MLS, and Masters (non MLS)). An average score is computed for each team. For educational diversity (science), a variable was created which indicated the number of science degrees held by the leadership team. The variable staff/professional profile is constructed by examining the ratios for years 2004 and 2009 and recording the percentage change in this ratio for these six years. If \( R_{04} \) equals the staff FTE/professional FTE ratio for the year 2004 and \( R_{09} \) equals the staff FTE/professional FTE ratio for the year 2009, then the staff/professional profile is computed as follows:  

\[ \frac{((R_{04} - R_{09})/ R_{04})*100}. \]
The variable \textit{decision awareness} captures the leadership team’s understanding of decisions their organization has made about innovation adoptions. The importance of this concept is highly intuitive. If leaders are not aware of a decision to adopt an innovation, they are unlikely to support the innovation throughout the implementation stages, making it more difficult for the organization to successfully implement an innovation. For the 32 innovations in the survey, a percentage is calculated for those innovation decisions in which there is a consensus (i.e. all “yes” or all “no”). A higher percentage represents a leadership team with more awareness, a situation that is likely to positively affect innovation performance. The variable \textit{singular leader} is created from the university librarian’s responses to the six questions on the creativity of their library (Appendix C - Section D – Exploration). A mean response is computed from these six responses to obtain a single score for the university librarian. The scale for \textit{singular leader} appeared to have good internal consistency, $\alpha = 0.90$.

\textit{Measures - Control Variables.} In this study, certain variables can lead to alternative explanations or have an overriding effect on the dependent variables. To understand these effects, two control variables – organization size and type of institution (public or private) - are included in the research model.

Larger libraries typically have more slack resources that can be applied to major new initiatives. This imbalance can possibly obscure the effects of the major constructs. As shown in Figure 3, organizational size will be considered a control. There are several different approaches for operationalizing the \textit{size} variable. A personnel measure works best for a labor intensive, service organization whereas a volume measure is more appropriate for a manufacturing organization. Because of the curvilinear relationship
between size and innovation (Damanpour, 1992), a log transformation of total personnel will be used in this study. The natural log transformation reduces the variance in value distribution throughout the sample (Camison-Zornoza, et al., 2004). Total personnel (FTE) is taken from the annual Association of Research Libraries statistics for the academic year 2010-2011. For type of institution a dummy variable is created where a public institution is assigned the value of 1 and a private institution is assigned the value of 0.

---

Chapter Six

Analysis

Multivariate regression analysis is the primary analytic procedure used in this study. It is expected that a better overall prediction of innovation performance scores can be obtained by using multiple independent variables. In addition, the multivariate procedure allows for the control of variables that may be extraneous or have an overriding effect on the dependent variable. By controlling for certain variables, multivariate analysis can provide more reliable evidence to support the research hypotheses. The analysis for this study will be conducted in four phases: bivariate analysis, hierarchical regression analysis, a binary logistic regression analysis, and the final step which includes a mediation analysis.

Zero-order Correlations. An initial examination of zero-order correlations with innovation performance provides useful insights into the important independent variables. Interpretation of these correlations is offered in light of the theoretical model discussed in Chapter 4. Given the correlations, it may be possible to eliminate some variables that appear to have minor effects in order to develop a more parsimonious set for the final analysis. Table 9 organizes the independent variables according to the major categories of interest that are expected to impact innovation performance and reports the Pearson correlations of the independent variables with innovation performance. Means and standard deviations for all variables are presented in Appendix F. Correlations for all quantitative variables are shown in Appendix G.

In Table 9, there are significant correlations between innovation performance and two of the major factors in the research model of Figure 3 – behavioral integration and an
ambidextrous orientation. Regarding the first category of library leadership, the factors of behavioral integration, decision awareness, and singular leader attitude have positive correlations with innovation performance ($r = .33$, $r = .42$ and $r = .24$ respectively). In the category of organizational learning, an ambidextrous orientation is positively correlated with innovation performance ($r = .42$). Ambidexterity (balance) captures the difference between the exploratory and exploitative factors of ambidexterity and a larger score represents those libraries that are less able to simultaneously conduct both exploration and exploitation activities. As expected from the theoretical model, this factor is negative and also significant ($r = -.36$). There are four independent variables related to the structure of the organization. Organizational size is positively related to innovation performance ($r = .35$) and structural differentiation is negatively related ($r = -.22$) but not significant. Staff/professional profile and affluence (expenses per student) are not significantly correlated with innovation performance. For the external environment, the factors for environmental munificence (change in expenditures) and environmental uncertainty do not have significant correlations with innovation performance.

Preliminary observations are useful at this juncture. Significant correlations exist in the hypothesized directions for the two major constructs in the research model of Figure 3 – behavioral integration and ambidextrous orientation. The enabler variables – decision awareness and singular leader attitude – are significant and positive. However, both environmental munificence and environmental uncertainty appeared to have little impact on innovation performance. What is unexpected and will be discussed further is the lack of any significant correlation for those independent variables in the demographic
and education categories. The demographic variables (TMT age, tenure in the profession, and tenure in position) showed a very small correlation with innovation performance. For education, educational diversity had a small negative correlation with innovation performance. A second educational diversity measure was constructed by examining those TMTs whose members held science degrees. It was hypothesized that more science education would benefit innovation performance since many library innovations emerge from science and technology related efforts. Educational diversity (science) has a small, positive correlation with innovation performance ($r = .08$). Educational level showed a small negative correlation with innovation performance ($r = -.10$), opposite to the direction that was hypothesized.
Table 9

Zero-order Correlations of Predictors with Innovation Performance (N=50)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Correlation with Innovation Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team Behavior and Leadership</strong></td>
<td></td>
</tr>
<tr>
<td>Behavioral integration</td>
<td>0.33a</td>
</tr>
<tr>
<td>Decision awareness</td>
<td>0.42a</td>
</tr>
<tr>
<td>Singular leader attitude</td>
<td>0.24b</td>
</tr>
<tr>
<td><strong>Organizational Learning</strong></td>
<td></td>
</tr>
<tr>
<td>Ambidextrous orientation</td>
<td>0.42a</td>
</tr>
<tr>
<td>Ambidexterity (balance)</td>
<td>-0.36a</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>0.35a</td>
</tr>
<tr>
<td>Structural differentiation</td>
<td>-0.22</td>
</tr>
<tr>
<td>Staff/professional profile</td>
<td>0.08</td>
</tr>
<tr>
<td>Affluence (expense per student)</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Environmental munificence (change in expenditures)</td>
<td>0.22</td>
</tr>
<tr>
<td>Environmental uncertainty (unpredictability)</td>
<td>.11</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td>TMT age</td>
<td>.03</td>
</tr>
<tr>
<td>TMT professional tenure</td>
<td>-0.02</td>
</tr>
<tr>
<td>TMT tenure in position</td>
<td>-0.04</td>
</tr>
<tr>
<td><strong>Educational Level and Diversity</strong></td>
<td></td>
</tr>
<tr>
<td>TMT level of education</td>
<td>-0.10</td>
</tr>
<tr>
<td>TMT educational diversity</td>
<td>-0.11</td>
</tr>
<tr>
<td>TMT Educational diversity (science)</td>
<td>0.08</td>
</tr>
</tbody>
</table>

a Significant (1-tailed) at .01 level, b Significant at .05 level
c Institutional type is a dummy variable (0 = private, 1 = public). Correlations, means and standard deviations are not reported for this variable.
Regression Analysis. The research model consists of the four major constructs and a set of variables organized into three classes: demographics, enablers, and control variables. As such, there are 17 independent variables reported in Table 9 that were initially indentified as possibly impacting innovation performance.

In the first step of the regression, the analysis was limited to the expected best predictors based on the theoretical model and the preliminary correlation analysis. The results are reported in Tables 10 and 11. Additional predictors are then brought into subsequent regressions and the respective $t$-values and $R^2_{inc}$ values are evaluated to determine how they contribute to the overall model (Table 12). Adding variables to the regression equation that do not explain innovation performance will reduce the values for adjusted $R^2$ and the standard error of residuals by reducing the degrees of freedom.

Prior to undertaking the regression analysis, preliminary data screening was conducted. Histograms for each independent variable and the dependent variable indicate that the univariate distributions were reasonably normal and that there were no extreme outliers. Variances in scores on each variable are approximately the same across scores on other variables – the homogeneity of variance assumption. Scatter plots between every pair of variables revealed linear relationships and in most cases no extreme bivariate outliers. However, the data for three libraries revealed bivariate outliers with respect to behavioral integration and structural differentiation and were not included in the regression analysis, resulting in a sample for analysis of 47 libraries.

In this study, we want to understand how well innovation performance can be predicted by the complete set of independent variables and how much variance is predicted uniquely by each independent variable when the contributions of other
predictor variables are statistically controlled. In sequential regression analysis (Warner, 2013, pp 579-584), the independent variables are entered into the analysis in a sequence of blocks, each block containing one or more variables. In each step, the effect size that describes the unique contribution of each variable is adjusted to partial out or control for any linear association of this variable with predictor variables that have been entered previously. The order of entry is determined based on the theoretical model and the results from exploratory analysis. In this study, the size of the organization and the type of institution are considered controls and entered first. As illustrated in Table 10, the controls (size, institutional type) and predictors for behavioral integration, structural differentiation, decision awareness, and an ambidextrous orientation are entered as separate models into the regression analysis.

In SPSS, zero-order, part, and partial correlations are requested for each independent variable with the dependent variable – innovation performance. Partial correlation represents the relationship between the dependent variable (DV) and an IV when the relationship between the DV and other IVs has been removed or partialed out from the variance of both the IV and the DV. Part correlation is the portion of the total variance in the DV that is contributed by the IV. The square of part correlation is the amount of change attributed to $R^2$ by including this variable. The standard error of residuals is the standard deviation of the DV about the regression plane. The residuals can represent other factors, apart from the variable under consideration, that are influencing innovation performance. In the regression analysis, residuals should be reasonably small since they represent the part of innovation performance that is not predicted by the independent variables.
For each model in Table 10, the null hypothesis states that the change in $R^2$ (contribution of this block to the variance in the DV) is zero when the variable is first entered into the regression ($H_0: R^2_{\text{inc}} = 0$). The baseline model (Model 1) introduces the control variables into the regression. Models 2 – 5 include the direct effects of the independent variables. For the overall model, the F value is examined for the final step in the sequential regression. If $p$ is less than the predetermined alpha level (typically .05), the overall regression is considered significant.

Results. Sequential multiple regression was performed in which each of the major predictors was entered in a single block. Table 10 provides a summary of $R^2$ and $R^2$ changes for each step in the sequential regression.
Table 10

*Model Summary of $R^2$ and $R^2$ Changes (N=47)*

<table>
<thead>
<tr>
<th>Predictors Included</th>
<th>R for Model</th>
<th>$R^2$ for Model</th>
<th>Adjusted $R^2$</th>
<th>F for Model</th>
<th>$R^2$ Change</th>
<th>F for $R^2$ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1 – Controls (size and institution)</td>
<td>.428</td>
<td>.184</td>
<td>.146</td>
<td>F(2,44) = 4.95*</td>
<td>.184</td>
<td>F(2,44) = 4.95*</td>
</tr>
<tr>
<td>Model 2 – Controls, Behavioral integration (BI)</td>
<td>.520</td>
<td>.271</td>
<td>.220</td>
<td>F(3,43) = 5.32**</td>
<td>.087</td>
<td>F(1,43) = 5.13*</td>
</tr>
<tr>
<td>Model 3 – Controls, BI, Structural differentiation (SD)</td>
<td>.593</td>
<td>.351</td>
<td>.290</td>
<td>F(4,42) = 5.69**</td>
<td>.081</td>
<td>F(1,42) = 5.21*</td>
</tr>
<tr>
<td>Model 4 – Controls, BI, SD, Decision awareness (DA)</td>
<td>.648</td>
<td>.420</td>
<td>.350</td>
<td>F(5,41) = 5.95***</td>
<td>.069</td>
<td>F(1,41) = 4.88*</td>
</tr>
<tr>
<td>Model 5 – Controls, BI, SD, DA, Ambidextrous orientation (AO)</td>
<td>.699</td>
<td>.488</td>
<td>.411</td>
<td>F(6,40) = 6.36***</td>
<td>.068</td>
<td>F(1,40) = 5.29*</td>
</tr>
</tbody>
</table>

*p<.05,** *p<.01,** ***p<.001

The overall regression, including the two controls and the four predictor variables, was statistically significant, $R = .70, R^2 = .49$, adjusted $R^2 = .41, F(6,40) = 6.36, p < .001$ (Table 10, Model 5). The $R^2$ value indicates how much variance in the dependent variable can be explained by variation in the independent variables. The overall model (model 5) indicates that 49% of the variation in research library innovation performance
can be explained by the controls and the four predictor variables. After controlling for size, the four predictor variables contribute almost equally to the variance in innovation performance.

To assess the contributions of individual predictors, the $t$ ratios for the individual regression slopes are examined for each variable in the step in which it was first introduced into the analysis. The $F$-ratio is a measure of the variation explained by the model and the variation explained by unsystematic factors (Field, 2005, p. 323). When a variable produces little or no increase in $R^2$, the $F$-value may go down because of the loss of degrees of freedom. In Table 1, the $t$-values of the five best predictors are reported.

In step 1 (model 1), organizational size was statistically significant, $t (44) = 3.11$, $R^2_{\text{inc}} = 0.184$. The relationship of size to innovation performance is positive and was expected. In model 2, behavioral integration was significant and had a positive relationship to innovation performance as predicted in the research model of Figure 3, $t (43) = 2.26$, $R^2_{\text{inc}} = 0.087$. For model 3, structural differentiation had a significant and negative relationship to innovation performance as indicated in the research model, $t (42) = -2.29$, $R^2_{\text{inc}} = 0.081$. In model 4, decision awareness had a significant and positive relationship to innovation performance, $t (41) = 2.20$, $R^2_{\text{inc}} = 0.069$. For model 5, an ambidextrous orientation had a significant and positive relationship to innovation performance, $t (40) = 2.30$, $R^2_{\text{inc}} = 0.068$. Except for structural differentiation which is negatively related to innovation performance, the slopes of the other four predictors were positive. The regression coefficients (Table 11) indicate the “size” of the effect on innovation performance for each predictor variable.
Table 11

*t-values for the Five Best Individual Predictors (N=47)*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Un-standardized Regression Coefficient</th>
<th>Standardized Regression Coefficient</th>
<th>t-Value</th>
<th>p-Value</th>
<th>R²_increment</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational size (model 1)</td>
<td>25.67</td>
<td>.42</td>
<td>t(44) = 3.11</td>
<td>.003**</td>
<td>.184</td>
<td>.184</td>
</tr>
<tr>
<td>Behavioral integration (model 2)</td>
<td>4.59</td>
<td>.32</td>
<td>t(43) = 2.26</td>
<td>.029**</td>
<td>.087</td>
<td>.271</td>
</tr>
<tr>
<td>Structural differentiation (model 3)</td>
<td>-4.88</td>
<td>-.29</td>
<td>t(42) = -2.29</td>
<td>.027**</td>
<td>.081</td>
<td>.351</td>
</tr>
<tr>
<td>Decision awareness (model 4)</td>
<td>0.37</td>
<td>.33</td>
<td>t(41) = 2.20</td>
<td>.033**</td>
<td>.069</td>
<td>.420</td>
</tr>
<tr>
<td>Ambidextrous orientation (model 5)</td>
<td>2.62</td>
<td>.35</td>
<td>t(40) = 2.30</td>
<td>.027**</td>
<td>.068</td>
<td>.488</td>
</tr>
</tbody>
</table>

*p < .10, **p < .05, ***p < .01

From the results in Tables 10 and 11, we can assume that innovation performance in research libraries can be reasonably well predicted from these five variables. Additional regression analyses were done to determine what other variables might have significant impact on innovation performance and could improve the overall model (Miller, 1984). Table 12 summarizes the analyses in which different variables are brought into the regression equation.
Table 12

*t-Values for Selected Independent Variables (N=47)*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>1 t-value</th>
<th>2 t-value</th>
<th>3 t-value</th>
<th>4 t-value</th>
<th>5 t-value</th>
<th>6 t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Size</td>
<td>3.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.11&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Behavioral integration</td>
<td>2.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.26&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Structural differentiation</td>
<td>-2.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.29&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Decision awareness</td>
<td>2.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.20&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ambidextrous orientation</td>
<td>2.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.30&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Affluence</td>
<td>-1.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-1.65</td>
</tr>
<tr>
<td>Staff/professional profile</td>
<td></td>
<td>0.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singular leader</td>
<td></td>
<td></td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental munificence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>Environmental uncertainty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.09</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.49</td>
<td>0.52</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
<td>0.54</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.41</td>
<td>0.44</td>
<td>0.40</td>
<td>0.41</td>
<td>0.41</td>
<td>0.44</td>
</tr>
</tbody>
</table>

<sup>a</sup> Significant at .01 level, <sup>b</sup> Significant at .05 level, <sup>c</sup> Significant at .10 level
It should be noted that the regression in column 6 of Table 12 shows a marginal improvement in $R^2$ and the standard error of the estimate. However, the two added variables for this model (affluence and environmental uncertainty) are not significantly related to innovation performance. By adding affluence and environmental uncertainty to the equation, the overall model from column 6 accounts for 54 percent of the variation in innovation performance ($R^2 = .54$, adjusted $R^2 = .44$).

**Binary Logistic Regression (BLR).** Binary logistic regression provides an approach for assessing the adequacy of the model achieved through multiple regression. In BLR, the outcome variable is dichotomous, allowing the researcher to predict membership in a target group. In this study, the target groups are identified as the innovative libraries and the non-innovative libraries. The dependent variable, innovation performance, is dichotomized based on the mean of innovation performance to arrive at two groups. From the regression analysis, the set of five predictor variables from the best model were used in the logistic regression. In BLR, we can determine whether the association of each variable is significant in predicting the odds of a research library being innovative. The classification table will also tell us the percentage of libraries that have been correctly classified as being innovative.

A binary logistic regression analysis was performed to predict which research libraries were innovative. The outcome variable was coded as follows: 0 = non-innovative and 1 = innovative. Five quantitative predictor variables were included in the BLR model – organizational size, behavioral integration, structural differentiation, decision awareness, and an ambidextrous orientation. A test of the full model with the five predictors compared with a constant-only model was statistically significant with
$\chi^2(5) = 15.248, p < .01$. The Cox and Snell $R^2$ of .277 and the Nagelkerke $R^2$ of .371 indicate a moderate association between innovation and the five predictor variables. The classification table (Table 13) displays the percentage of research libraries correctly classified as innovative as 84.6%; the percentage of research libraries correctly classified as non-innovative was 71.4%. The overall correct percentage was 78.7%.

**Table 13**

*Classification Table for Innovative/Non-Innovative Research Libraries (N=47)*

<table>
<thead>
<tr>
<th>Classification Table$^a$</th>
<th>Observed</th>
<th>Predicted</th>
<th>Percentage Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Research Libraries</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-innovative</td>
<td>Innovative</td>
<td></td>
</tr>
<tr>
<td>Step 1 Research Libraries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-innovative</td>
<td>15</td>
<td>6</td>
<td>71.4</td>
</tr>
<tr>
<td>Innovative</td>
<td>4</td>
<td>22</td>
<td>84.6</td>
</tr>
<tr>
<td>Overall Percentage</td>
<td></td>
<td></td>
<td>78.7</td>
</tr>
</tbody>
</table>

$^a$. The cut value is .500

Of the five variables entered in the logistic regression, the two variables with significant coefficients were an ambidextrous orientation and structural differentiation. The binary logistic model for predicting innovation from an ambidextrous orientation and structural differentiation is reported in Table 14.
Table 14  
Model Summary for Binary Logistic Regression to Predict Innovation (N=47)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B Coefficient</th>
<th>Wald $\chi^2$</th>
<th>Degrees of Freedom</th>
<th>Significance</th>
<th>Exp(B)</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambidextrous orientation</td>
<td>0.687</td>
<td>4.925</td>
<td>1</td>
<td>.026</td>
<td>1.987</td>
<td>.122</td>
<td>.953</td>
</tr>
<tr>
<td>Structural differentiation</td>
<td>-1.074</td>
<td>4.208</td>
<td>1</td>
<td>.040</td>
<td>0.342</td>
<td>1.084</td>
<td>3.645</td>
</tr>
</tbody>
</table>

The Exp (B) indicates, for each one unit change in the predictor variable, how much change can be predicted in the odds of a library being innovative. The Exp (B) for an ambidextrous orientation was 1.987 indicating that for a one point increase in ambidexterity, the predicted odds of a library being innovative were almost doubled. Since Exp (B) is less than one for structural differentiation, the odds of being innovative decrease as the scores for structural differentiation increase. The predicted probabilities from the regression equation for being innovative are shown in tabular form in Table 15. Figures 6 and 7 provide a graphical perspective on how the innovative and non-innovative libraries are distributed across the ten probability ranges.
Table 15

*Predicted Probabilities for Innovative and Non-Innovative Libraries (N=47)*

<table>
<thead>
<tr>
<th>Probability</th>
<th>Non-Innovative</th>
<th>Innovative</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; .1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>.1 &lt; p &lt;= .2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>.2 &lt; p &lt;= .3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>.3 &lt; p &lt;= .4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>.4 &lt; p &lt;= .5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>.5 &lt; p &lt;= .6</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>.6 &lt; p &lt;= .7</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>.7 &lt; p &lt;= .8</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>.8 &lt; p &lt;= .9</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>.9 &lt; p &lt;= 1.0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>
Figure 5

Predicted Probabilities for Non-Innovative Libraries (N=21)

(There were zero cases in the following probability ranges: .4 < p < .5 and .9 < p < 1.0)

Predicted Probabilities for Non-innovative Libraries (N=21)
From Figure 6, it can be observed that the majority of innovative libraries have predicted probabilities of being innovative in the range of .5 to 1.0.

From the classification table, 78.7% of the observations were correctly classified. Although this percentage appears quite good, it must be acknowledged that the same data used to create the model was also used to evaluate the predictability of the model. A better procedure would have involved gathering new data from other research libraries.
and applying the model to see how it performs. Given the complications in getting additional data, this approach is beyond the scope of this study. Simonoff (2012) and Garson (2012) offer some basic diagnostic procedures that provide more insight as to the predictive effectiveness. A very basic diagnostic provides a lower bound by assuming that every observation comes from the larger group of either observed successes or failures. The correct lower bound percentage \( C_{LB} \) is calculated as follows: 

\[
C_{LB} = \max \left( \frac{21}{47}, \frac{26}{47} \right) \times 100 = 55.3\%.
\]

The observed correct percentage of 78.7% is considerably larger than this estimate, supporting the usefulness of the logistic regression. A second heuristic builds on the notion that the regression would have no power if the actual group observation is independent of the predicted group. By multiplying the probabilities of success for these two groups (from Table 14), we can obtain a percentage for observations classified correctly by random chance. This computation is as follows:

\[
\Pr (\text{actual group success}) \times \Pr (\text{predicted group success}) = \left( \frac{26}{47} \right) \times \left( \frac{28}{47} \right) \times 100 = 33.0\%
\]

A similar computation can be done for failures as follows:

\[
\Pr (\text{actual group failure}) \times \Pr (\text{predicted group failure}) = \left( \frac{21}{47} \right) \times \left( \frac{19}{47} \right) \times 100 = 18.1\%
\]

Thus, assuming that the logistic regression had no predictive power for the actual group success or failure, one would expect that 51.1% of the observations (i.e. 33.0 + 18.1) would be correctly classified. Finally, Simonoff recommends that this percentage be inflated by 25% to adjust for the data being used twice. This computation yields a final diagnostic estimate of 63.9% (i.e. 1.25 * 51.1). The observed correct classification of 78.7% is considerably higher than this percentage, suggesting that the logistic regression
is performing considerably better than what one would expect from random classifications.

*Mediation Analysis.* As illustrated in Figure 3, it is hypothesized that an ambidextrous orientation mediates the relationship between behavioral integration and innovation performance. For mediation to occur, it must be shown that there is a possible causal sequence that makes sense. As reported earlier, one would expect a more integrated team to develop before the TMT could support an ambidextrous orientation. Intuitively, behavioral integration would likely be developed by the TMT well before there is evidence of the more sophisticated ambidexterity, thus making a causal relationship possible. The rationale is that supporting both exploratory and exploitative activities represents a new experience for the research library and it is likely to cause conflict as the team debates the tradeoffs between supporting new services and continuing to support traditional services. New organizational structures and revised strategies resulting in more ambidexterity will challenge existing authority and embedded power structures. A more integrated and collaborative senior team will be able to cope with these challenges better than the less integrated team.

To show that an ambidextrous orientation (AO) mediates the relationship between behavioral integration (BI) and innovation performance (IP), we must first show that BI is significantly related to IP and also that BI is significantly related to AO. Two additional steps are needed. First, while controlling for BI, it must be shown that there is a significant relationship between AO and IP. Secondly, while controlling for AO, the association between BI and IP is significantly decreased.
A mediation analysis was performed using the Baron and Kenny (1986) causal steps approach. The initial causal variable is BI and the outcome variable is IP and the proposed mediating variable is AO. Preliminary data screening suggests that there are no serious violations of normality or linearity. The total effect of BI on IP was significant, \( c = 4.456, t(49) = 2.447, p < .05 \). BI was significantly predictive of the mediating variable AO, \( a = 1.128, t(49) = 5.677, p < .001 \). When controlling for BI, AO was significantly predictive of IP, \( b = 2.583, t(49) = 1.014, p < .05 \). The estimated direct effect of BI on IP while controlling for AO was \( c' = 1.542, t(49) = 0.675, p > .10 \). Given that both the \( a \) and \( b \) paths are statistically significant and \( c' \) (controlling for AO) is significantly reduced and no longer statistically significant, this test has passed the criteria established by Baron and Kenny (1986) and AO can be considered a mediator of the relationship between BI and IP. Figure 7 displays the un-standardized coefficients for the variables in the mediation analysis. When the variables are measured in different units, the un-standardized coefficients may not be very informative. The standardized coefficients for the paths BI/AO/IP are shown in Figure 8.

For the standardized coefficients, the unit-free strength of the mediated relationship is estimated by the product of the \( a \) and \( b \) coefficients \((a \times b)\), in this case \(0.634 \times 0.344 = 0.218\). Therefore, for a one-standard deviation in BI, we can predict a 0.218 increase in IP. The direct or remaining effect of BI on IP when controlling for AO is 0.115. The total effect on IP is the sum of the direct and mediated effects, \( c' + a \times b = 0.115 + 0.218 = 0.333\). This result indicates that mediation explains a significant part of the total effect of behavioral integration on innovation performance.
**Figure 7**

*Un-standardized Path Coefficients for the BI/AO/IP Mediation Analysis (N=50)*

![Diagram](image)

- $a = 1.128^{***}$
- $b = 2.583^{**}$
- $c = 4.456^{**}$
- $c' = 1.542$

`$p < .10$ level, $^{**} p < .05$ level, $^{***} p < .01$ level`

**Figure 8**

*Standardized Path Coefficients for the BI/AO/IP Mediation Analysis (N=50)*

![Diagram](image)

- $a = 0.634^{***}$
- $b = 0.344^{**}$
- $c = 0.333^{**}$
- $c' = 0.115$

`$p < .10$ level, $^{**} p < .05$ level, $^{***} p < .01$ level`
Chapter Seven

Discussion

Overview. In the research model of Figure 3, we have argued that behavioral integration, an ambidextrous orientation, structural differentiation, and environmental dynamism will have a significant impact on innovation performance in research libraries. Of these major factors, the regression results have shown that behavioral integration, an ambidextrous orientation, and structural differentiation all significantly impact the innovation performance of the research library. The impact of environmental dynamism was not significant.

We also acknowledged that this study might reveal other factors that were not part of the original research model. For example, during the data collection process, it was evident that many librarians were confused about whether a decision had been made regarding a specific innovation. This observation led to the creation of the independent variable, decision awareness, which has been shown to have a positive impact on innovation performance. The regression results of the previous section also demonstrate that there are many variables impacting innovation, many of which contribute a relatively small amount to the change in variance of the dependent variable. The research questions, hypotheses, and unexpected results will be discussed further in the following sections. Each of the five models of Table 11 are discussed; the null hypothesis for each model is that $R^2_{inc}$ is zero ($H_0: R^2_{inc} = 0$).

Discussion - Research Questions, Hypotheses, and Regression Models. Referring to the model summary of Table 10 and the more detailed results of Table 11, model 1 (controls) is statistically significant ($p < .05$) and indicates that organizational size...
positively affects innovation performance, \( t (44) = 3.11, p < .01, R^2_{inc} = .184 \).

Institutional type was not significant \( (t (45) = -0.22, p > .10, \) not shown in Table 11), however the negative slope suggests that libraries in private institutions may be a bit more innovative than libraries in public institutions.

It is useful to examine the size-innovation relationship a bit more closely. Organizational size is identified in Figure 2 as one of the major components of the library structure that affects innovation. As reported earlier in Table 1, the size-innovation relationship has varied considerably over the course of many studies of different types of organizations. For nonprofits such as schools, libraries, and hospitals (Baldridge & Burnham, 1975; Damanpour & Childers, 1985; Kimberly & Evanisko, 1981), size has been shown to be positively related to innovation, however Daft and Becker’s study (1978, p. 60) of high school districts did not show a positive relationship. More recently, an extensive meta-analysis (Camisón-Zornoza, et al., 2004) of 53 empirical studies appears to confirm a more enduring positive relationship between size and innovation.

Although size was not a major focus of the theoretical model in this study, the positive effect on innovation was expected. In many informal discussions, library leaders and scholars have generally suggested that organizational size is a dominant factor in affecting innovation. The typical explanation is that large organizations have more slack resources and are therefore able to undertake more risky projects without jeopardizing current services.

However, others have suggested that the small library might have fewer bureaucratic obstacles to overcome and therefore is more flexible and able to address major change more quickly. Given the unique nature of the research library, it is useful
to probe this result in somewhat more detail. There were seven research libraries with less than 200 FTE that scored above the mean on innovation performance – the small library innovators. For this small group, one predictor variable – environmental uncertainty – seemed to stand out. By comparing means (Table 16), it appears that the small library innovators viewed their environment as more uncertain than the sample population. Environmental uncertainty was created as a subjective variable which captured perceptions of the library leaders regarding their ability to predict certain aspects of the external environment such as government impact or budget. It is noteworthy that environmental uncertainty is highly correlated with innovation performance in this small group ($r = .75, p < .05$). It is possible that these library leaders might view their organizations as more vulnerable which accounts for this heightened environmental uncertainty. As the theory suggests, this uncertainty can prompt leaders to take action to address the uncertainty by creating new positions or units.

**Table 16**

**Small Library Innovators**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Small Library Innovators (N=7)</th>
<th>Full Sample (N=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean for Small Sample</td>
<td>Correlation with Innovation Performance</td>
</tr>
<tr>
<td>Innovation performance</td>
<td>44.63</td>
<td>1.0</td>
</tr>
<tr>
<td>Environmental Uncertainty</td>
<td>5.18</td>
<td>0.75*</td>
</tr>
<tr>
<td>(unpredictability)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Correlation significant (1-tailed) at .05
Model 2 added the effect of behavioral integration while controlling for size and the type of institution. Model 2 is statistically significant ($p < .01$) indicating that behavioral integration has a positive impact on innovation performance as hypothesized, $t(43) = 2.26, p < .05, R^2_{inc} = .087$ (Table 11). Hypothesis H1, which proposed that behavioral integration is positively related to innovation performance, was supported and the null hypothesis ($H_0: R^2_{inc} = 0$) is rejected.

As originally hypothesized, the rationale for this result originates with the leadership team’s ability to collaborate and to share information. In joint decision making, the TMT becomes aware of the decision made by the team and the complete team is more able to support the innovation throughout the innovation stage and introduction to the user community. Information sharing can result in new ideas that can ultimately become innovations. Leaders in a behaviorally integrated team are not likely to withdraw into their own domains where incremental improvements to existing services are the prevailing mode of innovation. This more integrated behavior is especially significant in relation to radical innovations and effecting major change in the organization. As Hambrick (1994, p. 200) has proposed, the less integrated team will be slower in the implementation of organizational-wide strategic changes. It is in these types of changes that collaboration becomes very important.

Although behavioral integration had a positive and significant impact on innovation performance, the resultant contribution to $R^2$ was not as large as expected. This result might be expected given the three components of the behavioral integration scale. For research libraries and the leadership team, the components of the scale that focus on collaboration and joint decision making are most important for impacting
technical innovations. In this respect, it is useful to take note of the types of services that are offered by research libraries. In order to deliver high quality service to the client, the leaders of the various units – technical and public services – must collaborate since there are extensive interdependencies among these units. In contrast, in a for-profit firm with a highly diversified portfolio, the relatively autonomous units would not require a high degree of collaboration. On the other hand, the component of behavioral integration related to information sharing might not be as important in this study of technical innovations. It is likely that ideas for new technical innovations do not routinely originate with the leadership team. One might expect a stronger relationship with this information sharing component if we were to examine administrative innovations which are usually instigated by the leaders and managers of the organization.

Model 3 added the effect of structural differentiation while controlling for size, type of institution, and behavioral integration. Model 3 (Table 11) is statistically significant ($p < .01$), indicating that structural differentiation has a negative impact on innovation performance as hypothesized, $t (42) = -2.29, p < .05, R^2_{inc} = .081$. Hypothesis H2, which proposed a negative relationship between structural differentiation and innovation performance, was supported and the null hypothesis (H0: $R^2_{inc} = 0$) is rejected.

To explain the negative impact of structural differentiation on innovation performance, it is necessary to discuss the differing perspectives regarding organizational structure. The classical view has found that organizational complexity will positively affect innovation (Hage & Aiken, 1970, pp. 33-38; Hage & Dewar, 1973) where complexity is operationalized as the number of different units in an organization or the number of different occupational specialties. Duncan’s theory of ambidexterity posits a
slightly different perspective, suggesting that different organizational structures are
needed in the different stages of innovation diffusion. During the early initiation stage,
less structure in the organization facilitates the free flow of ideas. During the
implementation stage more structure is needed to support the processes and schedules
that will produce a high quality, timely product for the user community. Jansen et al.
(2009) utilize the concept of structural differentiation – the subdivision of organizational
tasks into different units – to propose that ambidextrous organizations buffer their
exploratory work from exploitative activities by physically separating these capabilities
across multiple units. These observations present three possibilities for how libraries
might structurally organize: 1) different structures are created for the different stages of
innovation diffusion, 2) more autonomous units are created for conducting exploratory
work, or 3) exploratory activities are conducted within the traditional units of the library.
There are two more dimensions to the structure conundrum that must be brought into the
discussion. Obviously, the type and function of different units will affect the innovative
capacity of the organization. If special units are created to explore new opportunities and
these units have some autonomy from those units supporting current services, then the
organization may be able to create new knowledge and ideas. However, these new ideas
need to be integrated into the decision and implementation stages in the innovation
diffusion process. New ideas and functionally different units can create conflict and
tension within the organization and can represent a challenge to established power
structures. In this more dynamic environment, the leadership team becomes essential to
champion new ideas, facilitate the innovation process, provide psychological protection
to unorthodox thinkers, and, finally, to explain to the organization that conflict is a normal part of the process and should be accepted as such.

Thus, two possible explanations can be offered for the negative slope for structural differentiation. As Budd has indicated (2012, pp. 104-109), most academic libraries still retain the traditional structures—public services, collections, technical services—that have served them well throughout the 20th century. First, these classical structures will limit innovation to the specific activities and services that are offered by that unit. It would be unusual for library staff to develop new knowledge to apply to a service provided by another unit. As a consequence, radical innovations and the associated new knowledge are not likely to be disseminated throughout the organization. If a librarian or staff member develops a new idea, it typically enhances capabilities within their unit. Secondly, these classical structures are typically bound together in a centralized organization in order to provide high quality, existing services. Exploratory work that might lead to radical new innovations requires a degree of autonomy from this centralized organization. Some of the research libraries did indicate that their exploratory and production services are structurally separated. If these non-traditional units are able to generate new ideas, it will likely remain difficult in a classical structure for library leaders to move any of these new ideas into the decision and implementation process.

These classical structures not only limit the spread of knowledge throughout the organization, but also restrict new knowledge coming into the organization. Of the 15 libraries that indicated that they did have separate units for R&D work24, only eight of these libraries scored about the mean for innovative performance. Although it is difficult

---

24 This determination was made by identifying those libraries in which at least one leader responded with either an 8 or 9 on the Likert scale for question 10, Appendix C – Section B.
to draw any conclusions from this observation, it does suggest that research libraries are beginning to restructure in order to support more exploratory work, but are having difficulty utilizing exploratory results in the more traditional units of the institution.

Model 4 added the effect of decision awareness while controlling for size, type of institution, behavioral integration, and structural differentiation. Model 4 (Table 11) is statistically significant ($p < .001$), indicating that decision awareness has a negative impact on innovation performance as hypothesized, $t (41) = 2.20, p < .05$, $R^2_{inc} = .069$. Hypothesis H7, which proposed that decision awareness would be positively related to innovation performance, was supported and the null hypothesis ($H_0: R^2_{inc} = 0$) is rejected.

In the innovation diffusion process of Figure 1, the decision stage focuses on the choice to implement or not to implement an innovation (Duncan, 1976, p. 169). In this study, library leaders were presented with a list of 32 innovations and asked to indicate if their institution had made a decision to implement. The decision awareness variable was created based on whether the library TMT had arrived at a consensus regarding the decision to implement. Although this variable was not one of the four major factors in the research model of Figure 3, decision awareness was identified as an enabler variable. There are several explanations for why decision awareness has a significant, positive impact on innovation performance. First, decision awareness is related to behavioral integration ($r = .38$), however it represents a different aspect of the leadership team. In most complex social organizations, it is difficult to establish clarity about a decision. Leaders may leave a meeting with quite different views about whether or not a decision has been made to implement an innovation. The decision awareness predictor provides insight as to how well an organization can establish clarity regarding a decision and how
effectively it can communicate the decision within the TMT and to the larger organization. Secondly, the impact of decision awareness on innovation is quite obvious. For innovations to succeed, leaders in the library must provide their full support. Obviously, an innovation will not garner much support if organizational members are not aware that a decision has been made. Uncertainty in the leadership team regarding the decision to implement will surely affect aspects of the implementation process such as obtaining resources, especially if those resources are to be drawn from another unit. Further, if there are political differences within the team, uncertainty about a decision provides a convenient excuse for not supporting the innovation.

Model 5 added the effect of an ambidextrous orientation while controlling for size, type of institution, behavioral integration, structural differentiation, and decision awareness. Model 5 (Table 11) is statistically significant \(p < .001\), indicating that an ambidextrous orientation has a positive impact on innovation performance as hypothesized, \(t(40) = 2.30, p < .05, R^2_{\text{inc}} = .068\). Hypothesis H4, which proposed that an ambidextrous orientation would be positively related to innovation performance, was supported and the null hypothesis \(H_0: R^2_{\text{inc}} = 0\) is rejected. In addition, a separate mediation analysis was conducted (Figure 7) which provided strong evidence that an ambidextrous orientation mediated the relationship between behavioral integration and innovation performance. As a result hypothesis H4a was also supported. These findings have significant implications for practitioners and will be discussed further in Chapter 8.

For the ambidextrous orientation, this study used a scale developed by Lubatkin et al. (2006). The questions posed to the library leaders enabled them to express their views on their organization’s ability to conduct both exploratory and exploitative activities. In a
sense, these perspectives create a picture of the organization’s current status and also a strategy that the leadership team would like to pursue. The regression results do, in fact, demonstrate that a more ambidextrous orientation does lead to improved innovation performance and the ability to implement both radical and incremental innovations. What is not revealed in this study is how these leaders are achieving the ambidextrous orientation. Given the traditional structures in research libraries, it is likely that the more exploratory work is carried out within the traditional structures of the library rather than in a more dedicated R&D unit. Although this type of approach can lead to some radical innovation, it is unlikely that major, new capabilities that require change across all units can emerge from this approach.

It is useful to examine the structural aspects of the library as they relate to ambidexterity. As noted earlier, only 15 libraries claimed to have separate structures to conduct exploratory work and only 8 of these were considered innovative. To shed some further light on how R&D structures might contribute to an ambidextrous orientation, one other variable was examined that focused most on an explicit R&D structure (Appendix C – Section B, questions 10, 12, and 13). These three questions were part of the scale used for structural differentiation. For those libraries with an ambidextrous orientation greater than the mean for the sample (mean = 13.65), the correlation between R&D structure and innovation performance was negative and significant ($r = -0.41$, $p < .05$). Although this result seems counter-intuitive, there are two possible explanations. If libraries are moving to separate R&D units to conduct exploratory work, leaders may not, as yet, have found ways to integrate these non-traditional units into an institution in which the structure has not changed for most of the past 100 years. Secondly, these R&D
units may not be able to create new knowledge and ideas that culminate in significant innovations. It is possible that these units exist with few resources and considerable resistance in moving their ideas into the decision process. From these observations, one can speculate that ambidexterity in these libraries is being achieved by conducting both exploratory and exploitative activities within the traditional units rather than through separate R&D structures.

In the research model of Figure 3, the external environment was the only major factor that was not significantly related to innovation performance. In the preliminary analysis, dynamism or environmental uncertainty did not have a significant impact on innovation performance. In the subsequent exploratory analysis of additional predictors, the effect of environmental munificence and environmental uncertainty were added while controlling for size, type of institution, behavioral integration, structural differentiation, and an ambidextrous orientation (Table 12, columns 5 and 6). Although the overall models remained statistically significant ($p < .001$), the effect of environmental munificence was not significant, $t (39) = 0.91, p > .10, R^2_{inc} = .011$ and the effect of environmental uncertainty was not significant, $t (39) = 0.109, p > .10, R^2_{inc} = .015$. From these results, hypotheses H3a and H3b are not supported and the null hypotheses ($H_0$: $R^2_{inc} = 0$) cannot be rejected.

Intuitively, we would expect a more munificent environment to provide more resources that could be used for innovative purposes. However, there is another concept, organizational slack, that is conflated with munificence and which we were not able to measure. Organizational slack is defined as a “cushion of resources” in the sense that these resources are not needed for the effective functioning of the organization (Nord &
Tucker, 1987, pp. 337-339). It is frequently reported that slack resources can be used to facilitate innovation (Damanpour, 1987; Daft & Becker, 1978; Hambrick & Snow, 1977; Sidhu et al., 2004). Even though a library may have a considerable increase in expenditures over the 10 year period as represented in the munificence variable, it is very difficult to determine if they have any cushion of resources. Daft and Becker (1978, p. 60) report a negative relationship between slack resources and innovation in high schools. Highlighting an important insight, these researchers found that innovative high school districts seemed to be spending in a different way and that slack resources were not needed to innovate. Beyond these explanations, it should be noted that the regression model controlled for the size of the organization. Since there is a significant and positive bivariate correlation between organizational size and environmental munificence ($r = .22$), it is expected that these two variables share variance. Since the regression analysis controls for size, much of the impact of environmental munificence has already been accounted for in model 1 of the regression.

Several explanations regarding the non-support for hypothesis H3b (environmental uncertainty) are offered. First, it is interesting to view the results from the questions relating to environmental uncertainty in the survey (Appendix C – Section C, questions 15-20). The mean for team responses on environmental uncertainty (Appendix F) was 4.47 on a nine-point Likert scale (SD = 0.72, N=50), suggesting that most TMTs did not view their environment as all that uncertain. The low variance among these TMTs could possibly account for the statistically insignificant relationship. It is also useful to examine individual leader responses. There are four questions in the survey (Appendix C – Section C, questions 16-19) that ask about the predictability of
change in funding for the library, government regulatory control, political attitude toward the library, and the actions of peer institutions. If the scores are reversed to represent the unpredictability on these dimensions, the mean for all individual leader respondents is 4.46 on a nine-point Likert scale (SD = 1.75, N=183). In the reported research, it was pointed out that one of the most lethal aspects of a turbulent environment is the inability for leaders to predict the impact on their organization (Anderson & Tushman, 2001, Boyne & Meier, 2009). From these mean scores, one can speculate that library leaders felt reasonably confident that they can predict the effects of these four dimensions on their library. Perhaps even more telling, leaders were very confident in predicting the actions of their peer institutions. This observation provides an interesting insight into the research library community and suggests that individual libraries are not venturing into more risky areas that might have unpredictable results.

As depicted in Table 12 (column 4), the effect of singular leader attitude was added to the regression while controlling for all previously entered variables. Although the overall model remained statistically significant ($p < .001$), the effect of the singular leader was not significant, $t (39) = 0.80, p > .10$, $R^2_{inc} = .02$. From these results, hypothesis H9 is not supported and the null hypotheses ($H_0: R^2_{inc} = 0$) cannot be rejected. Although this study is primarily focused on the leadership team in the research library, there is sufficient evidence from earlier research (Jantz, 2012a) that the singular leader can have a major impact on the innovative capabilities of the institution. It should be noted that the bivariate correlation of singular leader attitude with innovation performance was significant and positive ($r = .25, p < .05$). The singular leader variable was created from the university librarian’s view of the exploratory capabilities of their
library, suggesting that a more positive view will translate into the leader providing more aggressive support for innovations. The issue here is more likely a methodological one in that it is very difficult to construct a variable which captures the essence of the library leader’s impact. This area is worthy of more investigation in future research studies and will be discussed further in the section on implications.

Unexpected Results. The TMT average age and tenure in profession have correlations with innovation performance that are close to zero ($r = .03$ and $-.02$ respectively). Examination of the scatter plot indicates that an inverted U-shaped distribution for these variables was not present. Preliminary regression results also indicated that these independent variables did not have a significant relationship with innovation performance. In addition, several statistical models were used in an exploratory analysis including squared-X, exponential, and reciprocal Y. Although these various models did improve $R^2$, a significant relationship did not exist between TMT age, tenure in the profession and innovation performance. As a result, hypotheses H5a and H5b were not supported. Several studies have shown that older leadership results in risk-averse behavior that is not likely to lead to innovative practices (Bantel & Jackson, 1989; Finkelstein & Hambrick, 1990; Hambrick, 1994, p. 185). However, Damanpour and Schneider (2009) found that the age of managers in public organizations was not significantly related to innovation and an inverted U-shaped relationship did not exist. To explore the innovation performance-TMT age relationship further, these two variables were dichotomized using the means to create the four quadrants shown in Table 17.

---

25 For this analysis, StatGraphics Centurion XVI, version 16.1.18 was used.
Table 17

*Distribution of Innovative Libraries and TMT Age (N=50)*

<table>
<thead>
<tr>
<th></th>
<th>Innovative Libraries</th>
<th>Non-Innovative Libraries</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young TMT</td>
<td>15</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>Mature TMT</td>
<td>12</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>23</td>
<td>50</td>
</tr>
</tbody>
</table>

As is evident in Table 17, there is almost a uniform distribution across the four quadrants with the highest frequency in the Young TMT-Innovative category. A similar distribution exists for innovative performance and tenure in the profession. In framing the hypotheses for H5a and H5b, it was suggested that younger teams would not have the experience or confidence to support innovation in libraries. Because of career and retirement concerns, older teams would be less likely to take on the risk that is associated with major change. In this sample, libraries with younger TMTs and more mature TMTs have clearly been able to innovate. These results suggest that other factors are compensating for the possible negative effects of age. From a theoretical perspective, Finkelstein and Hambrick have noted that Upper Echelon Theory will have more explanatory power in organizations where managerial discretion is high. Given the power of the singular leader in research libraries, one might speculate that managers have less autonomy to make decisions therefore accounting for some of the unexpected results for TMT age and tenure.

Alternatively, library leaders may be achieving more innovative capability from TMTs who have worked together for prolonged periods. In particular, as discussed in the
framing of the mediation hypothesis, ambidexterity will take time to develop as the TMT experiences more positive interactions. Although the exploration of these various causal effects was beyond the scope of this study, it might be expected that the age of the TMT would positively affect ambidexterity which in turn has a positive impact on innovation performance. Therefore, the more mature TMT may be more ambidextrous, resulting in a more innovative organization.

The two most puzzling results relate to hypotheses 6a and 6b which suggested that both educational level and educational diversity of the senior team are positively related to innovation performance. As noted previously, several empirical studies (Bantel & Jackson, 1989; Wiersma & Bantel, 1992) have found that leaders with higher levels of education are more open to different points of view and cognitive diversity can help offset the negative tendencies resulting from leaders existing for long periods in a single profession.

Although not significant, both of these educational indicators were negatively correlated with innovation performance (Table 9). There is one additional insight from the correlations of Table 9 – the correlation of education diversity (science) is small but positive suggesting that senior teams with science degrees might have more of an impact on innovation performance. According to our hypothesis, science education in the senior team would be positively related to innovation performance; however this relationship was not significant in the regression analysis. To further examine this relationship, the correlation of science education in the senior team and radical innovation performance was examined (correlations with radical innovation performance are shown in Appendix
H). The correlation is more positive ($r = .11$), suggesting that it might be useful to look more closely at this indicator in future research, perhaps as part of a longitudinal study.

Some further speculation is in order as to why these variables had little impact on innovation performance. One perspective originates with the innovations that, thus far, have been initiated in research libraries. The observation relates to the “iron cage” metaphor cited as part of the theoretical framework for this study. We might expect that leaders continue to operate within the limited confines of research library traditions and are finding it unnecessary to utilize new knowledge from other domains. The library initiatives can still be considered classical library innovations that have not depended on new knowledge from other more technical domains, suggesting that educational level and diversity are not, as yet, very important for the research library to innovate.

It is also useful to return to some of the research literature on innovation in the service sector and the use of knowledge (Cohen & Levinthal, 1990; Forsman, 2011; Grant, 1996). The findings suggest that knowledge is a critical input and plays an important role in creating an innovative capability in the organization. Grant, however, postulates that knowledge acquisition is a very individualistic endeavor, and it is the application of knowledge within the organization that is essential for stimulating innovation. Hence, although educational level and diversity in the leadership team might represent accumulation of knowledge, the fundamental task of leaders is to apply this knowledge within the organization. More importantly, leaders might turn their efforts to coordinating the application of their knowledge and members’ knowledge throughout the organization.
One other enabler variable, staff/professional profile, was examined in the exploratory analysis and found not to contribute significantly to the overall model (Table 12), $t(39) = 0.61, p > .10, R^2_{inc} = .050$. As a result, hypothesis H8 is not supported.

Almost without exception, these research libraries actually decreased their staff/professional ratio over the six year period from 2004 to 2009. Frequently, the FTE for professional librarians was increased for the period while the FTE for staff was reduced. Table 18 summarizes the changes in professional and support staff for the six years.

**Table 18**

*Changes in Professional and Support Staff (FTE) from 2004 to 2009 (N=50)*

<table>
<thead>
<tr>
<th></th>
<th>Mean 2004</th>
<th>Mean 2009</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Staff</td>
<td>151.60</td>
<td>132.90</td>
<td>-12.3%</td>
</tr>
<tr>
<td>Professional Librarians</td>
<td>103.88</td>
<td>110.36</td>
<td>6.2%</td>
</tr>
</tbody>
</table>

The results in Table 18 also appear to contradict Regazzi’s study (2012) which reported a growth in library positions not requiring an MLS.

Several observations are offered to address this puzzling trend. First, Regazzi’s data is based on a much larger sample that includes non-ARL libraries. Research libraries may be trending in a different direction regarding their staff/professional profile than what is found in the larger community of academic libraries. One might expect research libraries to put more of an emphasis on maintaining or increasing their professional librarian ranks in order to support the research demands of the parent institution and to sustain the importance of tenure for librarians. Secondly, the logic of
hypothesis H8 may still be valid. In other words, significant increases in the staff/professional ratio may be found to positively affect innovation performance. The assumption is that the base of IT related skills and knowledge is held by staff members rather than professional librarians. This IT knowledge would be expected to result in more technology-based radical innovations. These innovations will require IT knowledge and skills that are not typically found in the professional librarian population.

A Review of the Research Questions (RQ). For RQ1, the regression analysis indicates that behavioral integration does have a significant and positive impact on innovation performance. For RQ2, more structural differentiation had a significant and negative impact on innovation performance. In response to RQ3, the findings suggest that dynamism – uncertainty in the external environment – and environmental munificence did not have a significant impact on innovation performance. One of the most significant findings from this study provided answers to RQ4 and RQ5. First, an ambidextrous orientation had a significant and positive impact on innovation performance. Further, an ambidextrous orientation was shown to mediate the relationship between behavioral integration and innovation performance. RQ6 posed a more general question regarding contextual factors of the research library. Of these factors, it was found that only decision awareness had a significant and positive impact on innovation performance. TMT age, educational level and diversity, the singular leader perspective, and the staff/professional profile did not have a significant impact on innovation performance.

The results for the research questions are summarized in Table 19. Hypotheses H1, H2, H4, H4a, and H7 were supported. The remaining hypotheses were not supported.
### Table 19

*A Summary of the Research Questions and Hypotheses*

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Related Hypothesis</th>
<th>Regression Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RQ1</strong>: What effect does the behavioral integration of the senior team have on the innovation performance of the research library?</td>
<td><strong>H1</strong>: The extent of senior team integration in the research library is positively associated with innovation performance.</td>
<td><strong>H1</strong>: hypothesis supported</td>
</tr>
<tr>
<td><strong>RQ2</strong>: How does a more structurally differentiated organization affect the innovation performance of the research library?</td>
<td><strong>H2</strong>: A more structurally differentiated research library will be negatively related to innovation performance.</td>
<td><strong>H2</strong>: hypothesis supported</td>
</tr>
</tbody>
</table>
| **RQ3**: How do the factors of munificence and dynamism in the external environment affect the innovation performance of the research library? | **H3a**: Environmental munificence is positively related to innovation performance.  
**H3b**: Uncertainty in the external environment, as perceived by library leaders, is positively related to innovation performance in the research library. | **H3a**: hypothesis not supported  
**H3b**: hypothesis not supported |
| **RQ4**: What is the effect of an ambidextrous orientation on the innovation performance of the research library? | **H4**: An ambidextrous orientation is positively related to the innovation performance of the research library. | **H4**: hypothesis supported |
| **RQ5**: Does an ambidextrous orientation mediate the relationship between senior team integration and innovation performance? | **H4a**: An ambidextrous orientation mediates the relationship between behavioral integration of the senior team and innovation performance. | **H4a**: hypothesis supported |
| **RQ6**: How do contextual factors of the research library affect innovation performance? | **H5a**: TMT average age  
**H5b**: TMT average tenure  
**H6a**: TMT level of education  
**H6b**: TMT educational diversity  
**H7**: TMT decision awareness  
**H8**: Library staff/professional profile  
**H9**: Singular leader perspective on the library’s creative abilities | **H5a** not supported  
**H5b** not supported  
**H6a** not supported  
**H6b** not supported  
**H7** supported  
**H8** not supported  
**H9** not supported |
Chapter Eight

Implications for Practice, Future Research, and Limitations

Implications for Practice

Librarians might view this study as having little relevance to their daily lives since several important factors such as TMT age, tenure, and educational level cannot be readily altered. However, a closer examination clearly reveals areas that practitioners can address. Shera (1966, p. 95) some 50 years ago suggested a librarian mindset for creating a more innovative library: “In a world of mingled menace and promise, the winds of change blow as surely through the library stacks as they do through the corridors of the United Nations . . . . The librarian, therefore, must be both critic and architect – destroyer of that which is obsolete and builder of his own future”. To explore possibilities for building this future, we first examine the implications of the external environment, organizational structures, and the radical-incremental continuum. To conclude this section on implications, a discussion of ambidexterity and leadership provides insights as to how leaders can move forward in transforming the research library.

The External Environment. In this study, it was expected that uncertainty in the external environment would positively impact innovation performance – a hypothesis that was not supported. However, it is still useful to examine the implications of this result and the different findings from other innovation studies. One major difference between the for-profit firm and the research library is the lack of any compelling trigger events that might result in major change. The innovation process of Figure 2 highlights the importance of trigger events in the external environment which can stimulate innovative thinking in the organization. In the for-profit sector, a variety of innovation and
performance indicators have been used in innovation studies including profit/loss results, return-on-investment, revenue from new products, and the number of patents. In addition to these more objective indicators, the emergence of a strong competitor can cause a business leader to take action. For example, Apple’s recent introduction of the mini-iPAD was a direct response to the popularity of the smaller Kindle e-book reader.

Natural disasters also serve as major trigger events for the for-profit sector. Similar compelling trigger events in the institutional environment appear to be either non-existent or have little impact. In the research library, competition is much more muted and reliable performance indicators are not available, resulting in less impetus to initiate major change. Leaders who are aware of the turbulence in the external environment are also in a better position to seize emerging opportunities for innovation. For-profit universities, commercial publishers, Amazon, Google, and open-source platforms not only represent competition but also a source of new ideas. Library leaders and professional librarians are well aware of these external pressures. However, these entities and many others that are innovating in the information world can provide ideas and technology that can be put to use in the library. Researchers (Phene & Almeida, 2008) have found that a major factor in utilizing knowledge and improving innovation capability is the range of external sources available to the organization. These resources become especially important to envision and create radical innovations which will require new knowledge, new technology, and an altered vocabulary within the library. As part of an innovative culture, library leaders and organizational members can all participate in boundary-spanning activities that can enhance the library’s ability to undertake more radical innovations.
Organizational Structure. Although this study has relied, in part, on theories that have emerged from studies of innovation in the for-profit sector, it would be a mistake to assume that research libraries should adopt a more business-like organizational structure. In a study of nonprofit organizations, Alexander and Weiner (1988) report “the adoption of structures and practices from the for-profit sector is neither a feasible nor even a desirable solution to problems facing many nonprofit organizations”. Robert Birnbaum (1988) captures the essence of the higher education management conundrum (as cited in Budd, 2012, p. 72):

The apparent paradox that American colleges and universities are poorly run but highly effective is easily resolved if either or both of these judgments are wrong. But what if they are both right? . . . Or, strangest of all, it might be that to at least some extent our colleges and universities are successful because they are poorly managed, at least as management is often defined in other complex organizations.

Research libraries leaders should therefore be wary of adopting more corporate-like structures. However, the for-profit innovation studies and associated vocabulary are instructive for articulating a vision and management structure for the research library. Competition, out-sourcing (possibly to machines), and industry-exit are all business terms that are relevant for the research library of the 21st century. Although industry-exit and failure are not likely outcomes for the library, similar outcomes can be imagined in which the library gradually descends into irrelevance for research in the university and becomes primarily a study space for students. It appears that the research library is in a state of organizational evolution which may be a transitional process leading to a hybrid in which
many of the more corporate practices are found to be appropriate. One of these practices that is related to organizational structure is the establishment of an exploratory unit.

Several issues regarding exploratory or R&D units should be examined more closely by practitioners. As reported in the previous discussion of results, it appears that those few libraries with separate R&D units did not benefit significantly by improving their innovation performance. Practitioners should not prematurely abandon the separate R&D unit, but rather they should examine how exploratory efforts can be effectively integrated into the traditional structures of the library. Several research reports cited in this study suggest that separate R&D units, buffered from those units supporting current services, are necessary to generate ideas for major change. These R&D units can benefit the library in several ways. First, creative ideas that impact the whole library are more likely to emanate from a unit that is not located within one of the traditional units that support existing technical or public services. Secondly, although members of a new R&D unit might be doing original research, one of the primary tasks of the unit is to transfer technology from other domains (commercial or nonprofit) and explore how this technology can be adapted for use within the library. The technology transfer activity can be further augmented by enhanced boundary spanning as mentioned earlier. The objective is not only to take advantage of these new technologies but also to accelerate the transfer of technology into the library for the benefit of users within the university.

As represented in the results of this study, more structural differentiation can have a negative impact on innovation performance. More diverse organizational structures can create barriers to the free flow of ideas and information. As a result, the introduction of an R&D unit or other new service units can possibly act against a more innovative
capability by restricting information flow. This observation leads us back to another result in this study – the importance of the integration of the senior team. Leaders who excel at collaboration and information exchange can facilitate communication across the more dissimilar units in their organization by introducing new vocabulary and facilitating the application of new knowledge.

The Radical-Incremental Continuum. This study has focused on radical and incremental innovations. From observations and earlier studies (Jantz, 2012a), it appears that research libraries have been able to implement the more routine incremental innovations, however the radical innovation requiring major change is much less likely to occur. As Nadler and Tushman (1990) have noted, continued incremental innovation in an increasingly turbulent external environment is a recipe for failure. One of the premises of this study is that research libraries will need to develop a culture in which both incremental and radical innovations are brought to fruition in order to survive and thrive into the future. To understand the importance of radical innovations and the impact of the external environment, one can first look to the transformations occurring in the parent institution. Recently, Harvard University officials warned of “rapid, disorienting change” at colleges and universities, citing the difficulty of meeting the aspirations of the institution within current budget constraints (Martin, 2012). Beyond the budget constraints, rapidly evolving technology is resulting in major, disruptive events for the university. Recently, a free, online course in Artificial Intelligence was offered to 160,000 students by Google researchers (Hyman, 2012) - an example of massive, open, online courses (MOOCs). In conjunction with these corporate ventures, many of our flagship research universities are beginning to offer free, online courses in computer
science and related subjects. One can rightly ask where the research library fits in this ongoing evolution. The growing dissonance between the rapid advancement of technology and the research library’s ability to adapt will be difficult to overcome. As there is more pressure from university administrators and the state political environments to reduce budgets, library leaders can take advantage of the rapid technological evolution to envision more radical innovations. The implications will impact the organization’s skills profile, requiring librarians and staff who can readily apply technological advancements within the library.

_Leadership Demographics._ The unsupported hypotheses in this study related to leadership age and tenure were unexpected. In a recent meta-analysis, Damanpour and Aravind (2012, p. 509) report managers’ age has a non-significant impact on innovation. What might be important for recruiting new librarians as possible leaders is an individual profile with a breadth of experience, possibly in non-library entities, and where age is less of a concern. In fact, those potential leaders who are older are likely to have more experience in different venues, an attribute that can bring new knowledge into the innovation process.

_Integration of the Senior Team and Ambidexterity._ This study has focused on the leadership team and the team’s ability to foster a more innovative culture in the research library. There is evidence that a competing model exists in these libraries. This alternative model is one that is based on the singular leader. Various studies have reported on the effects that the singular leader’s attitude has on innovation (Daft & Becker, 1978; Damanpour & Schneider, 2009) and have demonstrated a positive relationship with innovation. A recent meta-analysis (Damanpour & Aravind, 2012, pp.
502-503) reveals a persistent positive relationship between a leader’s attitude toward change and innovation. Unfortunately, the attitude or innovativeness of the singular leader cannot readily be packaged and reduced to a process that can be used by organizational members. Further, these singular leaders move on to other jobs or they retire, suggesting that the singular leader model is not sustainable. For the long term survival and success of the library, it will be important for the leadership team to develop a more collaborative and information-sharing culture that is not dependent on the singular leader. Examples of where leaders can take action include the viewing of failures as an opportunity to learn, open and transparent communication, revised organizational structures that can be both flexible and loose and the development of a vision that encourages creativity and innovation. Investing in creativity as an organizational process (Martins & Terblanche, 2003) might start with a vision that embraces innovation such as the following – adapted from Salge and Vera (2009):

The library will have a culture of integrated research and service delivery which will drive the highest standards of knowledge and information dissemination as well as fostering innovation, and the critical evaluation of innovation, to pioneer new ways of multidisciplinary collaboration, both within the research library community and between the library and the university community.

We have suggested that depending on the singular leader will not result in a sustainable innovative culture. Inherent in this study from the outset is the argument that the leadership team, specifically a more integrated team, is critical to create and sustain an innovative culture in the library. The results of the analysis do show that a more integrated team with more decision awareness can have a positive effect on innovation
performance. However, research library leaders should note, especially, the strong mediating effects of ambidexterity. As illustrated in Figure 7, an integrated team that develops an ambidextrous orientation has a much more positive impact on innovation performance, highlighting the importance of being able to simultaneously improve existing services while also conducting more exploratory activities. There are many management paradoxes on the road to achieving ambidexterity – strategic intent (focus on innovation vs. current services), shared responsibility among the leadership team (versus the singular leader model), and the organizational structure conundrum (more functional structures and loose-tight flexibility). These opposing and even contradictory concepts must be embraced in order for a library to become ambidextrous.

The mediating effect of ambidexterity is most revealing and has profound implications for management practice. In research libraries and similar nonprofits, trigger events – the stimuli for initiating major change and innovation – will need to come from the senior leadership team. The more quantitative, objective indicators that business leaders rely on simply do not exist in the nonprofit organization. In the absence of these trigger events, library leaders can take a more activist, interventionist role, not along the lines of traditional management practice, but rather in recognizing and promoting new ideas while also facilitating implementation of these ideas across the multiple units of the library. A fundamental element in the discussion of ambidexterity is the notion of simultaneity – the ability for an organization to conduct exploratory work while simultaneously supporting existing services. For ambidexterity to be developed, library leaders will need to become ambidextrous themselves and promulgate this flexibility throughout the organization by creating a supportive context and nurturing
organizational members through the inevitable conflicts that will arise as the library undergoes major change. As discussed earlier, ambidexterity can be developed using either a contextual or structural approach. At this juncture, it is not useful to be more prescriptive since there is considerable diversity in the research library community and each library will develop a path to ambidexterity based on its own unique circumstances.

It must be acknowledged that the concept of ambidexterity continues to evolve in the research literature and a practitioner might ask how the ambidextrous organization is to be created. How do new structures become established and effective or how does the organization manage the inevitable conflicts that will result in becoming ambidextrous? O’Reilly and Tushman (2008) best describe the ambidexterity concept and the challenge for research libraries:

Ambidexterity is a specific capability embodied in the senior leadership’s learning and expressed through their ability to reconfigure existing organizational assets and competencies in a repeatable way to adapt to changing circumstances.

As O’Reilly and Tushman found in their case studies, a clear consensus about the unit’s strategy and agreement about the importance of both exploration and exploitation will increase the likelihood of ambidexterity. It is in this observation that we can see the direct and positive effect between the integration of the senior team – specifically, collaboration and joint decision making – and ambidexterity. Much of the innovation research of the for-profit sector has revealed how many outstanding firms have ultimately failed. The dynamism represented in an ambidextrous orientation suggests a way forward for research libraries by simultaneously embracing both exploratory and exploitative activities. The implications and suggestions presented herein will, hopefully,
assist research library leaders in transforming their institutions to meet the challenges of the 21st century information society.

**Future Research**

If the conjecture regarding educational level and diversity has some merit, one might conclude that research libraries were not, as yet, developing significantly new knowledge that can lead to major change and the implementation of radical innovations. Research libraries are reasonably adept at implementing incremental innovations. One could hypothesize that the ability to go beyond the more routine incremental innovations and embrace major change is the key to transforming the research library. Examining the characteristics that uniquely lead to radical innovations can shed light on factors to be explored in future research. For example, Germain’s study (1996) indicated that environmental uncertainty was a good predictor of radical innovations. However, correlations of the variables in this study with radical innovation performance did not reveal significant differences. The factors leading to a radical innovation capability are important in the long term transformation of the research library and are worthy of a more focused study.

The question of the long term survival of the research library is a perplexing one. One can imagine the library continuing at a rather slow rate of transformation. Another scenario might include a realization of the library as primarily a symbolic presence on the campus where most resources are available electronically and the library serves as a study and social gathering space for students. Another view is that libraries will successfully create and implement radical new service innovations. An assumption of this study is that research libraries will need to simultaneously manage both incremental and
radical innovation streams in order to survive and prosper over the long term. Some organizational theorists have posed the question “why can’t an institution thrive by only conducting incremental innovations”? Based on observation, one can conclude that research libraries might survive quite nicely for many years. However, this incremental trajectory can be particularly insidious in an institution with ageing professionals and inadequate performance indicators, allowing leaders to rationalize a traditional strategy of supporting the status quo. In contrast to the for-profit sector, we do not yet have examples of a failed research library. Understanding the impact of a continued incremental approach would help practitioners devise appropriate actions to avoid what might be considered a “failed” research library. Given the time intervals required for more radical innovations, a more extensive longitudinal study should be considered.

This study has focused on the factors that affect technical innovations as opposed to administrative innovations. From a methodological point of view, administrative innovations are sometimes more difficult to identify and vary widely across different libraries. Administrative innovations such as Total Quality Management (TQM) are frequently implemented piecemeal and it is difficult to discern when the total innovation has been completed (Ravichandran, 2000). In a more centralized organization, the singular leader might introduce a major process change such as creating a totally new service unit and thereby provide the structure and resources that will lead to radical innovations. Library leaders might also push to revolutionize the byzantine performance appraisal processes that persist in the university, giving managers the authority to award outstanding performance. These initiatives are considered administrative innovations. Damanpour, Szabat, and Evan (1989) have highlighted the importance to organizational
performance of a balanced rate of adoption for both administrative and technical innovations. Within an institutional nonprofit, the drivers for technical and administrative innovations are likely to be quite different. Scholars continue to differ on which type of innovation originates first in the diffusion process. Some have argued that technical innovations precede administrative innovations in time. For example, one might expect a radical innovation to force major change in the organization, a situation which can prompt leaders to introduce new administrative practices. What might be the temporal order in a more ambidextrous organization in which managers create both incremental and radical innovations? Research libraries have centralized structures and are frequently led by those who have a vision for how the library should be transformed. Understanding the factors that drive administrative innovations would provide a more complete picture of how research libraries innovate and also provide library leaders with key insights as to appropriate actions to be taken.

A quantitative approach and a regression model do not provide a complete picture of innovation in institutional nonprofits. This study demonstrated that approximately 50% of the variance in innovation performance can be explained by five factors. What other factors are affecting innovation in the research library? A qualitative case study including interviews of research library leaders is likely to reveal interesting aspects of library culture, the singular leader, and the institutional environment. For future research, one might select a sample of the most innovative and least innovative libraries and go on site to talk with leaders and observe the unique culture of these institutions.

Further research is also required to understand the relationship between the research library and the research university. How does the innovative university affect
the research library and vice versa? Can an innovative research library help the university become more innovative? Answering these questions might lead to a better understanding of the role of the research library in the 21st century university.

**Limitations**

This study examined 17 possible independent variables that might impact innovation performance in research libraries. The significant predictors accounted for about 50 percent of the variance in innovation performance. However, there are other factors that would be useful to investigate. Urbanization, tenure status within the library, and the extent of grant funds are areas worthy of further investigation. The urbanized locale of the university and research library is a factor that cannot easily be changed from a practical perspective; however, urbanization can provide some insight as to the origins of new ideas. One rationale is that the dynamism of the urban environment can provide a richer source of ideas and the turbulence of the urban environment might motivate library leaders to initiate major change. Many research libraries offer faculty status and tenure to professional librarians. Interesting and conflicting hypotheses can be posed regarding tenure status. Are libraries with tenure status more or less innovative? How do libraries balance the apparent conflicting priorities of being a service organization while also requiring tenure-track librarians to conduct research?

If libraries are conducting more research, the question remains as to how this research is being funded. Grant funds offer the research library a method for supplementing limited budgets. It is expected that much of library research is being funded through grants. Unfortunately, it was very difficult to obtain complete data on grants received for the sample in this study. All of these areas represent possible
independent variables that can impact innovation and suggest possibilities for capturing a larger context of the university library environment.

Respondent bias is always an issue in a survey-based study. In this study, it was very important to obtain responses from the leadership team as opposed to the singular leader. Therefore, respondent bias was minimized by considering the responses of all of the TMT members. This aspect was especially important when the library leaders were asked to assess the extent of implementation for each innovation. It was, however, obvious that the university librarian generally had a more positive view of the organization than the associate university librarians. There is little convincing research that either contradicts or supports the generally accepted belief that top administrators can provide reliable information about their organizations (Koberg et al., 2003). Although self-assessment measures can be prone to bias, they are the most commonly used approach, given that other measures are difficult to obtain and can also be biased (Gatignon, et al., 2002).

Regarding the underpinnings for upper echelon theory, demographics are, at best, imperfect proxies for psychological constructs, the major problem being that demographic characteristics do not co-vary perfectly with psychological attributes (Edmondson et al., 2003). As Edmonson and colleagues have pointed out, the stability and lack of precision in demographic characteristics can lead to conflicting empirical results. This limitation may, in part, help explain the unexpected results regarding the age and educational level of the library leadership team. It should be noted that effective leaders are able to modulate their styles based on the situation at hand. The concept of behavioral integration does not capture the dynamics that are likely to occur in any
organization. TMT effectiveness can vary from situation to situation whereas demographics remain relatively constant for extended periods of time. Situation leadership studies may be another research stream that can help explain team effectiveness.

Because of the small population (99 research libraries) and the sample of 51, structural equation modeling (SEM) could not be used in this study. However, SEM provides a powerful tool to examine multiple latent factors and to more effectively model the causes and effects of mediators. A future study could use SEM and the larger population of academic libraries to undertake a more comprehensive path analysis.

In a cross-sectional study, it is difficult to account for how innovative capability increases over time. For example, research libraries may be achieving ambidexterity by partially overlapping exploratory and exploitative activities over time rather than conducting these activities simultaneously. As Piao (2010) points out, too much or too little overlap in exploration and exploitation tends to reduce firm longevity whereas moderate overlap will extend firm longevity. Longitudinal studies will provide a more complete picture of how research libraries create both incremental and radical innovations.
Chapter Nine

Summary and Concluding Remarks

Despite the limitations noted earlier, this study has made important contributions in several significant areas. First, from a methodological perspective, the innovation performance construct captures three dimensions of innovation. Researchers have noted that a binary adoption decision has some serious methodological issues. By capturing the extent of innovation as part of the performance construct, a more complete picture of innovative capability was embodied in the dependent variable. Secondly, this study represents one of the very few empirical analyses of innovation in the institutional nonprofit sector and contributes to the growing body of literature in innovation studies. As such, it is expected that the research model represents a more comprehensive theory of innovation and can be applied to the larger community of academic libraries and possibly to other nonprofit organizations. Thirdly, given that relatively few innovation studies of research libraries existed, it was important to capture and understand as much of the organizational context as possible. This study brought 17 possible predictors into the analysis and reported on several unexpected results regarding the age of leadership, educational level, and the external environment that appeared to contradict some of the extant theory. More importantly, four major factors relating to leadership in research libraries and organizational innovation have emerged – behavioral integration, an ambidextrous orientation, decision awareness, and structural differentiation. Finally, an extensive section on implications for practitioners provides insight as to how research libraries leaders can use this research to transform their institutions.

The significant factors in this study provide some hint as to what research libraries must do to accomplish these transformations in their institutions. More
integration within the senior team, more flexibility in pursuing both incremental and radical innovations, and more effective integration of different organizational structures will stimulate both creativity and innovation. As an unexpected result, research libraries in this study with leadership teams in different age groups and with widely different levels of education were able to innovate without the negative impact suggested by published theories. Yet, this study also reveals some troublesome indicators that leaders must address. The uncertainty in the external environment will continue to force change on the university and the university library. It will be important for libraries to anticipate and understand these forces rather than react to external events that are beyond their control. In addition, the changes in the integration of the team and possible structural changes will be difficult to manage at best. In all likelihood, changes in the vision and strategy of the library will have to come first in order to provide a framework for change. And, in the final analysis, these changes probably suggest a change in the leaders themselves.

Martell (2000) was very articulate in suggesting that libraries will need to create new services in the 21st century that were unthinkable in the 20th century. However, Martell’s perspective did not impart a sense of urgency. As noted earlier, Harvard University officials have warned of the rapid and disorienting change that is confronting universities (Martin, 2012). Libraries have also witnessed their inability to adapt quickly to the rapid changing technological environment. In this study, even the radical innovations do not appear to be all that unthinkable. Research libraries are gradually edging into services for scholarly publishing and providing repositories for science data. Although these initiatives represent important new services, they cannot be considered
ones that represent major change. These issues raise questions regarding the rate of transformation and the nature of innovations, suggesting that the introduction of major change will need to be accelerated and that creating an innovative culture may represent the major challenge for research library leaders in the coming years.

For concluding thoughts, it is appropriate to return to the comments of two library scholars who bracket the past half-century of library literature. Their writings reveal a common refrain about how the library profession can change by placing the focus on knowledge rather than information exchange. In his many philosophical writings, Jesse Shera has emphasized the importance of reflection. He has succinctly stated the professional dilemma: “The first responsibility of a profession is to know itself, which means, first, knowing what a profession is; second knowing what kind of a profession it is; and third, knowing what differentiates it from all other professions” (Shera, 1965, p. 162). Shera claims that librarianship needs a new approach – an epistemological discipline that develops a body of knowledge about knowledge (1965, pp. 15 – 16). More recently, John Budd offers a framework for understanding and debating difficult problems regarding the use of technology, the library building, and the future of librarianship – all with an emphasis on reflection and ethical implications. He voices optimism in the following quote (2001, p. 328): “If there is any grounding for doubting the future of LIS, and particularly of librarianship, it would be any betrayal of the commitment to knowledge.” These thoughts are not prescriptive, but they suggest a reorientation in thinking and the benefit of occasionally distancing ourselves from the details of management in order to think more philosophically about the profession.
References


Carmeli, A., & Schaubroeck, J. (2006). Top management team behavioral integration,


Damanpour, F. (1996a). Organizational complexity and innovation: Developing and
testing multiple contingency models. Management Science, 42 (5), 693-716.


Germain, R. (1996). The role of context and structure in radical and incremental logistics


Hambrick, D. (1994). Top management groups: A conceptual integration and


Shera, J. (1966). *Documentation and the organization of knowledge*. Hamden, CN:
Archon Books.


Appendix A - Innovations in Research Libraries - 2007 to 2011

These proposed innovations in research libraries have been implemented in at least one ARL library during the period 2007 to 2011. The list of 40 innovations has been developed from many sources including the searching of primary library journal indexes including *Library and Information Science Abstracts* and *Library Literature & Information Science*, Google Scholar, research library websites, books on innovation and libraries, and various publications including *Inside Higher Ed*, special reports from the Association of Research Libraries, and the more recently published journal – *The Journal of Library Innovation*.

1. A collaboration with another library to share collection development
2. Sharing of a major technology platform (e.g. for an OPAC or institutional repository) with another library
3. Provision of mobile access to the library online catalog
4. Provision of a service to publish e-journals
5. A device and associated service to allow students and faculty to check out their own books
6. A service for submission, access and preservation of ETDs (electronic theses and dissertations)
7. Use of live chat and instant messaging for reference service
8. The provision of a GIS (Geographical Information System) service to students and faculty, including software, training, and consultation
9. Installation of a coffee bar/restaurant/cafè in the library
10. The offering of a Wi-Fi service to the local community (i.e. not members of the university community)
11. The creation of a publishing service as a new unit in the library
12. The embedding of library liaisons with students and the instructor in course management systems
13. Provision of mobile access to the library website
Appendix A (continued)

14. Provision of a service to faculty and students for multimedia production including instruction, software and equipment platforms to support multimedia creation and publication

15. Provision of a science data service including archiving, preservation, and access to research data and liaison support to researchers

16. Provision of a service to inexpensively print, bind and trim bookstore-quality paperbacks from digital book files (for books that are out of copyright)

17. A collaboration with the university press to publish monographs and e-journals

18. Providing access to library information using mobile devices and two dimensional barcodes, also called QR barcodes, enabling patrons to easily access online information by scanning the barcode

19. The use of gaming technology for bibliographic instruction

20. Provision of a mobile lending service (laptops, netbooks, iPADs, etc)

21. Use of RSS feeds (or similar technology) to provide library news and event descriptions to library patrons

22. Provision of federated searching across the library OPAC, the institutional repository, and other open repositories

23. Use of digital object identifiers (DOIs) to create long-term, stable links to digital resources that should be preserved (dissertations, special collections, journal articles, etc)

24. Delivery of bibliographic instruction using online tutorials

25. Reconfiguration of physical space and redesigned services to provide information or learning commons (a central location for workstations, information resources, and librarian assistance).


27. Provision of a suite of mobile services to access information about the library (library hours, reserve study rooms, renew books, etc.)
Appendix A (continued)

28. Creation of a website or portal for faculty that provides services and assistance for article deposit into the institution’s repository

29. The provision of digital exhibits for special collections or other unique materials that are owned by the library

30. A service to digitize and provide online access to course catalogs

31. Made the transition to a bookless (i.e. no print books) library for certain disciplines (e.g. engineering).

32. Implemented a liaison service to provide assistance to faculty researchers for managing their copyrights, e.g. in order to fulfill article deposit requirements from the National Institute of Health and other institutions.

33. The development of a flexible bibliographic instruction course structure that gives students the option of attending sessions in the classroom, participating online, or doing both

34. Outsourced reference service to another organization (e.g. another library, nonprofit, or a commercial organization)

35. Provided for the digitization and access to university yearbooks

36. The creation of an institutional repository to contain the research output of the university (e.g. faculty research, dissertations, etc.)

37. Implementation of faceted browsing for the library OPAC

38. Collaboration with faculty or academic departments to publish student research

39. Provided personal librarian service to freshman

40. A dynamic mapping application for the OPAC to provide patrons directional information to find a shelved item
Appendix B – Panel to Assess Innovations in Research Libraries

A special panel of librarians and library science scholars was convened to assess the radicalness of specific innovations in research libraries\(^{26}\). According to Zaltman, et al.\(^{27}\) (1984, p. 24), a radical innovation is always “to some extent disruptive of the status quo” and involves changes in the organization’s subsystems, values, and incentives. Radical innovations involve new knowledge that is used to make fundamental changes in a product or process technology whereas an incremental innovation uses existing knowledge to create minor improvements in a product or process technology. Radical innovations represent a clear departure from existing practice whereas incremental innovations are more routine and support existing practice.

The online survey lists 40 innovations. For each innovation, the panel member is asked to assess radicalness based on five criteria. For each criterion, the extent of agreement on the nine point scale should be selected. The item “N/A” should be selected if the panel member is unsure about the extent of agreement. Candidate innovations are technical, providing new services to library patrons as opposed to administrative innovations which focus on the social and administrative aspects of the library (e.g. budgeting, the reward system, performance review, etc). All of the innovations have been implemented in at least one research library in the period 2007-2011. Using the above definitions of radical and incremental, the panel member should identify the extent of agreement or disagreement for each criterion by selecting a number on the nine point scale.

\(^{26}\) Questions have been adapted from Gatignon, H., Tushman, M., Smith, W., & Anderson, P. 2002. A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics. *Management Science*, 48 (9), 1103-1122.

Appendix B (continued)

As in the following example, the panel member answers these five survey questions for each of the 40 innovations.

**A collaboration with another library to share collection development**

1. The innovation is a major improvement over the previous product or service or a significant new addition to library services.
   
   1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree) NA

2. The innovation is considered a breakthrough (i.e. solved a particularly difficult or new problem).
   
   1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree) NA

3. The innovation will lead to organizational changes or new roles in the library.
   
   1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree) NA

4. The innovation is based on new knowledge that is not typically part of traditional library training.
   
   1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree) NA

5. The innovation required the library to develop new skills.
   
   1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree) NA
Appendix C – Survey for the Research Library Top Management Team

Responses to all the questions in the following sections are on a nine point scale where 1 is strongly disagree and 9 is strongly agree.

A. The Management Team

The top management team (TMT) is the relatively small group of influential leaders and managers at the apex of the organization. Within a research library, this team typically consists of the university librarian, associate university librarians, and directors. The following questions have been adapted from a scale developed by Simsek and colleagues (2005). Respondents should indicate their extent of agreement or disagreement about their management team on a nine point scale.

1. When a team member is busy, other team members often volunteer to help manage the workload.
   1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree)

2. Team members are flexible about switching responsibilities to make things easier for each other.

3. Team members are willing to help each other complete jobs and meet deadlines.

4. Our team is effective in exchanging high quality ideas.

5. Our team is effective in exchanging a high quantity of ideas.

6. Our team has a high level of creativity and innovativeness.

7. Team members usually let each other know when their actions affect another team member’s work.

8. Team members have a clear understanding of the joint problems and needs of other team members.
Appendix C (continued)

9. Team members usually discuss their expectations of each other.

B. Structural Differentiation

The scale for structural differentiation has been adapted from the study by Jansen et al. (2009). The questions relate to how the library segments its organization into spatially dispersed units. In the following questions, respondents should indicate their extent of agreement or disagreement about structural differentiation in their library.

10. In our library, exploratory and production activities are structurally separated.
   1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree)

11. Our library has units that are specialized in specific functions.

12. The library has separate units for research and to develop new knowledge.

13. The library has units that are uniquely focused on long term projects.

14. In our library, user needs are served from separate units

C. Environmental Uncertainty

Respondents should answer the following question: “How would you characterize the external environment within which your library functions”? In rating the environment, each respondent should consider not only the economic but also the social, political, and technological aspects of the environment, both within and external to the university.

The environment external to the library is very dynamic:

1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree)

15. I can accurately predict the changes in the amount of funding for my library

16. I can accurately predict the impact of government regulatory control
Appendix C (continued)

17. I can accurately predict the impact of the political attitude of the community and other public constituencies toward the university and the library.

18. The actions of peer library institutions are increasingly unpredictable.

19. Unpredictable change in the external environment creates a lot of stress.

D. Exploration and Exploitation

Researchers have identified two fundamentally different organizational learning processes – exploitation and exploration – that can lead to either incremental or radical innovations respectively. The essence of exploitation is the refinement of existing competences, technologies, and services while the essence of exploration is experimentation with new alternatives in order to develop significantly new capabilities. Please indicate your agreement or disagreement with the following statements regarding the extent of exploration and exploitation that occurs in your institution.

Exploration: Your library. . .

20. Looks for novel product and service ideas by thinking “outside the box”.

1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree)

21. Bases its success on its ability to explore and develop new technologies and services.

22. Creates products or services that are innovative for the library.

23. Actively targets new client groups.

24. Aggressively launches new products or services.

25. Looks for creative ways to satisfy its clients’ needs.

Exploitation: Your library . . .


1 (Strongly Disagree) 2 3 4 5 6 7 8 9 (Strongly Agree)
Appendix C (continued)

27. Continuously improves the reliability of its products and services.

28. Increases the level of automation in its operations.

29. Periodically surveys clients to determine satisfaction with existing products and services.

30. Refines existing services to keep current clients satisfied.

31. Strives to extend current products and services to all clients.

E. Candidate Innovations in the Library

In each of the following questions, a candidate library innovation is identified. For each question, the respondent should check off whether or not the university library has made a decision to adopt the innovation. Note that the respondent should check “Yes” if the decision to adopt has been made, even if the innovation has not yet been put to use. The respondent should check “No” if no decision has made to adopt the innovation. For each innovation, the respondent is also asked to estimate the extent of implementation of the innovation, using a ten-point scale where 1 is considered “Not Implemented” and 10 is considered “Fully Implemented”. “N/A” can be selected if the respondent is unsure of the impact.

The library has made a decision to adopt the following innovations:

32. A collaboration with another library or libraries to purchase and share collections (exclude inter-library loan agreements)

☐ Yes     ☐ No

33. Regardless of your decision, if the library is working on the innovation, please indicate the extent of implementation:

1 (Not Implemented)  2  3  4  5  6  7  8  9 (Fully Implemented)  NA
Appendix C (continued)

(Note: See Appendix E for a list of the final 32 innovations according to the radical, mid-range, and incremental classifications.)

F. Leadership Demographics

34. What is your chronological age in years: __________

35. Indicate your education beyond the Bachelor’s degree by checking all that apply:

☐ MLS

☐ MLS plus 2nd Masters degree (indicate area of study for 2nd masters: ______________

☐ Significant work toward the PhD (indicate area of study:

_____________________________

☐ PhD, no MLS (indicate area of study for the PhD:_____________________________

☐ MLS and PhD or equivalent (indicate area of study for the PhD or equivalent:

__________

☐ Other, please specify:_____________________

36. Please indicate the subject areas for your non-MLS degrees:

   Bachelor’s: ________________________________

   Master’s: ________________________________

   PhD: ________________________________

37. How many years have you served in your current position at your institution? ______

38. How many years have you served as a professional librarian (either in technical or administrative positions)? __________

Thank you for participating in this survey.
Appendix D – Cluster Membership for Each Innovation

In the following table, each innovation is identified as incremental, mid-range, or radical. The “distance” column indicates the proximity of each innovation to the centroid of its cluster group.

**Table 20**

*Cluster Membership for Each Innovation*

<table>
<thead>
<tr>
<th>Case Number</th>
<th>Innovation</th>
<th>Cluster</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A collaboration with another library to share collection development</td>
<td>Mid-range</td>
<td>.624</td>
</tr>
<tr>
<td>2</td>
<td>Sharing of a major technology platform (e.g. for an OPAC or institutional repository) with another library</td>
<td>Incremental</td>
<td>.511</td>
</tr>
<tr>
<td>3</td>
<td>Provision of mobile access to the library online catalog</td>
<td>Mid-range</td>
<td>.609</td>
</tr>
<tr>
<td>4</td>
<td>Provision of a service to publish e-journals</td>
<td>Radical</td>
<td>.491</td>
</tr>
<tr>
<td>5</td>
<td>A device and associated service to allow students and faculty to check out their own books</td>
<td>Incremental</td>
<td>.646</td>
</tr>
<tr>
<td>6</td>
<td>A service for submission, access and preservation of ETDs (electronic theses and dissertations)</td>
<td>Mid-range</td>
<td>.544</td>
</tr>
<tr>
<td>7</td>
<td>Use of live chat and instant messaging for reference service</td>
<td>Incremental</td>
<td>.403</td>
</tr>
<tr>
<td>8</td>
<td>The provision of a GIS (Geographical Information System) service to students and faculty, including software, training, and consultation</td>
<td>Radical</td>
<td>.537</td>
</tr>
<tr>
<td>9</td>
<td>Installation of a coffee bar/restaurant/café in the library</td>
<td>Incremental</td>
<td>1.102</td>
</tr>
<tr>
<td>10</td>
<td>The offering of a Wi-Fi service to the local community (i.e. not members of the university community)</td>
<td>Mid-range</td>
<td>1.375</td>
</tr>
<tr>
<td>11</td>
<td>The creation of a publishing service as a new unit in the library</td>
<td>Radical</td>
<td>.846</td>
</tr>
<tr>
<td>12</td>
<td>The embedding of library liaisons with students and the instructor in course management systems</td>
<td>Mid-range</td>
<td>1.031</td>
</tr>
<tr>
<td>13</td>
<td>Provision of mobile access to the library website</td>
<td>Mid-range</td>
<td>.782</td>
</tr>
<tr>
<td>14</td>
<td>Provision of a service to faculty and students for multimedia production including instruction, software and equipment platforms to support multimedia creation and publication</td>
<td>Radical</td>
<td>.740</td>
</tr>
<tr>
<td>15</td>
<td>Provision of a science data service including archiving, preservation, and access to research data and liaison support to researchers</td>
<td>Radical</td>
<td>1.848</td>
</tr>
<tr>
<td>16</td>
<td>Provision of a service to inexpensively print, bind and trim bookstore-quality paperbacks from digital book files (for</td>
<td>Incremental</td>
<td>.850</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Scale</td>
<td>Score</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>17</td>
<td>A collaboration with the university press to publish monographs and e-journals</td>
<td>Mid-range</td>
<td>.334</td>
</tr>
<tr>
<td>18</td>
<td>Providing access to library information using mobile devices and two dimensional barcodes, also called QR barcodes, enabling patrons to easily access online information by scanning the barcode</td>
<td>Mid-range</td>
<td>.794</td>
</tr>
<tr>
<td>19</td>
<td>The use of gaming technology for bibliographic instruction</td>
<td>Mid-range</td>
<td>1.209</td>
</tr>
<tr>
<td>20</td>
<td>Provision of a mobile lending service (laptops, netbooks, iPADS, etc)</td>
<td>Incremental</td>
<td>.888</td>
</tr>
<tr>
<td>21</td>
<td>Use of RSS feeds (or similar technology) to provide library news and event descriptions to library patrons</td>
<td>Incremental</td>
<td>.477</td>
</tr>
<tr>
<td>22</td>
<td>Provision of federated searching across the library OPAC, the institutional repository, and other open repositories</td>
<td>Mid-range</td>
<td>.324</td>
</tr>
<tr>
<td>23</td>
<td>Use of digital object identifiers (DOIs) to create long-term, stable links to digital resources that should be preserved (dissertations, special collections, journal articles, etc)</td>
<td>Mid-range</td>
<td>.742</td>
</tr>
<tr>
<td>24</td>
<td>Delivery of bibliographic instruction using online tutorials</td>
<td>Incremental</td>
<td>.930</td>
</tr>
<tr>
<td>25</td>
<td>Reconfiguration of physical space and redesigned services to provide information or learning commons (a central location for workstations, information resources, and librarian assistance).</td>
<td>Incremental</td>
<td>1.155</td>
</tr>
<tr>
<td>26</td>
<td>Replacement of stack book storage and preservation with digital book storage and digital preservation</td>
<td>Radical</td>
<td>.727</td>
</tr>
<tr>
<td>27</td>
<td>Provision of a suite of mobile services to access information about the library (library hours, reserve study rooms, renew books, etc.)</td>
<td>Mid-range</td>
<td>.514</td>
</tr>
<tr>
<td>28</td>
<td>Creation of a website or portal for faculty that provides services and assistance for article deposit into the institution’s repository</td>
<td>Mid-range</td>
<td>.632</td>
</tr>
<tr>
<td>29</td>
<td>The provision of digital exhibits for special collections or other unique materials that are owned by the library</td>
<td>Mid-range</td>
<td>.292</td>
</tr>
<tr>
<td>30</td>
<td>A service to digitize and provide online access to course catalogs</td>
<td>Incremental</td>
<td>.965</td>
</tr>
<tr>
<td>31</td>
<td>Made the transition to a bookless (i.e. no print books) library for certain disciplines (e.g. engineering).</td>
<td>Radical</td>
<td>.562</td>
</tr>
<tr>
<td>32</td>
<td>Implemented a liaison service to provide assistance to faculty researchers for managing their copyrights, e.g. in order to fulfill article deposit requirements from the National Institute of Health and other institutions</td>
<td>Radical</td>
<td>.583</td>
</tr>
<tr>
<td>33</td>
<td>The development of a flexible bibliographic instruction course structure that gives students the option of attending sessions in the classroom, participating online, or doing both</td>
<td>Mid-range</td>
<td>.530</td>
</tr>
<tr>
<td>34</td>
<td>Outsourced reference service to another organization (e.g.</td>
<td>Incremental</td>
<td>1.294</td>
</tr>
<tr>
<td></td>
<td>Provided for the digitization and access to university yearbooks</td>
<td>Incremental</td>
<td>.291</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>35</td>
<td>The creation of an institutional repository to contain the research output of the university (e.g. faculty research, dissertations, etc.)</td>
<td>Radical</td>
<td>.740</td>
</tr>
<tr>
<td>36</td>
<td>Implementation of faceted browsing for the library OPAC</td>
<td>Mid-range</td>
<td>.378</td>
</tr>
<tr>
<td>37</td>
<td>Collaboration with faculty or academic departments to publish student research</td>
<td>Mid-range</td>
<td>.690</td>
</tr>
<tr>
<td>38</td>
<td>Provided personal librarian service to freshman</td>
<td>Mid-range</td>
<td>.726</td>
</tr>
<tr>
<td>39</td>
<td>A dynamic mapping application for the OPAC to provide patrons directional information to find a shelved item</td>
<td>Radical</td>
<td>1.046</td>
</tr>
</tbody>
</table>
Appendix E – The 32 Final Innovations

Table 21

The Final Innovations Used in the Survey (N=32)

<table>
<thead>
<tr>
<th>Innovation Number</th>
<th>Radical</th>
<th>Incremental</th>
<th>Midrange</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Provision of a service to publish e-journals</td>
<td>The sharing of a technology platform (e.g. an OPAC or institutional repository) with another library</td>
<td>A collaboration with another library to share collection development</td>
</tr>
<tr>
<td>2.</td>
<td>The provision of a GIS (Geographical Information System) service to students and faculty, including access to GIS software, training, and consultation</td>
<td>A device and associated service to allow students and faculty to check out their own book</td>
<td>A service for the submission, access and preservation of ETDs (electronic theses and dissertations)</td>
</tr>
<tr>
<td>3.</td>
<td>Provision of a service to faculty and students for multimedia production including instruction, software and equipment platforms to support multimedia creation and publication</td>
<td>The use of live chat and instant messaging for reference service</td>
<td>The offering of a Wi-Fi service to the local community (i.e. not members of the university community)</td>
</tr>
<tr>
<td>4.</td>
<td>Provision of a science data service including archiving, preservation, and access to research data and liaison support to researchers</td>
<td>Installation of a coffee bar/restaurant/cafè in the library</td>
<td>The provision of digital exhibits for special collections or other unique materials that are owned by the library</td>
</tr>
<tr>
<td>5.</td>
<td>Replacement of stack book storage and preservation with digital book storage and digital preservation</td>
<td>Provision of a service to inexpensively print, bind and trim bookstore-quality paperbacks from digital book files that are out of copyright</td>
<td>The embedding of library liaisons with students and the instructor in course management systems</td>
</tr>
<tr>
<td>6.</td>
<td>Made the transition to a bookless (i.e. no print books) library for certain disciplines (e.g. engineering)</td>
<td>Provision of a mobile device lending service (laptop, netbook, iPAD, etc)</td>
<td>Provision of federated searching across the library OPAC, the institutional repository, and other open repositories</td>
</tr>
<tr>
<td>7.</td>
<td>Implemented a liaison service to provide assistance to faculty researchers for managing their copyrights, e.g. in order to fulfill article deposit requirements from the</td>
<td>Use of RSS feeds (or similar technology) to provide library news and event descriptions to library patrons</td>
<td>Use of digital object identifiers (e.g. DOIs or Handles) to create long-term, stable links to digital resources that are locally owned or created (digitized resources, dissertations, special</td>
</tr>
<tr>
<td></td>
<td>National Institute of Health and other institutions</td>
<td>Delivery of bibliographic instruction using online tutorials</td>
<td>Provision of mobile access to the library website and online catalog</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>8.</td>
<td>The creation of an institutional repository to contain the research output of the university (e.g. faculty research, dissertations, etc.)</td>
<td>Reconfiguration of physical space and redesigned services to provide information or learning commons (a central location for workstations, information resources, and librarian assistance)</td>
<td>Creation of a website or portal for faculty that provides services and assistance for article deposit into the institution’s repository</td>
</tr>
<tr>
<td>9.</td>
<td>Provided a dynamic mapping application for the OPAC to provide patrons directional information to find a shelved item</td>
<td>A service to digitize and provide online access to historic, print course catalogs</td>
<td>The development of a flexible bibliographic instruction course structure that gives students the option of attending sessions in the classroom, participating online, or doing both</td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td>Outsourced reference service to another organization (e.g. another library, nonprofit, or a commercial organization)</td>
<td>Implementation of faceted browsing for the library OPAC</td>
</tr>
<tr>
<td>11.</td>
<td></td>
<td>Provided for the digitization and access to historic university yearbooks</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix F – Means and Standard Deviations

#### Table 22

**Means and Standard Deviations for all Variables (N=50)**

<table>
<thead>
<tr>
<th>Variable Number</th>
<th>Variable Label</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Innovation performance</td>
<td>40.88</td>
<td>13.02</td>
</tr>
<tr>
<td>2</td>
<td>Behavioral integration</td>
<td>6.44</td>
<td>0.97</td>
</tr>
<tr>
<td>3</td>
<td>Decision awareness</td>
<td>61.43</td>
<td>11.56</td>
</tr>
<tr>
<td>4</td>
<td>Singular leader attitude</td>
<td>6.98</td>
<td>1.09</td>
</tr>
<tr>
<td>5</td>
<td>Ambidexterity</td>
<td>13.62</td>
<td>1.73</td>
</tr>
<tr>
<td>6</td>
<td>Ambidexterity (balance)</td>
<td>0.91</td>
<td>0.64</td>
</tr>
<tr>
<td>7</td>
<td>Organizational size</td>
<td>312.18</td>
<td>178.73</td>
</tr>
<tr>
<td>8</td>
<td>Structural differentiation</td>
<td>5.36</td>
<td>0.84</td>
</tr>
<tr>
<td>9</td>
<td>Staff/professional profile</td>
<td>15.19</td>
<td>15.01</td>
</tr>
<tr>
<td>10</td>
<td>Affluence (expense per student)</td>
<td>1250.70</td>
<td>902.14</td>
</tr>
<tr>
<td>11</td>
<td>Environmental munificence (change in expenditures)</td>
<td>36.50</td>
<td>21.75</td>
</tr>
<tr>
<td>12</td>
<td>Environmental uncertainty (predictability)</td>
<td>4.47</td>
<td>0.72</td>
</tr>
<tr>
<td>13</td>
<td>TMT age</td>
<td>55.52</td>
<td>4.13</td>
</tr>
<tr>
<td>14</td>
<td>TMT professional tenure</td>
<td>25.06</td>
<td>6.1</td>
</tr>
<tr>
<td>15</td>
<td>TMT tenure in position</td>
<td>7.33</td>
<td>4.30</td>
</tr>
<tr>
<td>16</td>
<td>Leader level of education</td>
<td>3.18</td>
<td>1.60</td>
</tr>
<tr>
<td>17</td>
<td>TMT educational diversity</td>
<td>1.98</td>
<td>0.62</td>
</tr>
<tr>
<td>18</td>
<td>TMT educational diversity (science)</td>
<td>0.56</td>
<td>0.71</td>
</tr>
</tbody>
</table>
## Appendix G – Correlations of All Variables

### Table 23

**Correlations of All Variables (N=50)**

<table>
<thead>
<tr>
<th>Var</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BI</td>
<td>0.33a</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DA</td>
<td>0.42a</td>
<td>0.38a</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LDR</td>
<td>0.24a</td>
<td>0.26a</td>
<td>0.09</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AO</td>
<td>0.42a</td>
<td>0.63a</td>
<td>0.36a</td>
<td>0.54a</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AOB</td>
<td>0.36a</td>
<td>0.17</td>
<td>0.13</td>
<td>0.50a</td>
<td>0.41a</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SZ</td>
<td>0.35a</td>
<td>0.30a</td>
<td>0.07</td>
<td>0.19</td>
<td>0.15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>STR</td>
<td>0.08</td>
<td>0.09</td>
<td>0.07</td>
<td>0.28</td>
<td>0.10</td>
<td>0.27b</td>
<td>0.14</td>
<td>0.04</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>STF</td>
<td>0.00</td>
<td>0.07</td>
<td>0.23</td>
<td>0.06</td>
<td>0.09</td>
<td>0.03</td>
<td>0.46a</td>
<td>0.13</td>
<td>0.17</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>ENM</td>
<td>0.22</td>
<td>0.03</td>
<td>0.02</td>
<td>0.14</td>
<td>0.14</td>
<td>0.12</td>
<td>0.31a</td>
<td>0.03</td>
<td>0.33a</td>
<td>0.10</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>ENU</td>
<td>0.11</td>
<td>0.23</td>
<td>0.21</td>
<td>0.20</td>
<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
<td>0.06</td>
<td>0.05</td>
<td>0.03</td>
<td>0.19</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>0.03</td>
<td>0.12</td>
<td>0.22</td>
<td>0.13</td>
<td>0.06</td>
<td>0.14</td>
<td>0.09</td>
<td>0.06</td>
<td>0.20</td>
<td>0.00</td>
<td>0.09</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TEN</td>
<td>0.02</td>
<td>0.26</td>
<td>0.22</td>
<td>0.13</td>
<td>0.02</td>
<td>0.22</td>
<td>0.12</td>
<td>0.01</td>
<td>0.20</td>
<td>0.27</td>
<td>0.13</td>
<td>0.15</td>
<td>0.66a</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TNP</td>
<td>0.04</td>
<td>0.23</td>
<td>0.03</td>
<td>0.08</td>
<td>0.20</td>
<td>0.02</td>
<td>0.30a</td>
<td>0.05</td>
<td>0.04</td>
<td>0.28b</td>
<td>0.21</td>
<td>0.14</td>
<td>0.19</td>
<td>0.21</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>EDL</td>
<td>-0.10</td>
<td>0.00</td>
<td>0.02</td>
<td>0.25</td>
<td>0.08</td>
<td>0.18</td>
<td>0.07</td>
<td>0.06</td>
<td>0.23</td>
<td>0.03</td>
<td>0.22</td>
<td>0.25</td>
<td>0.08</td>
<td>0.03</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>EDD</td>
<td>-0.11</td>
<td>-0.21</td>
<td>-0.13</td>
<td>0.13</td>
<td>0.10</td>
<td>0.02</td>
<td>0.11</td>
<td>0.23</td>
<td>0.01</td>
<td>0.29b</td>
<td>-0.23</td>
<td>0.17</td>
<td>-0.24</td>
<td>-0.13</td>
<td>-0.13</td>
<td>0.14</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>EDS</td>
<td>-0.08</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.29b</td>
<td>0.08</td>
<td>-0.23</td>
<td>0.09</td>
<td>0.10</td>
<td>-1.0</td>
<td>-1.9</td>
<td>0.01</td>
<td>0.16</td>
<td>-0.22</td>
<td>-0.23</td>
<td>-0.28b</td>
<td>-0.04</td>
<td>0.60a</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Significant (2-tailed) at .01 level,  
^b Significant at .05 level

Key to Variables: IP=Innovation performance, BI=Behavioral integration, DA=Decision awareness, LDR=Singular leader attitude, AO=Ambidextrous orientation, AOB=Ambidexterity(balance), SZ=Organizational size, STR=Structural differentiation, STF=Staff/professional profile, AFL=Affluence, ENM=Environmental munificence, ENU=Environmental uncertainty, AGE=TMT age, TEN=Professional tenure, TNP=Tenure in position, EDL=TMT level of education, EDD=TMT educational diversity, EDS=TMT educational diversity (science).
Appendix H – Correlations with Radical Innovation Performance

Table 24

Correlations with Radical Innovation Performance

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Correlation with Radical Innovation Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team Behavior and Leadership</strong></td>
<td></td>
</tr>
<tr>
<td>Behavioral integration</td>
<td>0.35&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Decision awareness</td>
<td>0.38&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Singular leader attitude</td>
<td>0.25&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Organizational Learning</strong></td>
<td></td>
</tr>
<tr>
<td>Ambidextrous orientation</td>
<td>0.43&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ambidexterity (balance)</td>
<td>-0.36&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
</tr>
<tr>
<td>Structural differentiation</td>
<td>-0.16</td>
</tr>
<tr>
<td>Size</td>
<td>0.42&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Institutional size (private or public)</td>
<td>-0.09</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Environmental uncertainty</td>
<td>0.04</td>
</tr>
<tr>
<td>Environmental munificence (increase in expenditures)</td>
<td>0.18</td>
</tr>
<tr>
<td>Environmental munificence (expenditures in 2009)</td>
<td>0.29&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td>TMT age</td>
<td>0.05</td>
</tr>
<tr>
<td>TMT professional tenure</td>
<td>-0.00</td>
</tr>
<tr>
<td><strong>Educational Level and Diversity</strong></td>
<td></td>
</tr>
<tr>
<td>TMT level of education</td>
<td>-0.16</td>
</tr>
<tr>
<td>TMT educational diversity</td>
<td>-0.01</td>
</tr>
<tr>
<td>Educational diversity (science)</td>
<td>0.11</td>
</tr>
</tbody>
</table>

<sup>a</sup> Significant (1-tailed) at .01 level, <sup>b</sup> Significant at .05 level