EXPLORING IDENTITY AND ORGANIZING FOR SUSTAINED INNOVATION
IN AN ENTREPRENEURIAL ACADEMIC LABORATORY:
TWO GROUNDED THEORY MODELS

A Dissertation in
Business Administration
by
Aimee Lou Hamilton

© 2012 Aimee Lou Hamilton

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

May 2012
The dissertation of Aimee Lou Hamilton was reviewed and approved* by the following:

Dennis A. Gioia  
Chair of Management and Organization  
Robert and Judith Klein Professor of Management  
Dissertation Advisor  
Chair of Committee  

Raghu Garud  
Research Director of the Farrell Center for Entrepreneurship  
Alvin H. Clemens Professor of Entrepreneurial Studies  
Professor of Management and Organization  

Glen Kreiner  
Associate Professor of Management  

Wenpin Tsai  
John and Kara Arnold Fellow in Management  
Professor of Business Administration  

Susan G. Strauss  
Associate Professor of Applied Linguistics, Asian Studies, Education, and Linguistics  

*Signatures are on file in the Graduate School.
ABSTRACT

In this dissertation, I conduct an interpretive study to investigate two related research questions regarding aspects of identity and organizing in an entrepreneurial academic laboratory that has a long history of successful innovation. Many organizations aspire to achieve sustained innovation, but find it difficult to accomplish. I employ both qualitative and social network methods to develop two empirically-grounded theory models. The first model describes how key constituent elements including identity dynamics and fluid organizing facilitate sustained innovation and shows how an organization might reconcile the dilemma of simultaneous flexibility and stability in pursuit of innovation. Prior research shows that organizational identity can foster innovation-inhibiting rigidities. In contrast, I found that interplay between organizational identity and members’ professional identities facilitated fluidity and innovation by providing a dynamically stable cognitive scaffold that guided the co-evolution of structures and resources. The resulting fluid organizing process was crucial to sustained innovation.

The second grounded theory model explores processes involved in professional identity development among scientists in a multidisciplinary context. I consider the influence of social network relationships and the identity work processes invoked by scientists to manage relational plurality and the development of their professional identities. I document several tensions associated with developing professional identity, as well as three primary identity work tactics used to balance these prevalent tensions. My social network analysis reveals strong relational plurality dimensions which provide diverse resources for identity work. In this study I extend theory concerning professional
identity development and demonstrate the importance of social networks to identity work. By connecting the (external) relational aspect of early career professional identity work to the (internal) intrapersonal aspects, I bring together the literatures on professional identity, identity work, and social network analysis and answer calls for greater exploration of the relationships among these concepts. In addition, this exploration of professional identity work demonstrates the import of individual professional identity development to organizational innovation, especially in science-driven fields. Finally, insights from this study into professional identity work in a multidisciplinary context may inform our understanding of the microfoundations of the process of professionalization and the formation of new professions.

Key words: innovation, academic entrepreneurship, professional identity, professional identity development, organizational identity, social network analysis, interdisciplinary science, knowledge workers, identity work, identity tensions, scientists, relationships, multi-level research, grounded theory, case study.
# TABLE OF CONTENTS

List of Figures ........................................................................................................ vii

List of Tables .......................................................................................................... viii

Acknowledgements ................................................................................................ ix

Chapter 1. INTRODUCTION ............................................................................. 1
   Research Questions ............................................................................................... 2
   Contributions .......................................................................................................... 9

Chapter 2. LITERATURE REVIEW ................................................................. 11
   Organizational Innovation .................................................................................... 11
   Identity Theory and Research ............................................................................. 26
      Professional Identity ......................................................................................... 28
      Organizational Identity ..................................................................................... 34
   Social Networks .................................................................................................... 38
   Fluid Organizing: An Emergent Dimension ....................................................... 44
   Integrating the Literatures .................................................................................... 46

Chapter 3. DATA AND METHODOLOGY ..................................................... 48
   Description of Research Setting ......................................................................... 48
   Data Description and Collection Procedures ................................................... 51
   Social Network Analysis ..................................................................................... 54
   Building Grounded Theory ................................................................................ 56

Chapter 4. FINDINGS FOR RESEARCH QUESTION 1 ................................. 58
   Dimension 1. External Context .......................................................................... 59
   Dimension 2. Identity Dynamics ......................................................................... 66
   Dimension 3. Flexible Resources ....................................................................... 74
   Dimension 4. Shifting Structure ......................................................................... 79
   Dimension 5. Fluid Organizing .......................................................................... 83
   A Grounded Model of Fluid Organizing for Sustained Innovation .................. 85

Chapter 5. DISCUSSION OF FINDINGS FOR RESEARCH QUESTION 1 .. 90
   Identity Dynamics and Organizing for Sustained Innovation ......................... 90
   Fluid Organizing and Sustained Innovation ..................................................... 91
   Interplay of Organizational and Professional Identity ..................................... 93
   A Multi-Level View of Sustained Innovation .................................................... 95

Chapter 6. FINDINGS FOR RESEARCH QUESTION 2 ................................. 98
   Features of Scientists’ Professional Identity Work ......................................... 98
   Influence of Relational Plurality and a Multidisciplinary Context ................. 107
Chapter 7. DISCUSSION OF FINDINGS FOR RESEARCH QUESTION 2

- Scientists’ Professional Identity Development in a Multidisciplinary Context .......................... 113
- Heterogeneity and Multiplexity ........................................................................................................... 114
- Professional Identity Development and Innovation .............................................................................. 114
- Professionalization and the Formation of New Professions ............................................................... 115

Chapter 8. CONCLUSION ......................................................................................................................... 117

- Limitations ........................................................................................................................................... 118
- Concluding Comments ....................................................................................................................... 119

References ................................................................................................................................................ 122

Appendix A. FIGURES ............................................................................................................................ 136

Appendix B. TABLES ............................................................................................................................... 145

Appendix C. SOCIAL NETWORK SURVEY QUESTIONS ..................................................................... 156

Appendix D. ORGANIZATIONAL IDENTITY SURVEY QUESTIONS .................................................... 157

Appendix E. INTERVIEW PROTOCOL .................................................................................................. 159
LIST OF FIGURES

Figure 1.  FACULTY VIEWS OF ACADEMY-INDUSTRY RELATIONS .......... 137
Figure 2.  DATA STRUCTURE FOR RESEARCH QUESTION 1 .................. 138
Figure 3.  BIOTECH LAB GROUPS AND PROFESSIONAL DISCIPLINES FALL 2008 ........................................................................ 139
Figure 4.  BIOTECH LAB GROUPS AND PROFESSIONAL DISCIPLINES SUMMER 2010 ......................................................................... 139
Figure 5.  BIOTECH LAB ADVICE-GIVING NETWORK FALL 2008 .......... 140
Figure 6.  GROUNDED MODEL OF FLUID ORGANIZING FOR SUSTAINED INNOVATION ................................................................. 141
Figure 7.  GROUNDED MODEL OF PROFESSIONAL IDENTITY WORK ...... 142
Figure 8.  BIOTECH LAB FRIENDSHIP NETWORK 2008 ......................... 143
Figure 9.  BIOTECH LAB ADVICE-GIVING NETWORK 2008 .................... 143
Figure 10. BIOTECH LAB POWER NETWORK 2008 ................................ 144
Figure 11. MULTIPLEX TIES (FRIENDSHIP, ADVICE AND POWER) ........ 144
LIST OF TABLES

Table 1. COMPRENDIUM OF ADDITIONAL REPRESENTATIVE QUOTATIONS FOR RESEARCH QUESTION 1 ........................................... 146

Table 2. DISTRIBUTION OF PROFESSIONAL DISCIPLINES ACROSS BIOTECH LAB GROUPS FALL 2008 & FALL 2010 .......................... 150

Table 3. DENSITY OF TIES IN BIOTECH LAB ADVICE-GIVING NETWORK WITHIN AND ACROSS GROUPS ........................................ 151

Table 4. REPRESENTATIVE QUOTES FOR THEMES PERTAINING TO RESEARCH QUESTION 2 .................................................... 152

Table 5. E-I INDEX MEASURE OF HETEROGENEITY IN SOCIAL NETWORKS .................................................................................. 155
ACKNOWLEDGEMENTS

“All marvelous scientific achievements are the works of the living spirit that dwells in human beings.” Paramahamsa Hariharananda

My deep gratitude goes to the founder of BioTech Lab (a pseudonym) for his exceptional generosity in terms of sharing his time, thoughts and access to his laboratory. I am also grateful to the members of BioTech Lab for their participation in this research. They were also quite generous with their time and candid observations. In addition, they were kindly tolerant of my being underfoot while they tried to conduct their own research. Without these informants, this study would quite literally not have been possible, and I hope that this dissertation does justice to their volunteer participation.

Others deserving of my sincere thanks are Glen Kreiner, Raghu Garud, and Wenpin Tsai, as committee members, mentors, and colleagues. Each of these individuals made a substantial and unique contribution to my dissertation and my development as a scholar, and I am very grateful to them all. Thank you, too, to Susan Strauss for serving on my committee and venturing to the Business Building for my benefit. Her insights as an applied linguist provided a fresh and invaluable perspective on my interview data. I also thank the members of the ORG seminar at Penn State for their helpful suggestions at an early stage of this dissertation. I would like to acknowledge the following Management and Organization faculty members for their support of me during the dissertation process and the PhD program more generally: Forrest Briscoe, Vilmos Misangyi, Barbara Gray, and Linda Trevino. Former Penn State professor, Ujwal Kayande, who is my mentor, co-author and friend, also has my deep appreciation.

Foremost among my mentors is my advisor, Denny Gioia, for whom I reserve my deepest thanks. He has been more than a mentor to me throughout the PhD program.
With his encouragement, I have grown personally and professionally and achieved more than I ever imagined. Words cannot express my appreciation to him, and I owe him a debt of gratitude that I can never repay. I hope only to pay it forward as I strive to be the type of colleague and mentor that he has been to me.

I also appreciate the support of family and friends as I have progressed through the PhD program and conducted my dissertation research. Thank you to my husband, Doug, for his advice, having “been there and done that” before me. Thank you to him, too, for his love and support during my ups and downs and for accommodating my schedule and needs during the last six years, which have been very demanding. His role in my achievements goes beyond what words can express. Thank you to my children, Carter and Keegan, for their unconditional love and for always being there to remind me that there is much more to life than work.

I am also very grateful to my treasured long-time friend Laura for her help during this journey. Her emotional support throughout and also her physical support as host to my field visits, were truly indispensable. It will always be special to me that my dissertation defense took place on a milestone birthday for her. Thank you also to my dear friend Jen for her support and encouragement. As my M&O soul sister, she has cheered my triumphs and provided a shoulder to cry on during my defeats. She has been there when I needed her, and her friendship is a great blessing. I also appreciate my other PhD colleagues – Dan, Hong, Kwangho, Niyati, Ravi, and Shubha – for various kindnesses too numerous to mention. A special thank you goes to Kristin, too, may she rest in peace. All of these friends in their own ways helped me along this journey, probably more than they realize, and I am grateful.
This work was sponsored in part by competitive dissertation summer stipend and doctoral research awards from the Smeal College of Business and a research grant from the Center for the Management of Technological and Organizational Change and the Smeal College of Business at Penn State.
“People from the outside sometimes call BioTech Lab, and I get annoyed by this, a factory. It is very insulting because it is so much not a factory. It is true that a lot of science is being done here and everyone envies the amount of funding that we get, but it is not a factory at all. A factory is a group of people who aren’t thinking, maybe two or three are thinking, but everyone else is just working. It is not at all about being a factory. It is about people inventing and feeling free to invent. There is a great freedom here for inventions.” BioTech Lab member

CHAPTER 1. INTRODUCTION

In this dissertation, I conduct an interpretive study to investigate aspects of identity and organizing in an entrepreneurial academic laboratory that has a long history of successful innovation. In the post-modern era competitive advantages are often fleeting, so an organization’s success and even survival have become increasingly predicated on a capacity for sustained innovation (Bartel & Garud, 2009; Garud, Gehman, & Kumaraswamy, 2011; Jelinek & Schoonhoven, 1990). Although many organizations try to generate a sustained flow of successful new products, services, or technologies, few have actually succeeded in doing so. Over several decades, considerable research has been devoted to an understanding of the innovation process and factors that facilitate or impede continuous innovation (e.g., Damanpour, 1987; Damanpour, 1991; Dougherty & Hardy, 1996; Paruchuri, 2010; Van de Ven, 1986; Yuan & Woodman, 2010; Zaltman, Duncan, & Holbeck, 1973). Practically speaking, however, sustained innovation remains an elusive goal for most organizations and, theoretically speaking, it remains an obviously important, if underspecified concept.

Operating on the premise that a promising avenue for investigating processes involved in the generation of sustained innovation was to study an organization that has demonstrated this ability over time, I conducted a study of BioTech Lab (a pseudonym), a world famous laboratory that has consistently and successfully innovated in the highly
competitive biotechnology field for over three decades. At any given time, many teams are working on innovations of various types and at different stages of development. BioTech Lab thus provided an extraordinary opportunity for understanding how an organization organizes for sustained innovation.

Research Questions

For this research, I initially adopted the theoretical lens of organizational identity. Organizational identity reflects organizational members’ shared beliefs about what they take to be central, distinctive, and continuous over time about their organization (Albert & Whetten, 1985). Organizational identity is a central yet largely unexamined issue related to the question of how organizations achieve sustained innovation. Organizational identity’s influence on sustained innovation poses an unresolved conundrum. Organizational identity is known to be a crucial and generative force in other consequential organizational activities, such as mergers and strategic change (Clark, Gioia, Ketchen, & Thomas, 2010; Dutton & Dukerich, 1991; Gioia & Thomas, 1996); yet when core identity beliefs are deeply held and rigid, they can inhibit an organization’s ability to adapt and innovate (Elshbach & Kramer, 1996; Nag, Corley, & Gioia, 2007). In the context of organizational innovation (and adaptability, more generally), organizational identity has been consistently portrayed as a cognitive framework that reduces complexity and thus limits flexibility (Schreyogg & Sydow, 2010) and it has been shown to inhibit innovation (Tripsas, 2009). Thus the literature has portrayed the relationship of organizational identity to organizational innovation as essentially one-sided, as a hindrance to innovation as well as its necessary antecedents. Organizational identity’s potential generative role in sustained innovation remains unexplored, however,
and therein lies the puzzle. It is unclear whether organizations that repeatedly and successfully innovate manage to do so in spite of their identities. Or, perhaps their identities somehow facilitate sustained innovation. Thus, my first research question was:

*Research Question 1: How is organizational identity related to sustained innovation?*

I addressed this research question through a qualitative, inductive study of BioTech Lab with the intent of developing theory that is grounded in the data. The grounded theory approach allows room for the discovery of salient concepts as part of the research and analysis process. In the interpretive research approach employed in this study, the theoretical concepts and framework are grounded in and emerge from the data and analysis (Glaser & Strauss, 1967; Strauss & Corbin, 1994), rather than being derived predominantly from prior theory (which often tends to guide and constrain data collection). Because of my grounded theory approach, some of the concepts discussed in the introduction and literature review actually emerged from the study itself. In particular, two additional concepts did emerge – fluid organizing and professional identity – and serve as important elements in the grounded theory model that addresses my initial research question.

The management literature has associated an organization’s capacity to innovate with its ability to be fluid or flexible and adaptive (e.g., Burns & Stalker, 1994/1961; Damanpour, 1991; Thompson, 1967). Therefore, understanding the relationship between identity and sustained innovation very likely involves understanding the relationship between organizational identity and organizational fluidity or flexibility and adaptability. Flexibility in terms of structure, routines, and asset allocation allows an organization to adapt and capitalize on opportunities to innovate (Brown & Eisenhardt, 1997; Rindova &
Kotha, 2001), whereas rigidities in these areas can hamper innovative efforts (Benner & Tushman, 2002; Leonard-Barton, 1992). Equally important, an organization must possess a cognitive orientation that enables flexibility and innovation (Tripsas & Gavetti, 2000). Cognitive rigidity, such as entrenched beliefs about what is central to “who we are,” i.e., the organizational identity (Albert & Whetten, 1985), can prevent organizational members from perceiving opportunities for innovation and can hinder the internal changes necessary to pursue them (Reger, Gustafson, Demarie, & Mullane, 1994; Tripsas, 2009). If innovation requires some degree of flexibility, then repeated and consistent innovation is likely to demand exceptional flexibility, including an organizational identity that allows or possibly even encourages and facilitates adaptation and change. Research has not yet addressed what the properties and contours of such an organizational identity might be.

A strong sense of identity might supply a kind of scaffold or conceptual framework for organization members to understand and invoke processes of sustained innovation, because identity can influence how key social and cognitive processes interact and affect action (e.g., Dutton & Dukerich, 1991; Nag, Corley, & Gioia, 2007; Weick, 1993). As Powell and Colyvas have pointedly noted, “identity is central because individuals act based on who they are, not on what choices they have...” (Powell & Colyvas, 2008: 284). A focus on identity, therefore, might facilitate theory-building about organizational innovation because it draws attention to the meaning frames that can guide organizational sensemaking and sensegiving. To my knowledge, only one empirical study has systematically investigated innovation from an identity perspective (Tripsas, 2009), which found that organizational identity influenced whether technological change
opportunities were even recognized, and that the implementation of a major new technology required an identity change. Other work in the area of organizational change and adaptation have tended to downplay the role of identity – or viewed it as a feature that actually inhibits flexibility (e.g., Reger, Gustafson, Demarie, & Mullane, 1994). I explore this assumption empirically, by investigating relationships between fluidity and identity and how these phenomena are related to sustained innovation.

Although I initially focused on the role of organizational identity, a second form of identity, professional identity, emerged as also important in this study. Therefore, I came to focus on two distinct types of identity – organizational and professional – which have not typically been considered together. Professional identity consists of the expert knowledge, beliefs and motives that individuals use to define themselves in professional roles (Ibarra, 1999; Pratt, Rockmann, & Kaufmann, 2006). In an increasing number of fields, like biotechnology and information technology, innovation depends on expert knowledge workers for whom professional identity influences thought and action. Professional identity connects individuals to an institutional logic based on education, training and tradition in that profession (Rao, Monin, & Durand, 2003), which confers upon them a cognitive framework that is not necessarily the same as that of the organization in which the professional work takes place. Thus, as a guide to action in organizations, professional identity is likely to interrelate with other sensemaking guides, such as organizational identity.

The saliency of professional identity and its development to my informants became apparent during the early stages of my research; pilot interviews and survey responses indicated that BioTech Lab’s members, who came from a diverse range of
disciplines, viewed their own professional identity development and career aspirations as somehow highly relevant to the mission their organization, which was to innovate. This discovery inspired me to explore more deeply the nature of professional “identity work” (Snow & Anderson, 1987), i.e., the activities involved in creating and maintaining a professional identity, in BioTech Lab. Little is known about the professional identity development of scientists, in their own right and as a special type of elite knowledge worker. In the twenty-first century, Western civilization is clearly deep into the era of the knowledge economy (Powell & Snellman, 2004) and the age of knowledge workers (Drucker, 1993). An increased dependence on goods and services based on knowledge-intensive activities has brought with it an expansion and diversification in the ranks of those considering themselves professionals (Sass, 1990), i.e., workers who are distinguished by their possession or claim of expert knowledge and whose work involves applying this knowledge to “tasks tied to core societal values” (Leicht & Fennell, 1997: 431).

Despite their importance in organizations, knowledge workers have not been the subject of much scholarly work. In particular, little is known about how they develop and maintain a sense of professional identity, i.e., the “attributes, beliefs, motives and experiences in terms of which people define themselves in a professional role” (Ibarra, 1999: 765). Because knowledge workers play a vital role in important organizational activities such as producing innovation (e.g., Rohtaermel & Hess, 2007) and because they represent a large and growing segment of the workforce, an understanding of how they construct their professional identities has implications for several aspects of organizing,
including the management of innovation processes, the management of knowledge workers, and the phenomenon of “professionalization” itself.

Management and organization scholars have devoted considerable attention to identity construction in the “classic” professions, such as medicine, banking and accountancy (e.g., Chreim, Williams, & Hinings, 2007; Ibarra, 1999; Kosmala & Herrbach, 2006; Pratt et al., 2006). Although existing research may provide transferable insights, professional identity construction for knowledge workers and other groups of non-traditional professionals may involve salient differences that have yet to be examined. For example, one important difference may be that knowledge workers frequently work in contexts that are unlike single-profession settings or fields such as healthcare where a shared logic can dictate the interaction between individuals possessing diverse professional identities. Multidisciplinary settings may pose a distinct set of opportunities and challenges to professional identity construction that have yet to be explored. These issues may be especially acute when early training takes place in a mono-disciplinary setting and subsequent identity work takes place in an organization that requires individuals with different professional backgrounds to form work relationships with each other.

Scientists are a group of professional knowledge workers that stands at the cutting edge of the knowledge economy because when successful, their work results in innovative and sometimes revolutionary technological change. Scientific research – particularly applied science – now tends to require collaborative efforts across scientific disciplines and, therefore, often tends to occur within diverse, multidisciplinary teams. As collaborative and multidisciplinary work becomes more and more prevalent, insights into
scientists’ professional identity construction could have broader application to other groups of knowledge workers and other professional sectors.

Therefore, I crafted a second research question focusing on this somewhat specific issue that was related to yet distinct from the first research question. The second research question was:

Research Question 2: What are the distinctive features of scientists’ professional identity work in a multi-disciplinary context??

The second research question was empirically-driven, arising out of my discovery of the importance of professional identity in my research setting, and the literature suggests that this topic has theoretical merit as well. My goal in exploring the second research question is to build grounded theory on the phenomenon of scientists’ professional identity work. In building theory, I sought to connect the internal (i.e., intrapsychic) aspects and the external (i.e., relational) aspects of identity work, which are two key themes underlying existing theory (e.g., Ibarra, 1999).

In conducting this dissertation research and exploring my two research questions, I drew on several different empirical sources from my research site, including interviews, archival records, survey and social network data. Social network analysis enriched my investigation of the first research question by revealing how elements of the organization’s informal and formal structure were inter-related and change over time. I then drew on other data sources to show how identity dynamics were associated with this shifting organizational structure. Social network analysis was also an integral aspect of my exploration of my second research question which focused on professional identity work. Network data provided insights into the nature of relationships in the organization.
and in concert with other data, allowed me to develop an understanding of how these relationships influenced professional identity work.

**Contributions**

In this dissertation I offer several contributions. First, I develop two empirically grounded theoretical models pertaining to identity and organizing for innovation. The first model describes how key constituent elements including identity dynamics and fluid organizing facilitate sustained innovation and shows how an organization might reconcile the dilemma of simultaneous flexibility and stability in pursuit of innovation. The first grounded model also extends theory on organizational identity, a concept that is crucial to innovation but has been understudied in this context. In addition, by considering both organizational and professional identity together, the model expands the line of inquiry into the relationships between these two cognitive frameworks.

The second grounded theory model extends what is known about the phenomenon of professional identity development among of scientists and knowledge workers more generally. By connecting the (external) relational aspect of early career professional identity work to the (internal) intrapersonal aspects, I bring together the literatures on professional identity, identity work, and social network analysis and answer calls for greater exploration of the relationships among these concepts (Ibarra & Deshpande, 2007; Ibarra, Kilduff, & Tsai, 2005). In addition, this exploration of professional identity work demonstrates the import of individual professional identity development to organizational innovation, especially in science-driven fields. Finally, insights from this study into professional identity work in a multidisciplinary context may inform our understanding
of the microfoundations of the process of professionalization and the formation of new professions.

This first chapter sets forth my two primary research questions and their motivation, as well as the intended contributions of this dissertation. The remainder of the dissertation is organized as follows. Chapter 2 presents the relevant literature and frames the theoretical context for my inquiry. Chapter 3 describes the data and methodology that I employed to explore the research questions. Chapter 4 sets forth the findings for the first research question regarding organizational identity and sustained innovation, and Chapter 5 discusses the implications of the findings. Chapter 6 presents the findings for the second research question pertaining to scientists’ professional identity work in a multi-disciplinary context, and Chapter 7 discusses the implications of the second set of findings. Chapter 8 provides concluding remarks including limitations and the implications of both sets of findings for research and practice.
CHAPTER 2. LITERATURE REVIEW

I begin by reviewing prior empirical and theoretical work in the areas of innovation and related topics including the knowledge-based view of the firm (e.g., Tsoukas, 1996, 2002) and social studies of science and technology (e.g., Galison, 1987; Latour & Woolgar, 1986). I next present theory and research relevant to organizational fluidity, an emergent concept in my research. After that, I consider the literature on professional and organizational identity and discuss how this body of work is relevant to my dissertation study. Finally, I address social network research and its relevance to the issues that I am exploring.

Organizational Innovation

Organizational innovation as a problem domain has attracted great scholarly interest for at least 50 years. March and Simon (1958) provided one of the earliest treatments of organizational innovation in their foundational book *Organizations*, devoting an entire chapter to the nature and management of innovation. Similar to other early authors, they framed the innovation process as a problem-solving exercise that could be broken down into simple elements that follow a linear sequence. After decades of research, the view of innovation as a straightforward progression through identifiable and distinct stages has been replaced by an understanding that innovation processes are cyclical and iterative, and frequently path-dependent and unpredictable (Garud, Kumaraswamy, & Karnoe, 2010; Van de Ven, Polley, Garud, & Venkataraman, 1999). Van de Ven et al. (1999), however, suggest that it is imprudent to assume that this complexity reflects randomness and that innovation processes are therefore unyielding to empirical examination. I would add that, for one thing, innovation is too important to
society for management scholars not to attempt to understand the complexity. For another, research accumulated over the past 30 years has shed light on many aspects of the innovation process, suggesting that it is a phenomenon that can be understood.

Scholars have identified several factors at the organizational, group and individual levels that facilitate or inhibit innovation. For example, a meta-analysis by Damanpour (1991) found that specialization (i.e., number of roles or job types), functional differentiation (i.e., departmentalization), professionalization (i.e., educational background of employees), and slack resources in organizations foster innovation. He found that centralization hindered innovation generally and other factors, such as formalization (i.e., emphasis on following formal rules) had mixed effects depending on the industry and type of innovation (Damanpour, 1991). At the group level, factors that have been found to facilitate innovation include team member heterogeneity, cohesiveness, longevity, and moderate levels of task conflict (Anderson, Dreu, & Nijstad, 2004; DeDreu, 2006; West & Anderson, 1996). High or low levels of task conflict actually inhibit innovation (DeDreu, 2006). Individual level factors have been the most frequently studied (Anderson et al., 2004). Although beyond the scope of my study, I briefly note here that several individual characteristics appear to foster innovation, including intelligence and personality traits such as self-confidence and tolerance for ambiguity (Anderson et al., 2004).

The identification of these diverse independent variables and moderators over the years has certainly advanced what is known about innovation. In a recent review, however, Anderson et al. (2004) noted that innovation studies are typically cross-sectional works that focus a single level of analysis (primarily the individual). Innovation
is known to be a complex process involving cross-level influences, and the bulk of existing studies are inadequate for revealing the underlying processes implied by these dynamic interactions. With some notable exceptions (e.g., Garud, Kumaraswamy, & Sambamurthy, 2006), few studies have adopted the multi-level and longitudinal designs required to explore the innovation process in a comprehensive manner at the organizational level of analysis. Before reviewing the few studies and their relevance to the present study, I make a brief but necessary detour regarding the definition of organizational innovation.

**Organizational innovation defined.** West and Farr (1989) and Van de Ven (1986) set forth definitions of organizational innovation that are the most commonly used in organizational studies. According to West and Farr (1989), workplace innovation is:

...the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, the organization or wider society (p. 16).

Similarly, Van de Ven (1986) stated that:

“The process of innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context.... An Innovation is a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved (1986: 591).

Although they have different emphases, the perspectives are compatible. In both, a defining feature of innovation is that it involves both introducing ideas that are new to a group, organization or society, and also implementing or applying them. Further, as West and Farr (1989) make explicit, there is an anticipated benefit to some person or group, possibly even a group as grand as “wider society.” The innovating individuals and
organization might not be the intended beneficiaries, and the gain might never actually be realized.

The types of innovations that have been studied include “technical innovations (new technologies, products, and services) and administrative innovations (new procedures, policies, and organizational forms)” (Van de Ven, 1986: 592). Van de Ven (1986) cautioned against making too fine a distinction because innovations frequently have features of both. He points out that implementation of technical innovations often rely upon administrative innovations and vice versa. While bearing this caution in mind, I note that extant studies of technical innovation have most direct relevance to the high velocity environment of biotechnology, the context for my study.

**Multi-level and longitudinal innovation research.** A relatively small number of innovation studies have investigated organizational innovation longitudinally or with a multi-level perspective. Field studies by Van de Ven and colleagues (Polley & Van de Ven, 1996; Schroeder, Van de Ven, Scudder, & Polley, 1986; Van de Ven et al., 1999) established that innovation processes involve multiple paths that diverge and converge and sometimes run parallel to each other, as well as participation over time by numerous parties internal and external to the organization. In the most extensive examination of intra-organizational innovation, Schroeder, Van de Ven, Scudder and Polley (1986) compared the longitudinal case histories of 14 innovations and derived an empirically grounded set of common elements. The data were collected as part of the Minnesota Innovation Research Program (“MIRP”) that conducted field studies of these innovations over a period of several years. Van de Ven et al. (1999) later placed the common patterns identified in the MIRP data within a process framework featuring three distinct periods:
initiation, development, and implementation/termination. Although this process framework does not address underlying mechanisms or theoretical processes, it represents an important milestone because it attempts to structure the nonlinear complexity of innovation and stood in stark contrast to the orderly and linearly sequenced problem solving exercise depicted by other earlier writers (e.g., Zaltman et al., 1973). Therefore, as I attempt to build theory, the key features of the three phases provide potentially useful points of comparison to the events that I might observe in my research setting. According to Van de Ven et al. (1999), during the initiation period, most innovations gestated for an extended period during which a combination of coincidental events “set the stage” for an innovation process to begin. Neither the ideation of a novel “good” idea nor personal influence tactics are sufficient to activate an innovation process; rather, some sort of large shock to the organization triggers dissatisfaction with the status quo and ignites the process.

During the developmental period, “the initial innovative idea soon proliferates into numerous ideas and activities that proceed in divergent, parallel, and convergent paths of development” (Van de Ven et al., 1999: 23). This phase is characterized by setbacks, mistakes, and changes in ground assumptions that can lead to rejection or enhancement of the innovation. Power struggles also arise during the development stage when different parties to the innovation process disagree over evaluation criteria. Further, participation is “highly fluid,” with innovators having only part-time involvement and high turnover on projects. “Development problems frequently require intervention by top managers and investors” (Van de Ven et al., 1999: 24). In addition, development involves creating relationships with external parties, and these linkages often lead to commitments
with unintended consequences for the next phase of the process. During the
implementation/termination period, the organization overlaps and integrates the
innovation with the existing situation, rather than completely replacing what exists.

The other two multi-level longitudinal studies stand in marked contrast to the
grand scope and scale of the MIRP studies. In the first, King (1992) compared two
process models, one consisting of sequential stages (Zaltman et al., 1973) and one based
on six key observations from the MIRP case studies that depicted more fluidity
(Schroeder et al., 1986). The author conducted a seven-month study that followed the
development of seven innovations within one ward of a large hospital. Throughout the
study he assessed the “fit” of the two models to the events that occurred during
implementation of each innovation. Based on his longitudinal research, King concluded
that neither model fit the data perfectly, but that the MIRP-based model “recognizes the
untidy nature of innovation process…” while “stage-based models are probably not very
useful as descriptions of how the innovation process proceeds in real-world cases” (King,
1992: 99-100). This study is relevant because it is one of very few longitudinal
innovation studies and it gives credence to the complex process model described by Van
de Ven et al. (1999).

Although the third longitudinal study (West & Anderson, 1996) treated the
innovation process as something of a black box, it is worth noting because it considered
cross-level effects. In the study, the authors examined group and organizational factors
that they hypothesized would affect top management team innovation. At the group level,
they identified four group process variables, including clarity of and commitment to team
objectives, cohesiveness, support for innovation, and task orientation. The authors did not
hypothesize about the relationships between these process variables. They did, however, estimate the correlation between these factors and the number innovations introduced by the team within the following six month period. They also did this for organizational level factors, including size (number of employees) and resources (budget). West and Anderson (1996) found that all team process variables were significantly correlated with team innovation, but that the organizational factors were not significant.

Similarly, another longitudinal study of team processes of innovation (Pearce & Ensley, 2004) found that shared vision, i.e., the degree to which team members agreed upon a “common vision for the goals and desired future state of the team” (p. 260) plays a critical role in team innovation. In particular, they found a reciprocal, positive relationship between shared vision and innovation effectiveness. Again, the authors did not hypothesize about the underlying mechanisms of the innovation process, but they found that shared vision played a central role in many team dynamics believed to facilitate team performance.

Garud and Rappa (1994) extended the findings of Van de Ven and colleagues to develop a socio-cognitive model of technological innovation at the field level by illuminating some theoretical relationships that are likely to be applicable at the organizational level as well. In their longitudinal study of the development of an innovative hearing aid based on cochlear implant technology, Garud and Rappa found that at both the micro-level (i.e., the individual scientists working on the innovation) and macro-level (i.e., the scientific community involved in cochlear implant research), the innovation process involved a recursive interaction between beliefs, artifacts that materially inscribe those beliefs, and routines used to evaluate the artifacts. This finding
was contrary to a more commonly-accepted notion that technological development flows uni-directionally from beliefs to routines to artifacts. Further, the micro-level and macro-level cyclical processes exerted conflicting forces – pressure toward a shared reality at the macro level and pressure toward variation (i.e., confirmation of scientists’ individual beliefs). Garud and Rappa found that the innovation process involved disagreement about which technology was better, and that the micro- and macro-level forces converged in such a way that shaped which technology was ultimately victorious. Although this study was done at the level of an organizational field, there are important insights that inform my dissertation research. First, as Garud and Rappa point out, existing beliefs play a critical role in guiding the course of innovation. Data that do not fit into one’s belief system are screened out as “noise,” precluding certain opportunities and lines of inquiry because they are not believed possible. Second, innovation involves the clash between divergent individual beliefs that ultimately shape a shared reality. Third, the authors demonstrated that the final product of technical innovation is not pre-determined, but rather the result of an iterative social process involving contested beliefs.

In another multi-level study, Rothaermel and Hess (2007) studied individual, organizational, and inter-organizational (“network”) factors that affected firm-level innovation. One key discovery was the importance of human capital to innovation processes, especially of “rank and file knowledge workers” (Rothaermel & Hess, 2007: 915), a finding somewhat at odds with prior research that emphasized the value of elite scientists (e.g., Zucker & Darby, 1997). Their results suggest that star scientists may set the direction of innovation efforts, while a critical mass of non-stars is needed to implement the strategy. In addition, they found that factors at the various levels of
analysis were not independent, affirming that organizational innovation involves complex interactions across influences at multiple levels of analysis. Also relevant to our current study, Garud, et al., (2011) explored the complexity of sustained innovation within 3M. They found that organizational members’ practice of sharing innovation narratives, along with other organizational practices, allowed members to simultaneously explore new ideas while exploiting existing capabilities, a finding that stands in contrast to prior research that conceptualizes exploitation and exploration as inherently conflicting and contradictory activities (see Lavie, Stettner, & Tushman, 2010).

Taken together, these longitudinal and multi-level studies of innovation processes suggest three potentially germane issues for my study. First, these studies underline a well-known theme in the innovation literature: that innovation processes are multi-faceted, multi-layered and dynamic. Second, they suggest that successful innovation may depend more critically on the nature of collaborations (i.e., social processes) among networks of individuals (beyond the human capital they supply) than on the resources provided by an organization. Finally, they also imply that some sort of shared understanding or unifying commitment is critically important to fostering the collaborations necessary to the innovation process. The grand theme reflected in all of these studies is that innovation processes involve beliefs, knowledge and practices at both the individual and collective levels, as well as networks of social interactions. Little empirical work, however, has focused on the interplay of these elements.

Howells (1995) called for a “socio-cognitive approach to innovation” research at the level of the organization. He proposed that a socio-cognitive model of innovation would take into account “the role of individual experience, the precise nature and effect
of personal interactions, and the fluctuating nature of attitudes and beliefs through time” (Howells, 1995: 886). Howells suggested that sensemaking (Weick, 1979/1969; Weick, 1995) provided an appropriate framework for such a model because it sets forth a recursive process through which beliefs and personal interactions guide organizational action. Although Howells does not explicitly state this, a core sensemaking concept is identity, in that “who we think we are (identity) … shapes what we enact and how we interpret” (Weick, Sutcliffe, & Obstfeld, 2005: 416). Howells’ call has not been directly embraced by management scholars, but similar ideas can be found in Tsoukas’ (1996) perspective on the firm as a “distributed knowledge system.” In this view, organizations are interpretive or sensemaking systems in which knowledge resides in the organization’s members and routines. Innovation in particular emerges from the knowledge embodied in the organizational members and their interactions. This knowledge, “which is not, and cannot be, known in its totality by a single mind” is “distributed” in several senses of the word, most importantly because it is “indeterminate: nobody knows in advance what that knowledge is or need be” (Tsoukas, 1996: 22). Therefore, a key challenge for innovation is effective coordination of distributed knowledge. This perspective suggests that innovation is essentially a relational activity or social process involving content (what is being understood) and relations (who is doing the understanding) and also implicates identity as an important filter through which sensemaking processes move.

**Other related research.** Biotechnology innovation is driven by scientific knowledge (Cockburn, Henderson, & Stern, 2000; Whittington, Owen-Smith, & Powell, 2009) and given that my setting is an academic laboratory, ethnographies in the tradition of the sociology of science addressing how scientific knowledge is constructed (e.g.,
Galison, 1997; Knorr-Cetina, 1982, 1999; Latour, 1987; Latour & Woolgar, 1986) also provide some potentially valuable insights. The university laboratories that these accounts observed typically engaged in public or open science, i.e., research that discloses information about methods and findings and is subject to peer evaluation and other norms of academic conduct as opposed to private science or technology that is proprietary knowledge used to generate economic profits. Still, BioTech Lab engages in both types of science, so several insights from this line of scholarship appear to be particularly relevant to my case study.

The first insight is that science is not a monolithic endeavor, but rather, disunified, engaged by subcultures with their own language, interpretive frames, values and norms (Galison, 1996; Knorr-Cetina, 1982). Innovation and scientific advances result from the interaction and translation of ideas within and across these heterogeneous communities (Galison, 1987, 1997). These findings suggest that in a multidisciplinary organization, how professionals from different academic backgrounds are able to communicate with each other might play a critical role in determining what type of scientific and technological knowledge is produced.

Although my research focuses on the scientists within one organization, an important side note is that Knorr-Cetina (1982) stressed that non-scientific communities are also involved in the production of scientific knowledge. Agents within and across the scientific and non-scientific communities are linked through relationships that are marked by “oscillations between conflict and cooperation, between the fission and fusion of interests that are reciprocally defined” (Knorr-Cetina, 1982: 122). Therefore, it is
important to bear in mind that external parties will likely have some influence on the processes of innovation in an entrepreneurial academic laboratory.

Studies of science and technology also draw attention to the patterns of interaction between scientists and their tools and methods of experimentation (Latour, 1987; Latour & Woolgar, 1986), because the technology employed by scientists for experimentation is crucial to the interpretive systems inscribed in these disunified scientific communities. In some cases, experimental methods might only have a localized meaning within one specific community. In other cases, scientific tools can serve as “boundary objects” (Carlile, 2002) that are understood by multiple epistemic communities and therefore facilitate cross-disciplinary understanding. In addition, Bechky (2003) found that control over a boundary object can define and legitimize the work domain claimed by an occupational group as it collaborates with other groups. In her case study, engineers used their authority over the boundary objects (drawings and machines) that they shared with assemblers and technicians to reinforce their dominance over the manufacturing process (Bechky, 2003).

Carlile (2004) suggested that boundary objects serve important roles in several complex processes involved in innovation because innovation involves sharing and assessing knowledge across boundaries. He theorized that there is a progression through three general types of boundaries that lead to increasingly novel innovations. The most straightforward involves knowledge “transfer” across a “syntactic boundary.” In this case, actors know the differences and dependencies that exist between them and need only a common lexicon or language with which to communicate. The second type is a “semantic boundary” that involves knowledge translation or interpretation. Not all
differences and dependencies are known, so differences in interpretations exist among actors. In this case, boundary objects allow the creation of common meanings. The most challenging is the “pragmatic boundary” in which actors have different interests that hinder their ability to share knowledge. Boundary objects here serve to create common interests and remove the political or social barriers to knowledge sharing (Carlile, 2004). This group of findings suggests that scientific instruments and research protocols used by different disciplinary groups may play several different roles in the innovation processes in my research site. First, these scientific technologies may both reflect and reinforce the interpretive frames of different groups of professionals. Second, they might serve as markers that legitimate professional boundaries, and third, they might provide vehicles through which interdisciplinary knowledge sharing or sensemaking might occur.

Another important insight from science and technology studies is that “epistemic cultures” (Knorr-Cetina, 1999) produce knowledge that serves the reward system of “science,” e.g., to vindicate prior work or create a pipeline of solvable puzzles (Latour, 1987; Latour & Woolgar, 1986). This reward system does not perfectly align with the economic rewards associated with a market logic and commercial science. Research suggests that the different reward systems of academic and commercial science may have developed mutual positive feedback loops in which success in one realm reinforces and permits greater success in the other (Nelson, 2005; Owen-Smith, 2003). For example, Owen-Smith (2003: 1099) found that over a two-decade period the reward systems of public and private science went from “separate and potentially contradictory institutional regimes … to a hybrid order in which advantage cumulates across the two different realms.” He contended that public science success, measured as publication impact, was
previously driven by reputation and peer review while private science success, measured as patenting activity, depended on learning how to recognize and capitalize on the value of intellectual property (Owen-Smith, 2003). The author found evidence that advantages within these two spheres accumulated independently of each until institutional changes encouraging academic entrepreneurship began to take hold. By examining several years of citation and patent data, Owen-Smith (2003) found that public and private science success began to reinforce each other, suggesting a merger of the two reward systems.

There is evidence, however, that these reward systems are not entirely integrated and that some scientists will forego the financial success of private science to pursue basic science research (Roach & Sauermann, 2010; Stern, 2004). This suggests that the interplay of academic and market logics might exert pressures favoring different outcomes at two levels of analysis. At the organizational or field level, the interaction might well foster greater overall productivity in both public and private science, while at the individual level there are likely to be a variety of responses to the combined logics based on individual beliefs and preferences. Therefore, a comprehensive understanding of how these influences affect innovation within an academic laboratory requires a multi-level approach.

Few studies have looked at how these logics shape the cognitions and belief systems of academic scientists. In one exception, Owen-Smith & Powell (2001) conducted interviews with 80 senior faculty members from various universities, all of whom were involved in life science academic research. The authors investigated the professors’ views regarding academic entrepreneurship and its effect on academia. Among their informants, the authors found four different ideal types of responses to
increasing academic entrepreneurship. They categorized these responses with a 2x2 matrix (reproduced as Figure 1). As shown in the figure, one dimension reflected scientists’ beliefs about whether commercialization did or did not threaten the Academy. The second dimension, also shown in Figure 1, reflected scientists’ beliefs about whether the Academy and industry should or should not overlap (Owen-Smith & Powell, 2001). These four belief typologies revealed some paradoxes. For example, two types of professors might agree about the implications of academic entrepreneurship but might disagree about the appropriate response to the trend. Conversely, two types might agree about the appropriate response but disagree about the importance to academia of the trend toward commercialization. Although Owen-Smith and Powell (2001) limited their sample to senior faculty, they suggested that academic entrepreneurship has produced “fault lines” between and among faculty, students and their institutions.

In the second study, Colyvas (2007) used archival records including invention disclosures and detailed meeting notes to trace the institutionalization of technology transfer practices at Stanford University. Similar to Owen-Smith and Powell (2001), the author found a set of four “models” for “the ways in which faculty enacted boundaries between science and commerce” (Colyvas, 2007: 463). She found that all four were based on the same norms about what practices were legitimate, but that academic norms generated disparate practices and rationales about why certain practices were beneficial. The author found that economic rewards spurred the codification of well-understood and enforceable practices, but not because scientists were trying to become wealthy. Rather, “pecuniary rewards pulled faculty into the debate over [the legitimacy of academic
entrepreneurship]” (Colyvas, 2007: 474). As a result, Colyvas surmised that norms and institutional change have a recursive relationship, shaping and being shaped by each other. Powell and Colyvas (2008) proposed an identity framework for understanding this change process:

The organizational ambiguity attached to definitions of inventor and invention, and procedures associated with commercializing science such as royalty distribution, provided multiple opportunities for generating disparate meanings and practices. These individual approaches resonated with the faculty members because they drew on their familiar identities and ideals as scientists in meaning-making processes. As the world of science came into contact with commerce, the identity associated with a university scientist expanded to include entrepreneurship. (p. 287).

Indeed, this perspective on the emergence of institutional entrepreneurship has much in common with the social and cognitive perspectives on innovation that have been addressed in this section of the literature. The grand theme reflected in all of these studies is that innovation processes involve beliefs, knowledge and practices at both the individual and collective levels as well as social interactions. Little empirical work, however, has focused on the interplay of these elements within intra-organizational innovation processes. Further, it is remarkable that the innovation literature has not drawn more extensively on the concept of identity, or “who we think we are” (Weick et al., 2005: 416), given its inextricable connection to both beliefs and knowledge and the way identity both enables and constrains action.

**Identity Theory and Research**

Identity refers to an (individual or collective) actor’s self-defined concept of oneself and sense of “selfsameness” over time (Erikson, 1959). Studies such as Weick’s analysis of the Mann Gulch fire disaster have shown that identity shapes sensemaking and constrains action, and can explain complex and otherwise inscrutable outcomes
An identity framework therefore appears highly relevant to understanding innovation processes, yet remains understudied in this domain. In the lone study of identity and innovation that I found, Tripsas noted that identity serves as an indispensable “guidepost, directing the development of some routines and capabilities over others and reinforcing some beliefs over others” (2009: 442). She found that an organization’s identity affected its ability to recognize opportunities for technological change, and that implementing new technology actually required a shift in the identity. In the current study, however, I consider how identity at more than one level of the organization might relate to innovation. Tajfel and Turner (1986), for instance, posited that individuals derive an important part of their identity through membership in social groups or categories (e.g., occupation, profession, gender and ethnicity). I therefore consider two types of identity, professional, and organizational, that might help explain dynamics within organizations that manage to sustain innovation over long periods of time.

As suggested in Chapter 1, professional identity is one of the most important types of social identity to individuals in contemporary society. In a knowledge-intensive organization consisting of highly trained and educated scientists, both professional and organizational identity are likely to play important roles in innovation processes. Biotechnology like many knowledge-intensive industries (Whittington et al., 2009), places great value in the possession of specialized, expert knowledge. So does academia. In a context like an entrepreneurial academic laboratory that combines both, the knowledge that organizational members believe they possess is likely to be an essential referent for both organizational and professional identity. In other words, expert knowledge is likely to be an important part of both professional and organizational
identity and therefore plays an important role in shaping the sensemaking activities involved in academic applied science laboratories. In next two subsections, I discuss professional identity and then organizational identity, highlighting theory and research that inform my study.

**Professional identity.** Professional identity is defined as the “attributes, beliefs, motives and experiences in terms of which people define themselves in a professional role” (Ibarra, 1999: 765). One central feature of professional identity is the possession of expert knowledge that is valued by society (Pratt et al., 2006). Related to this notion and especially germane for a study of scientists is the concept of “disciplinary identity,” rooted in the educational context of teaching and learning a specific body of knowledge (Schummer, 2004). “A discipline furnishes its members with definitions of what is ‘thinkable’, with appropriate assumptions as to what ‘count’ as research problems, suitable research methods, definitions of research programmes and the approved modes of graduate student research” (Li & Seale, 2008: 1000). Becher noted that disciplinary identity is not only constituted by this disciplinary knowledge, but is shaped by “characteristic attitudes, activities, and cognitive styles” (1987: 275).

These characteristic traits of a given discipline or occupation reflect the internalization of norms and a system of incentives for conforming to those norms (Chreim et al., 2007; Rao et al., 2003). In this sense, professional identity links individuals to institutions that constrain and enable their action. In one longitudinal case study, Chreim et al. (2007) showed that institutional factors played an important role in the professional identities of physicians as they moved from a traditional model of independent practice to a team-oriented approach to medicine. They found that
institutional structure both directly and indirectly influenced the reconstruction of professional identities based on the revised roles that physicians played in the new multidisciplinary environment (Chreim et al., 2007). Rao et al. (2003) documented a similar recursive relation between institutional and identity change in a study of the French nouvelle cuisine revolution. They noted that professional identity reflects an existing institutional logic and can also prompt changes in that logic. The authors suggested that members of a profession simultaneously value collective identity and individual autonomy, and when an external shock threatens autonomy, professionals will question the existing logic and work to instantiate a new one that restores autonomy (Rao et al., 2003). The new logic also brings about shifts in the professional identity. Discourse is an essential part of this process because “logics are mutable if they … rely on ambiguous appropriable language” (Rao et al., 2003: 802).

Language and discourse have been implicated as important cognitive tools for identity construction and maintenance by other scholars as well (Barley, 1983; Fine, 1996; Ibarra & Barbulescu, 2010; Li & Seale, 2008). For example, Fine (1996) found that among professional cooks, occupational rhetoric provided a self-definition and framework for justifying work to themselves and others. Ibarra and Barbulescu (2010: 135) theorized that an important cognitive tool for effecting identity change is narrative, especially “self-narratives—stories that make a point about the narrator.” The authors proposed that during social interactions, individuals engage in identity work by expressing self-narratives. Based upon feedback, they revise these narratives and shape professional identity at the same time.
Organizational studies of professional organizations indicate that professional identity can also be based on occupations and their associated work roles (Ibarra, 1999; Pratt et al., 2006). For example, in her study of junior banking and consulting professionals, Ibarra (1999) found that individuals constructed professional identities by finding senior role models who occupy the positions to which they aspire. The junior professionals used these role models to develop different conceptions of the appropriate professional identity for the position and then provisionally tried on these identities by adopting the demeanor that seemed appropriate for the position. Reflection and feedback from others lead to adjustments in the provisional professional identities and choices about which aspects to retain and which to discard (Ibarra, 1999). Pratt et al. found that work roles helped medical residents construct their professional identity (2006). In particular, the authors found that mismatches between identity beliefs and work roles triggered identity changes to bring professional identity and the content and process of the work into alignment. For these medical residents, the authors found that the process of learning how to do the work of a medical specialty was inextricably and recursively linked to the process of identity construction (Pratt et al., 2006).

Professional identity develops naturally over time as one’s career progresses but can also be actively developed (Dobrow & Higgins, 2005), for example, by working with mentors (Ibarra & Deshpande, 2007; Li & Seale, 2008). Dobrow and Higgins (2005) found that a diverse network of mentors resulted in greater clarity of professional identity. Li and Searle (2008) noted the importance of discourse between protégé and mentor for the development of an academic professional identity. These studies leave unanswered the important question of how early-stage professionals manage to develop
coherent identities in environments that provide diverse role models, work roles, and career paths. This question is important because the beginning stages of career development, including nascent professional identity development, often set individuals upon a rather path-dependent course that affects many aspects of their future careers (Rosenbaum, 1979; Sullivan & Baruch, 2009; Walsh & Gordon, 2008).

Relationships are likely to play an important role in professional identity development in such environments. Indeed, several scholars (e.g., Ibarra & Deshpande, 2007; Sluss & Ashforth, 2008; Sluss & Ashforth, 2007) have explicitly or implicitly suggested the importance of relationships and social interaction to the maintenance and construction of professional or role identity. The importance of social interaction is also a longstanding theme regarding identity construction more generally (e.g., Goffman, 1959; Mead, 1934) and suggests the need to account for the influence of social networks to better understand professional identity development. I will discuss these concepts further in the section of this chapter regarding social network analysis.

**Identity work, tensions and tactics.** In addition to the studies of professional identity development discussed above, considerable research of relevance to my dissertation has been devoted to “identity work” more generally. Identity work refers to the “range of activities that individuals engage in to create, present, and sustain personal identities that are congruent with and supportive of the self-concept” (Snow & Anderson, 1987: 1348). A common theme underlying many considerations of identity work has to do with resolving tensions inherent in different aspects of a person’s identity (e.g., Brewer, 1991; Kreiner, Hollensbe, & Sheep, 2006). For example, Brewer noted that identity work strives for a balance between two fundamental human tensions, the need for
a sense of belongingness and validation on the one hand and the need to be a unique person on the other. Thus, individuals strive to attain “optimal distinctiveness” in their identity (Brewer, 1991) through a combination of characteristics that distinguish or differentiate them from others, juxtaposed with those based on membership in various desired social categories.

Subsequent to Brewer’s (1991) landmark work on optimal distinctiveness, Kreiner, Hollensbe and Sheep (2006) developed the idea of “identity tensions,” which were defined as intrapersonal strains resulting from the varying demands of identity. In their study, Kreiner and colleagues (2006) found that Episcopal priests faced several identity tensions as they sought an optimal balance between their identity as a person and their identity as members of the priesthood. The negotiation of this balance was an ongoing process that was influenced by the demands of situational factors. Although they identified three identity tensions – over/underidentification, identity intrusion, and lack of identity transparency – they left open to future research the potential to document other tensions more germane to other contexts and populations. Although previous research has focused on the tensions between personal and social identity, little is known about the identity tensions that might be at play in the development of professional identity. In this study, I extend the idea of identity tensions by exploring their contours as applied to professional identity.

Another stream of research within the identity work literature focuses on various strategies or tactics that individuals or groups can enact to find optimal balance for identity. For example, Ashforth, Kreiner, Clark and Fugate (2007) documented identity work tactics for those in stigmatized or so-called “dirty work” jobs; these comprised
cognitive processes such as reframing or refocusing as well as behavioral tactics such as creating social buffers. Similarly, Kreiner et al (2006) documented specific identity work tactics, classified into three broad categories: “integration tactics” that increased the overlap between personal and social identity, “differentiation tactics” that decreased that overlap, and “dual-function” tactics that could be used to either increase or decrease the overlap. Thus, part of identity work can involve using such tactics in an ongoing effort to strike a desired balance between personal and social identities. I saw a great deal of potential in investigating how identity work tactics might be employed beyond what past research has demonstrated. Specifically, given the complexity and dynamism inherent in multidisciplinary organizations, it is possible that identity work could play a major role in managing relational plurality as part of professional identity development.

Management scholars have tended to consider only two aspects of professional identity work, work roles or discourse, leaving out or holding constant the many other facets. To my knowledge, no one has attempted a comprehensive portrayal of the multiple aspects of professional identity – or how individuals integrate these multiple aspects to construct professional identity. Further, management and organization scholars have devoted considerable attention to identity construction in the “classic” professions, such as medicine, banking and accountancy (e.g., Chreim et al., 2007; Ibarra, 1999; Kosmala & Herrbach, 2006; Pratt et al., 2006). These represent either single-profession settings or fields such as healthcare where status and hierarchy arguably dictate the interaction between various professional identities. As a study design, this affords researchers a simpler environmental context, but indicates that these studies have limited transferability to the applied science research organization because interdisciplinarity is
an essential part of its nature. Applied science innovation involves collaboration across multiple disciplines in which no one profession might have clear dominance. As an aside, I note here that an individual in applied science might also herself possess multiple professional identities (e.g., medical doctor with an M.D. and biochemist with a Ph.D.), adding another layer of complexity to the picture.

Interdisciplinarity is defined as “communication and collaboration across academic disciplines” (Jacobs & Frickel, 2009: 44). Schummer (2004) noted that discipline and interdisciplinarity are both cognitive and social categories, suggesting that interdisciplinary research is a combined cognitive and social phenomenon. Interdisciplinarity provides the heterogeneity of knowledge and cognition that innovation processes require, but at the same time raises the potential for disagreements and misunderstandings that might hinder collaborative processes. It is possible that while professional identities are the source of heterogeneity, identity at meso- and macro-levels provide a sense of unity that keeps these multidisciplinary teams from paralysis and dysfunction. For example, in one study of multiple professional identities, the authors found that a shared sense of organizational identity enabled diverse individuals to work together (Russo, Mattarelli, & Tagliaventi, 2008). Indeed, a strong organizational identity has been found to play a role in important intra-organizational processes, including effective knowledge transfer (Kane, 2009) and the success or failure of internal change efforts (Reger et al., 1994). In the following section, I discuss organizational identity theory and research that are relevant to my study.

**Organizational identity.** Organizational identity represents organizational members’ shared beliefs about what is central, distinctive, and relatively enduring about
an organization (Albert & Whetten, 1985). An important point from existing research is that organizational identity has dual aspects. First, it is an institutional claim intended to serve “sensegiving” (Gioia & Chittipeddi, 1991) purposes by letting internal and external stakeholders know “who we are, as an organization.” At the same time, it is a process of sensemaking by organizational members in which they intersubjectively negotiate “who we are” (Gioia, Price, Hamilton, & Thomas, 2010; Ravasi & Schultz, 2006). These dual aspects of identity are mutually constitutive and cannot be meaningfully separated (Gioia et al., 2010).

There is evidence that organizations, like individuals, attempt to construct identities that are optimally distinct (Ashforth & Mael, 1989; Gioia et al., 2010). An optimally distinct organizational identity provides “strategic balance” (Deephouse, 1999). By being similar to competitors, organizations gain the necessary legitimacy to operate in their field while differences from rivals provide a competitive advantage (Deephouse, 1999). Gustafson and Reger (1995) theorized that certain intangible organizational identity features might aid the survival of organizations in high velocity environments. They suggested that organizations with identities that valued and embraced change would be more likely to thrive in such fast-paced environments (Gustafson & Reger, 1995). They also noted that a loose coupling between substantive (e.g., products and core competencies) and intangible identity referents could facilitate organizational survival in high velocity environments because organizations would be less likely to hang on to outmoded ways of doing business (Gustafson & Reger, 1995).

Other researchers have explored the implications of organizational identity in a variety of settings. As examples of the range, studies include the origins of intense
organizational loyalty among college athletes (Adler & Adler, 1988), conflict in nonprofit boardrooms (Golden-Biddle & Rao, 1997) and the adaptation of banks to institutional changes (Fox-Wolfgramm, Boal, & Hunt, 1998). A common theme across studies of organizational identity is that it serves as an essential guide for many intra-organizational activities. For example, several researchers have observed that organizational identity exerts a powerful influence on strategic decision-making processes (e.g., Ashforth & Mael, 1996; Dutton & Dukerich, 1991; Gioia & Thomas, 1996). Like other forms of identity, organizational identity functions as a sensemaking framework that affects the way in which organizational members interpret events in the environment as well as their beliefs about the appropriate action to take in response to those events (e.g., Dutton & Dukerich, 1991; Elsbach & Kramer, 1996; Gioia, Schultz, & Corley, 2000; Martins, 2005; McGlynn, Harding, & Cottle, 2009). In some cases, organizational identity might prompt members to react strongly to perceived threats (Elsbach & Kramer, 1996; Martins, 2005) while in others organizational identity might prevent members from seeing opportunities in the environment (Tripsas, 2009).

Organizational identity has also been shown to affect intraorganizational relationships and collaboration (Brickson, 2007; Dukerich, Golden, & Shortell, 2002; Glynn, 2000). Its influence on internal social interactions has been found to determine to a large extent organizational change efforts succeed or fail (Chreim, 2005; Nag et al., 2007; Reger et al., 1994). Like professional identity, organizational identity is inextricably linked to work-related knowledge and practices (Nag et al., 2007). In their study of an organization focused on technological innovation, Nag et al. (2007) found that organizational identity was so fundamentally linked to knowledge and practice that a
strategic change effort to graft new knowledge and practice onto existing ones ultimately failed.

Organizational identity also has been theorized to serve a boundary-maintaining purpose for organizations, in that by defining “who we are,” it simultaneously establishes “who we are not” (Santos & Eisenhardt, 2005). In this capacity, it has been characterized as hindering the development of organizational fluidity or flexibility (see Schreyogg & Sydow, 2010) because it delimits member actions to what is considered “in character” for the organization. Fluidity, which will be discussed later in this chapter, emerged as a key concept in my exploration of sustained innovation, and existing conceptions of this concept might seriously underplay the role of identity, especially when both professional and organizational identities are considered in tandem.

One key theme across the identity literature is that identity shapes and is shaped by social interaction. Said in another way “who we are lies importantly in the hands of others” (Weick et al., 2005: 416). This suggests that a systematic analysis of intra-organizational social relationships and interactions is relevant to the study of identity. One approach to exploring social interactions and relationships is social network analysis (Kilduff & Tsai, 2003), which offers a means for investigating patterns in the ties that connect actors (including both individuals and organizations). Several scholars have explicitly linked identity and social networks (e.g., Ibarra & Deshpande, 2007; Ibarra et al., 2005; Podolny & Baron, 1997). Podolny and Baron (1997) theorized that “closure” in a social network (i.e., a pattern of dense and redundant ties) supported group norms and thereby conferred a sense of identity on the actors in the network. Ibarra et al. (2005) echoed Weick by suggesting that networks of social relationships and the identities of
individuals in those networks are recursively and inextricably related. They called for greater application of social network analysis to identity theory and research. Social network analysis has a long standing history of application to innovation research, but has not been applied extensively to the study of professional or organizational identity (for exceptions see: Higgins & Kram, 2001; Milton & Westphal, 2005). In this dissertation, I apply identity theory to a model of innovation processes, and a network approach holds the potential for integrating these domains. In the following section, I discuss the existing work on social networks and how it might inform my research.

Social Networks

Social network analysis ("SNA") is concerned with the patterns of relationships in which actors (whether individuals or collectivities) are embedded (Brass, Galaskiewicz, Greve, & Tsai, 2004; Kilduff & Tsai, 2003). Thus, to organization scholars, SNA lends itself to a consideration of the structure and dynamics of the organizational context (Borgatti & Foster, 2003; Borgatti, Mehra, Brass, & Labianca, 2009; Brass et al., 2004; Kilduff & Tsai, 2003).

Social capital (Coleman, 1988; Portes, 1998) is an important theoretical concept that laid the foundation for most of the SNA in organizational and management research. Social capital refers to the benefits that actors (e.g., individuals or organizations) can obtain by virtue of their relationships with other actors (Coleman, 1988; Portes, 1998). Social capital is inherent in the networks among individuals in a given group or community, and the structure of a network has implications for the social capital that can be provided. For example, Coleman (1988) theorized that closure (i.e., a dense network of ties) was needed to support group norms and foster trust. In contrast, Burt (1992)
theorized that a network with “structural holes” (i.e., sparsely connected) provide other types of benefits. For example, actors who bridge structural holes can bring together information and ideas in new combinations by drawing on the differential knowledge residing in the disconnected parts of the network.

Two main areas within the social network literature are pertinent to my dissertation. One is a relatively small area pertaining to the relationship between identity and social networks and the other explores knowledge sharing and innovation within organizations.

**Identity and social networks.** Social networks have been related in theory to identity at the individual (Ibarra & Deshpande, 2007; Ibarra et al., 2005; 2005) and organizational levels (Ibarra et al., 2005; Stryker & Burke, 2000). For example, Ibarra et al. (2005) suggested that identity and networks are recursively related, each shaping and being shaped by the other. They also theorized that identity affects the rate of adoption of innovations, arguing that innovations will diffuse faster through a network in which individuals share a common identity. Interestingly, they also suggest that identity is salient for a minority group in an organization, even if that minority status isn’t reflected in larger community (Ibarra et al., 2005). Despite considerable theorizing, little empirical work has been conducted regarding the relationship between identity and social networks. Three exceptions follow.

Podolny and Baron (1997) applied SNA intraorganizationally to look at differential rates of promotion and mobility among a sample of employees in a high-technology firm. They hypothesized that certain types of ties would facilitate promotion. Of particular relevance to this dissertation, the authors suggested that organizational
identity is conferred through both formal structure (i.e., position to position ties) and informal structure (i.e., person to person ties such as friendship) (Podolny & Baron, 1997). They found that sparse ties in these networks inhibited mobility while dense ties facilitated it.

Milton and Westphal (2005) examined “identity-confirming” networks. Based on self-verification theory (Seyle & Swann, 2007), the notion that people prefer to be seen as they see themselves, the authors hypothesized that individuals would cooperate more with others who confirm their self-definitions, even if the self-definition was negative (e.g., I’m not very bright). Milton and Westphal found that central positions in an identity confirmation network did indeed increase cooperation and performance (Milton & Westphal, 2005). Further, they found that “structural equivalence” (i.e., individuals occupied similar positions in an identity confirmation network) also increased cooperation, even if the individuals did not directly confirm each other’s identity and even if identities were dissimilar (Milton & Westphal, 2005).

Dobrow and Higgins (2005) found that density of a person’s developmental network of mentors is negatively related to clarity of professional identity. The authors defined mentors broadly, as anyone who takes an active interest in and action to advance the protégé’s career. Thus, mentors can be inside or outside or an organization and can be senior to, peer of or subordinate to the protégé. In this longitudinal study, high density referred to a network in which one’s mentors are connected to each other (i.e., know each other), while low density indicated a network with sparse ties between mentors. The authors suggested that a sparsely connected mentor network provides greater variety of
information, resources and cognitive flexibility which leads to greater exploration and self-understanding (Dobrow & Higgins, 2005).

Collectively, the literature at the intersection of identity and social networks suggests a field in which empirical research is still needed for both theory building and theory-testing. In particular the recursive interaction between individual and organizational identity and social networks is an important area for additional research.

The topics of identity and innovation have not tended to overlap in network research. Collectively, two works (Kogut & Zander, 1996; Nahapiet & Ghoshal, 1998) provide the rationale for putting the three together. Kogut and Zander (1996) reconsidered Coase’s (1937) question, “Why do firms exist?” and suggested that the answer goes beyond economic efficiencies. The authors theorized that an organization is greater than the sum of its parts because of organizational identity (Kogut & Zander, 1996). The set of shared norms and beliefs provided by an organizational identity facilitates social interaction among organizational members. Through social interaction, identity helps an organization “[achieve] communication and coordination among individuals with diverse competencies” (Kogut & Zander, 1996: 506).

Kogut and Zander (1996) also theorized that the act of organizing produces formal and informal structures that facilitate the creation and sharing of knowledge among an organization’s members. They proposed that this explains why organizational boundaries often correspond to differences in the distribution of knowledge and capabilities among individuals (Kogut & Zander, 1996). Nahapiet and Ghoshal (1998) extended Kogut’s and Zander’s insights, emphasizing the knowledge creation aspect. They theorized that social relationships within organizations provide a form of social
capital that builds intellectual capital (i.e., knowledge) and, most important for innovation, offers the potential to create new forms of knowledge (Nahapiet & Ghoshal, 1998). This social capital inheres in the network of social relationships among organizational members, and the authors note that the ties and the overall structure or configuration of the ties are both important to knowledge creation and innovation. Ties provide members with access to various resources while the structure of the network can determine what types of resources members can access and how easily they can obtain them (Nahapiet & Ghoshal, 1998). Putting the arguments of these two sets of authors together leads to the following conclusions: First, organizational identity facilitates social interaction that creates social capital. Second, social capital resides in social networks that permit the exchange of resources that can lead to the creation of new knowledge and foster innovation. Therefore, identity and social networks are both crucial to innovation processes.

**Networks and innovation.** In academic entrepreneurship research, scholars have analyzed co-authorship relations and patent citation patterns as types of ties to understand how inter-organizational relationships facilitate innovation (e.g., Breschi & Catalini, 2010; Murray, 2002; Owen-Smith, Riccaboni, Pammolli, & Powell, 2002; Powell, Koput, & Smith-Doerr, 1996; Whittington et al., 2009). Co-authorship and patent networks have also been used to indicate the structure of and new forms in interdisciplinary work (Schummer, 2004). Intra-organizational networks have not generally been examined in academic entrepreneurship. In one exception, Paruchuri (2010) looked at internal co-inventing ties (i.e., co-patenting) and found an inverted U-shaped relationship between an
inventor’s network centrality (i.e., extent of co-patenting) with the inventor’s impact on
the organization’s innovation process (measured as patent citations).

Other management scholars have done work on intraorganizational networks that
is relevant to my study (e.g., Tsai, 2001; Tsai, 2002). Particularly pertinent is research
exploring the connection among intraorganizational networks, knowledge transfer and
innovation. Tsai and Ghoshal (1998) drew on these ideas of Nahapiet and Ghoshal (1998)
in a quantitative study that related social interaction ties among business units to product
innovation within one organization. They proposed that social interaction ties reflect the
structural dimension of social capital and that these ties provide channels through which
business units share resources such as information, products, personnel and support, with
each other (Tsai & Ghoshal, 1998). Thus, a business unit’s centrality (i.e., relative
connectedness to other units) in the social interaction network should be positively
related to the degree of resource sharing in which it engages. Further, they suggested that
these resource exchanges and combinations would produce novelty that fosters
innovation. They found that social interaction ties did have direct and indirect effects on
resource exchange and that business units that engaged in more of these exchanges had a
relatively greater level of product innovation. Subsequently, Tsai (2000) found that a
business unit’s “absorptive capacity,” or ability to recognize the value of new knowledge
(Cohen & Levinthal, 1990) heightened the relationship between a business unit’s network
centrality and product innovation. Tsai (2002) also found that an organization’s formal
structure and competition between units dampened the relationship.

These studies of intraorganizational networks and innovation support the notion
that social networks are important to innovation processes. The studies that preceded
them in this section demonstrated that the concept of identity lends itself to social network analysis, although few studies have taken this approach to the study of organizational or professional identity. In addition, extant empirical research has left unexamined the interrelationships among identity, social networks and innovation.

**Fluid Organizing: An Emergent Dimension**

A fundamental concept in organizational research is that an organic structure, characterized by shifting leadership, horizontal communication and variable roles, is more conducive to innovation than a mechanistic structure (Burns & Stalker, 1994/1961; Hage, 1999) and that staying flexible is especially important in dynamic, hypercompetitive environments (Eisenhardt & Martin, 2000; Volberda, 1996). Scholars have used various terms, including flexibility, adaptability and ambidexterity (Schreyogg & Sydow, 2010), to describe a range of structural features and adaptive behaviors that are believed to contribute to organizational flexibility or fluidity. Traditional thinking, however, has juxtaposed the need for flexibility with an equally important need for predictability in terms of organizational routines (Thompson, 1967). Research has identified a critical organizational capability as one of achieving “organizational ambidexterity,” i.e., finding a balance between flexibility to facilitate innovation and stability to allow efficiency and profitability (Raisch & Birkinshaw, 2008). Related research on dynamic capabilities (e.g., Teece, Pisano, & Shuen, 1997; Volberda, 1996) presents a similar view. For example Volberda (1996) noted the paradox of flexibility: although it is conceived as standing in opposition to stability, he suggested that organizations in highly competitive environments actually must have both. He also theorized that organizations cannot achieve full flexibility without losing their identities,
echoing Weick (1982) who suggested that total flexibility results in no sense of identity or continuity.

A few studies have challenged various aspects of the prevailing view. For example, scholars have suggested that continuous change or “morphing” (Brown & Eisenhardt, 1997; Rindova & Kotha, 2001) is conducive to innovation and performance in high velocity environments. Eisenhardt, et al. (2010) suggested that to innovate, managers must counter-intuitively “unbalance toward favoring full flexibility.” One important prescription they offered was the encouragement of local autonomy. This concept emphasizes the importance of human capital in innovation, supported by extensive prior research. Weick (2000) has suggested that change is emergent and ongoing, not necessarily management-induced; rather, management notices it, labels it, and legitimizes it. Hence, an important and open question concerns the role and nature of local autonomy and how it unfolds in innovation processes. Extending the idea of continuous change, Rindova and Kotha (2001) went even further to suggest that “continuous morphing,” a co-evolution of resources, structure, and products, is preferable in hypercompetitive environments over a stable organizational form. Like Eisenhardt et al. (2010) they suggest that local autonomy and decentralized systems facilitate performance in such environments. In addition, the authors indicated that human assets are perhaps more important than other types of assets under such conditions. Importantly, their study highlights the significance of cognition, especially their finding that “evolvability” might be an essential part of the organizational belief system that allows an organization to adapt, an idea that again hints at the importance of core identity beliefs. More recently studies suggest that exploration and exploitation modes of learning
may be mutually facilitative rather than inherently contradictory (Feldman & Pentland, 2003; Garud et al., 2011; Garud et al., 2006). Intriguingly, Pentland and Feldman (2003) suggested that organizational routines, when understood abstractly, can actually enable flexibility and change because routines that are conceptualized in this fashion by members can provide a measure of stability without rigidity. In addition, researchers have found instances of organizations such as 3M, which simultaneously explores new ideas and exploits existing capabilities (Garud et al., 2011) or Infosys, which seamlessly blends flexibility and stability, transforming and adapting to its changing environment while still accomplishing the necessary day-to-day business activities (Garud et al., 2006).

Considered together, these studies of fluid organizing suggest that human assets and local autonomy are important facilitators of sustained innovation. In addition, in dynamic environments, organizations may need to emphasize flexibility to remain viable. Two critical and unanswered questions remain, however: how is local autonomy accomplished while allowing an organization to retain a sense of itself as a distinct entity and what, if any, might be the limits to organizational fluidity? Schreyogg and Sydow (2010) suggest that answers to these questions involve developing a process-based theory that provides a framework for conceptualizing contradictions and paradoxes.

**Integrating the Literatures**

This chapter has reviewed the innovation literature and also presented theory and research regarding identity, social networks and organizational fluidity that inform my study. I have characterized innovation processes as fundamentally a combination of social and cognitive process that involves the recursive interaction between beliefs, knowledge and practice. I have suggested that professional and organizational identities,
as essential elements to sensemaking, are likely to play a key role in these underlying social and cognitive processes. Further, I have suggested that social networks might reveal important aspects of how identity and innovation interrelate.

With some notable exceptions, existing studies on innovation have tended to adopt a single-level perspective despite the acknowledged need for multilevel analysis. In addition, an identity framework has not been applied to innovation research to any great extent, although it appears highly relevant. Further, within the realm of identity theory and research, the interplay between professional and organizational identity remains understudied, although both types of identity appear germane to the problem domain of sustained innovation. In addition, the concept of fluid organizing that emerged during the course of my study appears to be a crucial factor in sustained innovation, yet details regarding how fluidity is generated and maintained – and the interplay between identity and fluidity – have not yet been fleshed out. Therefore, I come full circle to repeat my primary research questions, stated in Chapter 1: How is organizational identity related to sustained innovation? and What are the distinctive features of scientists’ professional identity work in a multi-disciplinary context? The two grounded theory models developed in this dissertation both draw on and extend the literature touched upon in this chapter: organizational innovation, identity, fluidity and social networks. The next chapter describes my data sources and methodology. The remaining chapters after that present my findings and discuss their implications.
CHAPTER 3. DATA AND METHODOLOGY

My dissertation consists of a case study (Eisenhardt, 1989; Yin, 2003) of organizing for innovation and the concomitant professional identity development processes within entrepreneurial academic laboratory. Case study represents a “trade-off” of potential generalizability (or transferability) in exchange for “the opportunity to gain insight into an as yet incompletely documented phenomenon” (Lovas & Ghoshal, 2000: 877). It is this latter interest that led me to choose an interpretive case study to investigate linkages among professional identity, organizational identity, networks, and innovation in my focal organization. The interpretive approach treats informants as “knowledgeable agents” and gives them explicit voice in articulating their understanding of their organizational experience (Lee, 1991; Spradley, 1979).

Description of Research Setting

The research site was a successful biotechnology laboratory (for which I chose the pseudonym “BioTech Lab” or “BL”) at a major university in the Northeast. BioTech Lab had an extraordinary capacity for sustained innovation, as demonstrated by its strong track record of invention and commercialization. It was founded over 30 years ago by its current director and specialized in drug delivery systems and tissue engineering. BioTech Lab has achieved both commercial and academic success in these areas, having produced over 650 patents, 250 licensing deals and 40 spin-off companies, as well as over 1,000 peer-reviewed articles, many of those appearing in Science and Nature (archival materials). One long-time member of BL summarized the lab’s innovative contributions this way:

I can’t think of any academic lab, in terms of the number of companies, FDA-approved or clinically passed projects, that has made the same
impact as this lab. There are certainly labs where they’ve had big single things that have had huge impacts, but in terms of sheer quantity of different things having big impact… again, it’s within the area of medicine. Breadth and depth is a part of it, but overall impact is the key (Group head 1).

Because BL had an extraordinary record of successful sustained innovation, it provided an ideal setting for addressing my research questions.

The lab has grown significantly since its founding over 30 years ago, when its founder was hired as an assistant professor by BL’s home institution. By the early 1990’s, the lab had grown to about 30 researchers, including the founder, graduate students, and postdoctoral fellows and associates (collectively called “postdocs”), and laboratory assistants. In 2008 when my data collection began, there were 72 researchers in BL. As of March 2011, BioTech Lab had over 130 researchers including the lab director (now a full professor), professors and visiting professors, senior scientists, graduate students, postdocs and laboratory assistants. Five administrative staff and, during any given semester, approximately 50 undergraduate research assistants also worked in BL. The researchers in BL came from diverse professional backgrounds and included elite scientists, engineers, and physicians. BioTech Lab was known as prestigious training ground for junior scientists, and alumni typically received multiple lucrative job offers when they exited the organization. Roughly two thirds of BL’s funding derives from government grants and contracts. Corporate and foundation grants are the second largest source, providing approximately 25% of funding (archival materials).

BioTech Lab’s ability to innovate repeatedly over three decades attracted considerable attention from organizations and individuals interested in learning from its approach to sustained innovation. As BL’s renown grew, it had to begin accommodating
frequent non-scientific visitors and tours, something for which the lab’s facilities were not originally designed. Until recently, the lab occupied various floors of two buildings, an “old, cruddy and cramped” (according to one postdoc) jumble of bench and write-up space that had been patched together over the years as the lab’s membership and funding grew.

The lab recently consolidated onto one floor of a large brand-new building, and unlike typical academic laboratories, one of the factors anticipated during the build-out phase was the presence of lay visitors (field notes). For example, the founder has a dedicated conference room on BL’s floor, while this same location serves as an open lounge on the other floors in the building, a center for cancer research housed within BL’s home institution (field notes). In addition, there are signs posted here and there that state, “no pictures, please,” and interior window walls of some of the specialized work spaces are darkly tinted to obscure the view from the corridors, indicating that the lab’s designers expected uninitiated visitors to be walk through the hallways. In BL’s old space, the director would wrangle an available postdoctoral associate or graduate student into guiding informal and unscripted tours through the warren of laboratories that constituted the lab. In the new facility, the tour became somewhat standardized, and the lab administrator said that it took one hour to give (field notes). In another sign of the broad interest attracted by BL, the founder regularly fielded numerous invitations to speak at companies, foundations, and other laboratories about his insights into innovation. In addition, during the past year, the science-focused public television program *Nova* featured the founder in two different shows on advances in biotechnology.
Data Description and Collection Procedures

Unlike most prior grounded theory research that has relied exclusively on qualitative data, my project combined both quantitative and qualitative data to explore my research questions. I employed a range of data sources, including a survey, interviews, archival materials, and non-participant observation. The interviews were an important data source for revealing the role of professional and organizational identity in innovation and informants’ perspective on their professional identity development, but the other data sources served critical roles. First, portions of the survey and archival sources provided quantitative data on network ties. Second, both the quantitative and qualitative data derived from the alternative sources supplemented and provided triangulation for the interview data.

Survey. In the fall and winter of 2008-2009, I invited the 72 lab members identified as actively involved in research by BioTech Lab’s director and administrator to participate in a web-based survey. The survey consisted of questions pertaining to the social interaction ties (or networks) in the lab and to organizational identity beliefs. Overall, the survey received 69% response rate, with lower response rates on the network questions (50-60%). The network portion surveyed respondents for information on their communication, friendship, advice and power networks (see Appendix C for the specific questions). As an example, the communication network question was, “With whom do you regularly (i.e., at least once per week) communicate?” All 72 lab members were listed as potential responses to each question, and participants were free to select as many or as few people as they believed appropriate for the question. No broad consensus exists within the social networks literature regarding the “best” way to word network surveys,
so I developed the wording for my survey based on several published empirical pieces (e.g., Brass & Burkhardt, 1993; Fernandez & Gould, 1994; Gibbons, 2004; Ibarra, 1993; Kilduff & Krackhardt, 1994; Krackhardt, 1990; Mehra, Kilduff, & Brass, 2001; Rodan & Galunic, 2004). I also piloted the questions with a convenience sample of Penn State scholars and made adjustments based on feedback from the pilot. Using UCINET (Borgatti, Everett, & Freeman, 2002), I aggregated individual responses to produce a picture of the entire network for each type of tie.

The survey also queried respondents about their organizational identity beliefs. Appendix D provides the specific questions, the first two of which were adapted from Brickson (2005). In addition, I included a final question regarding “big, hairy, audacious goals” or “BHAGs” (Collins & Porras, 1996) to uncover aspirations that might reveal core identity beliefs. These survey responses helped shape the interview protocol and also provided a kind of baseline of information on BL’s organizational identity that I compared to the additional data that I collected. Survey responses helped shape the interview protocol and also provide a kind of baseline of information on BioTech Lab’s organizational identity that I compared to the additional data that I collected.

**Interviews.** I conducted interviews with lab members in 2010 and 2011. I adopted an interpretive approach to the study, deeming it the most advantageous way to explore my informants’ firsthand and detailed descriptions and understandings of the organizing and professional identity development processes within BL. In this procedure, informants are viewed as important research participants who help the researcher understand their experience from their point of view (Spradley, 1979). Following Lincoln and Guba’s (1985) guidelines for “purposeful sampling” I interviewed informants who were most
likely to provide insight into my primary research questions about innovation and identity. I began by sampling lab members who participated in the survey described below. Beginning with this group provides an opportunity to compare survey findings with participants’ interview responses. I also interviewed lab members holding key administrative positions as well as those who joined the lab post-survey. Interviewing was an ongoing, iterative process of collecting and analyzing interview data and then seeking additional participants on the basis of information provided by previous informants. Thus, the sample of participants “snowballed” until the concepts that emerged from the interviews were “theoretically saturated” (Charmaz, 2006; Strauss & Corbin, 1998), i.e., data collection and analysis offered no further insight into a given category or theme. In addition, I conducted additional interviews with several key informants to follow up on ideas raised during previous interviews. In total, I conducted 56 interviews with 43 informants who were affiliated with BioTech Lab. Informants included the founder, four group managers, a visiting professor, 22 postdocs, 12 doctoral students, two laboratory assistants, and the lab administrator. I conducted multiple interviews with BioTech Lab’s founder and the managers of the three largest groups. In particular, I discussed the preliminary findings with my primary informant, BioTech Lab’s founder and director, as a form of member check, and made adjustments to the grounded model based on his feedback.

I conducted semi-structured interviews, employing ethnographic-style interview questions (Spradley, 1979) designed to elicit both answers and additional questions that would be relevant to understanding the participant’s experience. Pilot interviews and the previously-administered survey provided some suggestions as to significant influences
within the lab. I digitally recorded all interviews and obtained verbatim transcriptions from which I removed any specific references that might jeopardize participant anonymity. Appendix E presents the interview protocol, which included a combination of “home grown” questions about work roles and innovation and questions adapted from previous identity research. I developed professional identity questions based on the work of Kreiner, Hollensbe, and Sheep (2006). Questions by Kreiner and Ashforth (2004) served as the models for two of the organizational identity probes. I based the final organizational identity question on the responses provided to the survey described above. This interview question allowed us to probe the current relevance and strength of the organizational identity referents reported in the survey.

**Archival records and non-participant observation.** I also collected unobtrusive measures (Webb & Weick, 1979) by examining archival data, including lab members’ curricula vitae, BioTech Lab’s official communications, and publications and media reports about BioTech Lab.¹ These sources provided various types of quantitative and qualitative data. In addition, I directly observed lab members during five planned, in-residence visits to the lab as they performed their day-to-day activities and documented these observations in detailed field notes. The field notes, lab communications and media reports contributed further qualitative data to supplement the interview data.

**Social Network Analysis**

I used UCINET software and MQAP analysis (Borgatti et al., 2002) to conduct several different kinds of network analyses. First I conducted blockmodeling analysis on the advice tie data to understand patterns in the flows of information through the lab and

---

¹ I obtained some of our data from published sources, which I have not identified in an effort to preserve the anonymity of our informants.
how those flows related to the lab’s formal structure. A blockmodel partitions actors in a network into specific subsets or positions and then permits analysis of the ties within or between positions (Wasserman & Faust, 1994), thereby showing patterns of relationships among individuals who are “structurally equivalent” (i.e., in similar positions within the lab) as compared to those who are not. Second, I used archival data on disciplinary background and subgroup membership of lab members to construct two-mode network maps (see Borgatti, 2009) that depict how professional identity affiliations are distributed across BioTech Lab’s subgroups. I developed maps for two different points in time, two years apart. The two-mode network maps allowed visualization of changes in the lab’s structure and human capital over the time period of the study.

In addition, I measured the heterogeneity in each network (advice, friendship, communication, and power) according to two different partitions: academic discipline and subgroup. In other words, I derived estimates of the degree to which members of a given academic discipline (or organizational subgroup) choose themselves for friendship, advice and power ties. To do so, I used UCINET to calculate an E-I Index of homophily. The E-I Index is the “number of ties external to the group minus the number of ties that are internal to the group divided by the total number of ties” (Borgatti et al., 2002). A value of -1.00 indicates complete homophily (i.e., a group only chooses other group members), whereas a value of 1.00 indicates complete heterophily (i.e., a group only chooses non-group members). I also joined the three networks to model a combined network consisting of all three types of ties and transformed the joined network to depict the multiplexity of the organization’s ties. The transformation created seven codes, and each code represented a different combination of relations. For example, absence of a tie
between two individuals was coded 0, while 1 meant friendship tie only. Codes 4, 5, and 6 represented the three possible types of duplex ties (i.e., friendship-advice, friendship-power, and advice-power), and 7 indicated a triplex tie (friendship, advice and power). Netdraw (Borgatti, 2002) allowed us to visualize the three networks and the multiplex ties.

**Building Grounded Theory**

In this dissertation, I develop two grounded theory models to address my two research questions. Given my interpretive approach, the theoretical frameworks were grounded in and emerged from the studies themselves. For each model, following established methods for naturalistic inquiry (Lincoln & Guba, 1985) and building grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1998), I examined all the qualitative materials to identify salient concepts (open coding). This represented a first order analysis that reflects the informants’ view of their experience (Van Maanen, 1979) and used in-vivo terms as much as possible. Next, I performed axial coding (Strauss & Corbin, 1998) to group these concepts into more abstract categories and to identify relationships between and among these general categories. This second-order analysis (Van Maanen, 1979) interpreted the first order concepts through relevant scholarly lenses. The quantitative corroborated the first and second order concepts that I developed from the qualitative data and also suggested novel, complementary themes not apparent in the other data. The themes from the second order analysis provided the primary building blocks of my grounded theory. The grounded theory presented a model in which these second order categories were “set in motion” (Nag et al., 2007: 829) by describing
the dynamic relationships between them. An important and distinctive feature of the model is its foundation on qualitative and quantitative empirical materials.

**Trustworthiness of the research.** Lincoln and Guba (1985) specify four criteria for trustworthiness in qualitative research: credibility, transferability, dependability, and confirmability. To help assure that my findings are credible, I protected the anonymity of informants and gave them the option of withdrawing from the study so that they have little or no reason to be untruthful. As I coded qualitative materials, I compared emergent concepts to the themes generated by the previous materials. This constant comparative method allowed for “within-method” triangulation across multiple data sources as a cross-check and to establish the internal consistency of the interpretive findings (Jick, 1979). The quantitative data analysis permitted “between-method” triangulation (Jick, 1979) to assure the credibility of the findings. As Lincoln and Guba (1985) noted, a researcher can make a case for transferability of her results, but ultimately, it is a matter of future empirical confirmation. I evaluated the potential transferability of the emergent grounded theories and developed propositions that future researchers can test.
CHAPTER 4. FINDINGS FOR RESEARCH QUESTION 1

My first research question was “How is organizational identity related to sustained innovation?” Figure 2 illustrates the data structure that emerged from the data analysis pertaining to this question. I drew first order concepts from the archival materials, survey data, and the reports of informants. I then categorized the first order concepts into more general, second order (theoretically relevant) themes that reflected the focus of my research. The aggregate dimensions reflect a greater level of distillation and abstraction for the purpose of theory building.

As shown in Figure 2, five aggregate dimensions emerged from my data analysis: 1) external context; 2) identity dynamics; 3) flexible resources; 4) shifting structure; and 5) fluid organizing. BioTech Lab displayed a high degree of openness to its external context and this had an effect on all aspects of the innovation processes that took place within the lab. Identity dynamics, particularly the reciprocal interaction between BL’s organizational identity and the professional identities of its researchers provided a shifting cognitive framework for sensemaking and “sensegiving” (Gioia & Chittipeddi, 1991) that guided decisions about what projects to pursue, how to deploy resources and how to structure the organization. BioTech Lab’s combination of flexible resources and shifting organizational structure produced a remarkable degree of fluid organizing that supported and enabled sustained innovation. Table 1 presents a compendium of representative quotes that contributed to the construction of the second order themes and aggregate dimensions presented in Figure 2.
One important goal of this study was to develop a model that accounted for the role of organizational identity in organizing for sustained innovation at BioTech Lab. I found that organizational identity did indeed play an important role. At the same time, there were other crucial concepts that emerged during my analysis. Thus, the grounded model reflects the interplay of organizational identity and these emergent themes and dimensions. The aggregate dimensions shown on the right side of Figure 2 are the primary building blocks of that model (which I will assemble after describing the constituent dimensions and themes).

Dimension 1. External Context

BioTech Lab’s external context played an important role in its ability to innovate successfully. Key factors in the external context were the role of BL’s parent organization, numerous cross-boundary relationships, and the science-driven high-velocity environment of the biotechnology field.

Parent organization. BioTech Lab’s parent organization, a major university, was an important proximal influence. The parent organization both enabled and constrained BioTech Lab’s ability to innovate. For example, BL’s university had “a good name, which helps in recruiting and fundraising” (founder). This was especially helpful in the early years, before BioTech Lab had established its own reputation. One informant who had been a postdoc in BL during the 1980’s said, “I called [founder] without knowing him. It was definitely [parent organization] that attracted me.”

In addition, the parent organization had developed significant expertise in technology transfer. At the time of this study, the technology licensing office was “one of the most active … in the country,” with a 34-member staff that included 14 licensing
officers (archival materials). In the most recently ended fiscal year, the office had been involved in numerous licensing and startup deals that generated over $70 million in revenues, split among inventors and the parent organization (archival materials).

Although BL was by no means the only engine of innovation in the parent organization, the technology transfer office’s proficiency was due in large part to its experiences with patenting and licensing BioTech Lab’s inventions over three decades. As the founder noted, “we have learned it together and gotten better at it over the years.”

The parent organization also provided other important resources, such as office and laboratory space, and, as the founder noted, “has always had strong ties to industry,” so that BL was surrounded by a climate of innovation and invention. Several lab members also cited the numerous lecture series and workshops held throughout campus that provided inspirations for invention and opportunities to develop ideas. One postdoc described the parent organization as “an entrepreneurial ecosystem … an intense, inspiring culture … that forces you to think about how to find the right application for your science” (postdoc P044).

Although the parent organization enabled innovation in several ways, it also constrained BioTech Lab. One of the most obvious and critical constraints was on research space. As one of the group heads observed, “Space is gold. People cut their arms off for a few feet of lab space.” In an interview, the founder concurred, saying, “That may change, but space is probably the biggest limitation.” Even though the parent organization provided new expanded space for BL, its policies constrained the square footage to what would be sufficient for the number of personnel that existed at the time of planning rather than the number projected to exist when the facility was complete.
BioTech Lab’s administrator explained, “The new space was based on the size of our group two years ago. And so an ultimate decision was based on how many full time equivalents we had at that point in time, which I was clear to point out that we were going to grow beyond.” Indeed, by the time BL moved into the new facility, they had already added over 30 positions (field notes).

Another important constraint that had implications for BioTech Lab’s structure and ability to innovate was the university’s complicated rules regarding who could serve as a Principal Investigator (PI) or co-PI, which was a necessary designation for obtaining grants and leading funded research projects. A group head explained, “There are certain advantages to being able to PI. It gets into granting finesse and red tape. For example, [founder] can’t dedicate more than 100% of his time. It gets to a point where it limits his ability to be on a grant. If I can be a PI then we can all leverage our time better.” Over the years, four talented postdocs who wanted to stay found creative ways to adapt BL’s structure to these rules and to maintain an affiliation with BL. These postdocs ultimately came to run their own groups in the BL organizational structure. The most common solution was to obtain an outside faculty appointment for which the parent organization would automatically grant PI status. In addition, one group head had successfully transitioned from postdoc to research associate (a sponsored research staff position without PI privileges that the lab administrator called a “long term appointment and real addition to head count”) and then to faculty (and PI) within the parent organization. According to the founder, the last step in that process had been “brutally hard,” and therefore it was an exceptional occurrence for both BioTech Lab and its parent organization. Faculty appointments not only allowed group heads to serve as PIs, but also
extended their affiliation with BioTech Lab indefinitely and to function essentially as permanent employees. This had three primary effects on the lab. First, it allowed BL to retain internally the research and mentoring talents of some of its senior members. Second, it brought in additional funds and third, it sometimes instigated structural changes, both of which facilitated new research projects. Thus, lab members’ willingness to seek creative solutions to institutional constraints affected the course of sustained innovation in BioTech Lab.

Other policies of the parent organization also forced members to be creative and resourceful. For example, several members complained of how difficult it was to navigate the parent organization’s bureaucracy to gain use of equipment and facilities elsewhere on campus and to obtain small research grants for their side projects. One postdoc captured the sentiment expressed by several researchers: “My previous two institutions, it was just so much easier to get stuff done. In terms of using other facilities [inside the parent organization], it’s just a nightmare of paperwork and bureaucracy.” In response to these difficulties, lab members would frequently look beyond the parent organization to find the equipment or research facilities that they needed. Thus, these limitations led to the unintentional consequence of fostering stronger cross-boundary relations between BioTech Lab and other organizations.

**Cross-boundary relationships.** BioTech Lab had numerous cross-boundary relationships with various external parties that facilitated different phases of the innovation process. One crucial type of cross-boundary relationship was with diverse funding partners, including government departments and agencies, companies, venture capitalists, and private foundations. The diversity of its funding sources was a major
strength because BioTech Lab was not dependent entirely on any one source, which helped assure a steady funding stream for innovation.

In addition, BioTech Lab had extensive cross-boundary research collaborations, as well as informal arrangements for reciprocal use of equipment and facilities. For example, BioTech Lab had several partnerships and shared grants with clinics and other academic laboratories to conduct ambitious, large scale projects, such as cancer research. In addition, BL frequently partnered with various companies that licensed its intellectual property to assist in the animal studies and clinical trials that were necessary to obtain regulatory approval for inventions. BL also collaborated with physicians at external institutions to conduct research. Informal reciprocity regarding equipment use was another important cross-boundary connection that facilitated innovation at BioTech Lab. For example, BL did not own a specific type of microscope, and several members reported that it was easier to “go down the street” and use the microscope owned by an independent laboratory than to attempt to schedule time on one owned by an institute in the parent organization (field notes). In addition, BL allowed outside researchers to use its equipment and frequently benefited in other ways from these courtesies. For example, a former postdoc who had an unusual expertise with a special mechanical testing device retained use of that machine and other BioTech Lab equipment for members of his new lab. As he explained,

I’m responsible for training everybody on that machine, and so I don’t know, a quarter of the people I’ve trained aren’t in BioTech Lab. And not just counting the people in my new lab where I’m also training people this year. There are a lot of spinoff companies or companies BioTech Lab collaborates with and some of them come here and use it. Neighboring labs that don’t have their own piece of equipment come and use it, so I mean there’s a lot of back and forth that way. (postdoc P525)
BioTech Lab’s porous boundaries facilitated the innovation process.

I think it’s sort of free flowing environment where there are very little boundaries for the flow of ideas. Those ideas can come from anywhere, from the industry side, from members of the lab or from other labs. The net result is that those ideas somehow create value and that value creation is very unique to BioTech Lab. (group head 3)

**High-velocity environment.** Another important external influence was the “high velocity environment” (Bourgeois & Eisenhardt, 1988) of the biotechnology field, characterized by rapid progress, continuous innovation, and discontinuous change. One of the most perceptible effects that this competitive and fast-paced field had on innovation in BioTech Lab was that companies and investors would proactively seek out market-driven partnerships with BL. Because the innovations in biotechnology are science-driven, investors and companies began to come directly to BioTech Lab as one source for those scientific advances (field notes). On occasion, the products suggested by profit-oriented outsiders, such as hair conditioner and shaving cream, seemed to be outside of BioTech Lab’s mission of improving human health and saving lives. Usually, these offers would be turned down, but members did not dismiss them indiscriminately. As one postdoc said,

> If there’s no other outlet for that intellectual property, then fine, but it certainly is not the original intent of any of our intellectual property to be used in that sense. If what it was originally intended for doesn’t exactly work out the way you intended it to, and another opportunity arises, why not?

When questioned about whether BL was acting in character by producing these types of products, he pointed out that the work of the organization has not fundamentally changed because of these forays. “To this day there is no section of BioTech Lab dedicated to cosmetic products” (postdoc P535).
Lab members did report that they felt somewhat buffered from the pressures that bore upon the industrial, revenue-focused segment of the biotechnology field; however, they were vying for “first in” innovation status in the “hypercompetitive” (D’Aveni, 1994; Wiggins & Ruefli, 2005) domain of biotechnology research, and this did affect them and their work. They felt competitive pressure to be first among their peers to publish and patent their ideas. As one doctoral student explained, “You’re not trying to get the lion’s share of the market [like profit-driven companies]. You’re trying to be the first one to figure something out and figure it out the best. In academics, it’s whoever did it first” (doctoral student P738). Further, although the competitive pressures were not directly profit-driven, they oriented lab members toward the biotechnology product market. As the following quote demonstrates, protecting the potential commercial value of intellectual property had become just as important to lab members as was producing academic papers:

If it’s something that’s a novel composition like matter, something like that, IP and publication are always talked about in the same sentence. It’s always like, great this is looking good, file the IP, then we’ll finish the paper. You know, the two are always in the same conversation like you have to do these two things with it (postdoc P535).

The degree of competition and sense of being buffered from commercial forces varied somewhat depending on the area. For example, in the more mature areas of biotechnology, researchers experienced the field as a very high velocity environment. As one researcher explained,

Bioengineering as an academic field is very competitive. You have an idea, and if you are not original enough, chances are someone’s already done it. And, I know several examples where someone in the lab had an idea and they got scooped by another lab who thought of it just a few months earlier. … I think stem cells is extremely competitive. It’s a very crowded field with a lot of very smart people. Drug delivery is definitely
crowded. Tissue engineering, I’m not that familiar with, but from my impression, is probably less crowded. It is still very new, so less of a chance of getting scooped there. But for the most part, the more mature the field is, the low-hanging fruit, if you want to call it that, is far less. It’s picked. (postdoc P535)

A postdoc in tissue engineering concurred:

Given that this lab does multiple different things, it really depends on what field you’re talking about. I do tissue engineering type stuff, which really has not taken off so much in terms of a commercial market yet. There aren’t too many big companies throwing billions and billions of dollars at tissue engineering products. The field hasn’t matured yet, so it’s too early for that. For us there really aren’t any companies that we’re competing with. We’re competing with other academics, so there’s always the fear of being scooped in terms of publication. The people that I talk to who are doing the drug delivery stuff, they’re always talking about this company doing this, this company’s doing that. And, our lab has all these connections to companies. We’re sort of working with them, but in a sense, we’re also competing with them. It’s complicated. (postdoc P333)

The intense competitiveness of the biotechnology field, along with the other factors in the external environment (BL’s numerous cross-boundary relationships and the resources and policies of its parent organization) had a significant effect on several aspects of the sustained innovation processes within BioTech Lab. Interestingly, survey responses suggested that Biotech Lab members grappled with the tensions and tradeoffs concerning the value of basic versus applied science and possessing proprietary versus shared knowledge. These findings suggest that the external context may have provided two different and at times contradictory logics, one commercially-oriented and one public-science-oriented, that both influenced action within BioTech Lab. I next discuss the primary dimensions of those internal processes.

**Dimension 2. Identity Dynamics**

This dimension refers both to the separate and combined influences of BioTech Lab’s organizational identity and of members’ professional identities. Both types of
identity were implicated in the intertwined factors that guided member action and led to sustained innovation.

**Organizational identity.** Based on the reports of survey participants and interview informants, a core aspect of BioTech Lab’s organizational identity was “innovation with impact.” When survey respondents (see Appendix D for questions) were asked what would be BL’s motto, if it had one, common responses were variations on the concept of BL focused on innovation with impact. Examples included: “Think big, think impact,” and “IMPACTS: work on things that can truly make a difference to the world and society.” Consistent with the survey results and interview reports, I observed during my field visits that the word “impact” was used frequently by BL members (field notes). In addition, an important and telling part of the organizational narrative was the phrase, “this is gonna be huge,” which was something the founder was known to say when presented with a great idea (field notes). The term had come to be a touch-stone phrase in BioTech Lab, repeated with pride and a bit of humor by BioTech Lab members when they felt they were onto a potentially impactful innovation.

Other key identity referents that were mentioned by survey participants and confirmed by interview informants included being the “best lab in the world,” “resource rich,” “multidisciplinary,” “playground for scientists,” and having a “mission of commercializing science.” Several survey participants mentioned “curing cancer,” as an ambitious yet achievable goal for BioTech Lab. These organizational identity elements attracted highly ambitious researchers who wished to focus on radical, game-changing scientific innovations that could be translated from “the bench to the bedside” (group head 3).
Observations from BioTech Lab support the point from prior research that organizational identity serves both sensegiving and sensemaking purposes. In BioTech Lab, organizational identity “gave sense” to members that we “work on high impact projects and try to solve really important problems” (founder). Informants uniformly echoed the founder’s sentiment in this regard. The founder and group heads would encourage members to think big and aim for impact. “A lot of other places, it’s very formulaic: you need to work faster, you need to have X number of papers by this year, kind of thing. Here it’s more like, well, if you spend five years only on one paper, but it's in Nature then you've really tackled a big problem” (postdoc P525).

Postdocs and doctoral students were given considerable freedom to figure out how this general directive to innovate with impact would manifest in their own projects. “For a graduate student or postdoc that I would hire, I might say take six months to a year and think about [what project you want to do], but if you think about it sooner, that’s good, too” (founder). One of the group heads noted, “You have to figure out how you are going to do what you are going to do. No one is going to tell you this. [Founder] is good for ‘go take that hill’ or ‘consider invading that country’ as opposed to ‘I would use an M1 rifle’ or something like that” (group head 2).

BioTech Lab’s espoused strategy for innovation strongly reflected its organizational identity. The strategy relied on three central pillars – platform technology (i.e., a Big Idea), blocking patent (to protect the idea), and seminal paper (proof of the idea’s validity). A fourth ingredient was a project champion, someone who would make the project his or her own and take it forward, persevere to assure that the innovation comes to fruition. According to the founder, “Very few things are truly impossible.
Having someone who will keep believing in herself and her ideas and be persistent no matter what, is what makes the difference.” The fourth ingredient implicated professional identity, because the project had to mesh with the project champion’s personal aspirations if it was to go forward. The strategy exemplifies how innovation in BL necessitated a dovetailing of organizational and professional identities as sensemaking and sensegiving guides. Organizational identity as a guide to cognition and action directed members to work on “something huge.” The details of what that would be were determined by the project champion’s interests and willingness to take on a particular project that had the potential to “be huge.”

Although some researchers were brought in to make progress on specific grants and contracts, the prevailing organizational identity generally encouraged to think broadly and develop their own ideas. “I tell my people explicitly, I think that some of the most exciting research is stuff that’s not on paper . . . so I want them to work on that” (group head 1). At the same time, managers encouraged researchers to think about their own careers (and professional identities) and to be practical. The founder explained:

Sometimes people develop their ideas to a point and then they want to go over it and get a critique or whatever. Whether it’s going to be huge is one thing that I look at. The second thing is how hard is it to do? In other words if it was a huge idea, but it was going to take fifty years to accomplish I would just want them to be realistic about it. You know I don’t want to discourage them, but I would want them to understand how hard it is going to be. Even if they did not accomplish everything and in other words just to have an idea, that there would be some stopping off point. That if they tried to do this thing that they would come away with something from it by the time they left the lab. A paper or a patent or something important.

Researchers generally shared an interest in biomedical science, yet they came from diverse academic and professional backgrounds and thus had diverse professional
identities and aspirations. In this multidisciplinary setting, organizational identity provided a general guide to member action as they endeavored to innovate. This guidance was akin to what a compass provides, i.e., directions to go not quite north and not quite west, but somewhere in between. The primary effects of BL’s organizational identity were to (1) raise the sights of members from incremental to more ambitious innovations, and (2) embrace multidisciplinary research as the route to achieving lofty goals. One group head said, “Here, they will get an expertise different from the one they came in with, and they will also get the perspective of, bio-medically speaking, who cares? It’s very nice that you made this gadget that like beeps every once in a while, but what use is it?” (group head 2). The founder explained,

We make it clear by the projects that we value, so that people get an idea of what is important and what is not. Another element is putting people in an environment where you try to encourage a lot of interactions with different ideas that stretch them. So the idea of multidisciplinarity to me stretches people so that they can learn things.

A lab member confirmed this perspective, stating, “I consider myself a scientist and I guess I’ve always had a certain goal in mind and my goal has always been to work at kind of an interface. I’ve never wanted to be a purist from very early on. And [being in this lab] has only helped me get farther along that goal” (postdoc P535). BioTech Lab’s organizational identity served as a general sensemaking guide to member action and also influenced the professional identity development of lab members, the majority of whom were at early stages of their careers.

**Professional identity.** Organizational identity shaped members’ individual professional identities in general ways, primarily by encouraging members to aim higher in their research goals and to think interdisciplinarily. Interview reports indicated that
members defined their professional identities in terms of other non-organizational referents, such as their education backgrounds, their skill sets, their scientific interests, and their career aspirations. Professional identity development, however, was an important reason why individuals came to BioTech Lab. As one lab member explained: “When you’re going to do a postdoc, the question is what are you looking to do with your life and how can I help you do that? So it’s not just what are you looking to do here, but it’s really one point to get to the next step” (postdoc P300). Postdocs and graduate students joined BioTech Lab with the expectation that they would be there for two to five years (field notes). During their relatively brief tenure, postdocs and graduate students would gain skills, knowledge, and connections, and decide what to do with their professional lives.

On the individual level, professional identity was an important guide for lab members. Answers to questions such as, ‘What projects would be most conducive to my development? With whom should I work?’ were guided by and also affected the development of an individual’s professional identity. As a result, professional identity issues at the micro-level also affected the course of innovation in the organization as a whole. In combination with the organizational identity, professional identity (and the ongoing work of developing it) helped direct individual efforts toward identifiable and concrete innovation goals. Further, the sensegiving provided by BioTech Lab’s organizational identity was relatively abstract so that members needed other resources to help make sense of how to express this belief in their own work. Professional identity was a crucial resource that members used to make sense of how to give form to the organizational identity referent of “innovation with impact.”
When [former postdoc] arrived in the lab, she says, she went to [founder] and asked what he’d like her to work on. “What excites you?” was [his] reply. After tossing around a few ideas, [he] told her to “go think some more.” For two and a half months, she says, [he] would tell her only to do what would make her happy. “The level of frustration was just enormous – and it was perfect,” she says. … After finally settling on an idea, and winning [his] approval, she was ready to pour her heart and soul into it. “He pushes you out of your comfort zone. That’s how you develop a scientific ego.” (archival materials).

Some members came in with well-developed professional identities around a specific problem domain. For example, a doctoral student said, “I came here with a very specific goal for my PhD, which is to work on treatments for spinal cord injury. This is my passion, my motivation” (doctoral student P092). Others were less clear, as represented by the postdoc who said, “I know what I won’t be, and that’s an industrial scientist” (P535).

Balancing the tension between acting in character with the organizational identity (i.e., thinking big) while also meeting one’s personal professional identity aspirations affected members’ actions and the course of the innovation process. One postdoc described it as follows:

I think the individual people in the lab have a mission which is to generate papers and [further their own] career. And then somewhere in there is also life-changing discoveries, if you are fortunate enough. I think it's above these two. If you're lucky enough and these two things also correlate with this higher ultimate goal then you hit the jackpot (postdoc P766)

A group head described BioTech Lab’s main goal of innovation with impact as “non-negotiable” and explained that within that goal, there was tremendous creative freedom for individuals to develop their own professional personas: “The beauty of BioTech Lab is that the standards of value creation are all very subjective. It depends on where a particular individual wants to land on the translational aspect of their work” (group head
3). Members used professional identity as a sensemaking guide to bracket the phase of the innovation process (e.g., discovery, synthesis, application, translation) where they chose to focus their work. As part of this process, professional identity helped members to rule in or rule out specific projects as well as specific goals (e.g., papers versus patents) and aspirations (e.g., academia versus practice).

Indeed, one of BL’s most appealing aspects to postdocs and graduate students was that they could explore many career options located at different points in the translation chain because of the exceptional relationships that the lab had developed with industry partners. Although BL members generally viewed postdoctoral positions as a preparatory step toward obtaining a faculty position, they also noted that BL postdocs frequently went in other directions (field notes). “I’d say most of the people I know who’ve left this lab go to like start ups or things like that. So that’s kind of a different avenue that’s available here” (postdoc 535). Another member said:

The first day I joined the lab in grad school I said I wanted to be a professor at a good school something like a large state school. I still think that’s what I want to do, but since being a postdoc here I have considered other things a little more seriously because I’ve been in contact with a corporate thing so it's been close contact with [company]. Close contact with [other company]. Whenever I’d talk to these people at the end of the day I want to go there. I want to work with them. (postdoc P300)

The founder observed,

If I had to guess, I would say the ratio of lab members going into academic versus industry is 50/50. It is hard for people when they are starting their careers to know what they want to do, and one goal is to expose them to a lot of different things so that they can figure it out.

To that end, BL recently organized a professional development seminar series for its postdocs and graduate students. The talks brought in lab alumni and other close colleagues from universities, pharmaceutical companies, start ups, funding agencies and
even investment firms to speak about their careers and help members explore options they might not have realized existed.

At the organizational level, BL’s professional identity was diverse and was an important resource for achieving sustained innovation. This aspect of BioTech Lab’s professional identity will be discussed in detail in the section entitled “Flexible Resources.” Here, the important point is that, at the individual level, professional identity served as a sensemaking guide that filled in the blanks left open by the more general organizational identity of “innovate with impact.” Acting in character with the organization, BL’s members endeavored to innovate with impact. In the absence of specific directives about exactly how to do that, they would rely on their own professional backgrounds and aspirations to provide a focus to their work and to decide what projects they would pursue. As a result, the individual professional identities of lab members directly affected the course of sustained innovation in BioTech Lab. Professional identity also set in motion other changes in BL that affected sustained innovation. For example, after a project champion had selected a project that was consistent with her professional identity and the organizational identity, she would have to assemble the resources necessary to bring her idea to fruition, thereby triggering a redeployment of the lab’s human and financial capital. In addition, professional identity also indirectly led to changes in BioTech Lab’s structure because it was an underlying reason why members decided to stay and create new divisions.

**Dimension 3. Flexible Resources**

“BioTech Lab is Disneyworld for academics. There is a ton of research funding, prestige, and really smart people! If you can’t do good work here, you can’t anywhere”
Human talent. Many informants identified the human talent in BioTech Lab as its most valuable resource. Echoing the comments of many members, one person said, “Funding and equipment are very nice to have, but I think the people come first” (postdoc P766). Arguably the most crucial aspect of BL’s human talent was its accessible and responsive leadership, including its founder and the group heads. The founder and group heads were the primary “sensegivers” of the organizational identity mandate to “think big.” In this role, they provided guidance that encouraged junior members to maximize the potential impact of their innovative projects. The founder also actively encouraged the growth and development of all BioTech Lab members, through personal contact and also by instituting lab-wide professional development seminars (field notes). The group heads adopted the same developmental stance in working with their protégés. For both professional and project guidance, BL’s founder and group heads made themselves available and accessible to members. “It doesn’t matter what time I email, I’ll get a thoughtful response from [the founder] in minutes. He does that for everyone, not just me. He’s incredibly busy, so this is amazingly responsive, but at the same time, it’s humbling and makes me want to be that way, too” (Group head 3).

In addition, the founder focused on recruiting the best and brightest individuals. BioTech Lab received thousands of applications for open positions and was extremely selective in its hiring practices for postdocs and acceptance decisions for graduate
students. Those fortunate to be chosen were the best and brightest and the most promising students in their disciplines. “I feel like at [BioTech Lab] it's sort of like the Yankees, right? They sort of sit back and they see where the talent is on all the other teams and then they buy them up” (doctoral student P162). Describing his selection criteria, the founder said, “I want people [when they recommend someone] to say, ‘this is the best student I ever had,’ and I don’t like it when they don’t say that.” In addition, because of its high level of sustained funding, BL could afford to hire for raw talent and not just for specific expertise that was needed to advance a given project. “If I think somebody is going to be an absolute superstar, I might cover them, too [out of my own funds]. So basically my feeling is this person is so good and I figure I will just take her and she could work on whatever she would want to work on” (founder).

These hiring practices contributed to another crucial aspect of BioTech Lab’s human talent: its diversity in terms of the academic disciplines represented in the lab. Although chemical engineering was the most common disciplinary background of lab members, no one academic field dominated. Twenty-six of the 121 researchers in the lab possessed their highest earned degree in chemical engineering (i.e., PhD or SciD for postdocs, master or bachelor for doctoral students), but other disciplines were also well represented, including related engineering areas (e.g., bioengineering and materials science), and allied disciplines (e.g., medicine, chemistry and biology). Lab members also possessed degrees in other fields, such as math, physics, computer science, and history. The diversity outside of mainstream biotechnology was intentional and provided a different perspective that helped fuel innovation. “I think the fact that I don't come from biology, I mean I have this materials background that puts me in this unique interface to
look at these biological problems from a completely different way that usually biologists don't think about” (postdoc P766).

In combination, the size, quality and diversity of BioTech Lab’s human talent provided the “requisite variety” of ideas necessary to foster sustained innovation.

One of the things that make it a successful, prolific, great lab to work in is the broad range of backgrounds and kinds of projects being conducted. I have the feeling that regardless of what your question is as you’re working through a project, there’s someone who is essentially expert in that question or that problem. (doctoral student P938).

BioTech Lab focused on hiring the best and the brightest, and that produced an unrivaled opportunity set of potential innovations. As members talked to each other and shared ideas or sought collaborators with expertise different from their own, they would combine their respective knowledge bases in novel ways, thereby generating lots of ideas for innovation. In addition, as discussed in the following section, BL’s extensive social capital extended the lab’s opportunity set by providing additional knowledge and expertise from outside sources.

Social capital. In knowledge-intensive, science-driven fields, such as biotechnology, there are many complicated steps involved in putting new ideas to use. Would-be innovators must not only develop novel concepts and demonstrate proof of the concept through initial research, they must then conduct “in vivo” tests and then clinical trials involving humans before receiving regulatory approval. These aspects of the innovation process frequently cut across organizational boundaries, and BioTech Lab had a large and diverse external network of collaborators with whom members could work to develop their innovations. A group head described an example:

I had an idea … and said let’s try a couple of things, and it worked. And so we started expanding and expanding and things started looking good
and we did a couple of quick experiments with a local company, and it was at the right time and things worked for them and so we started working with the company, getting it to work in animals and it worked in hamsters and it works in rats and monkeys. Maybe it’ll work in people. There’s some complexity and all kinds of difficulty. I wouldn’t say we’re at the end point by any means, and that’s kind of how it grew (group head 1)

Further, BioTech Lab’s social capital was more diverse than that of a typical academic lab. “In general the corporate ties are different, so we have better relations with industry. … Even the business ties are different. I know a bunch of venture capitalists, and probably most academics don’t know a bunch of VCs or lawyers. I know a bunch of lawyers” (group head 1).

An important source of BL’s social capital was its ever-expanding group of lab alumni. Because doctoral students and postdocs would leave after an average of three to five years, the lab experienced a high degree of turnover. BioTech Lab turned this potential problem into a competitive advantage by continuously tapping the valuable knowledge of its human talent even after that talent left. “There is this network of academics that have trained here and moved on. So a lot of these guys come and go here as if it’s their second home” (group head 3). The alumni network served as a source for several valuable resources. Alumni served as referrals for potential recruits and also provided job opportunities for other alumni. In addition, they frequently provided facilities and equipment and were important collaborators in research projects (field notes).

**Financial resources.** Extensive funding allowed BioTech Lab to capitalize on its internal human talent and external social capital to achieve sustained innovation. The lab received over $10 million in funding annually from various sources (archival materials),
a level of continuous funding that gave the BL a great degree of latitude for launching
new projects.

One of the reasons that you can start a new project in this lab is because of
the money situation. In most labs, you have X number of grants, and a few
that are pretty specific and you’re maxing those out. Adding a new project
isn’t something that can easily be done. It’s easier here. (doctoral student
P938)

At the same time, BL’s funding also affected the lab’s structure, both the formal aspects
and the informal ones (i.e., internal social networks). Regarding the relationship
between financial resources and formal structure, the founder said, “If I was looking at
anything as a focal point for understanding the org chart it is funding sources.” The
following section discusses the relationship between funding and structure in more
detail.

**Dimension 4. Shifting Structure**

BioTech Lab’s formal and informal structures changed frequently over time, and
these changes affected the course of sustained innovation in the lab. As noted above, one
important catalyst for BL’s structural changes was its external funding. Funding had
several important effects on BL’s structure. First, funding increases through the years
permitted BL to grow and hire new members, thereby adding positions to the
organization chart. Second, as BL members obtained their own large amounts of funding,
they were able to start subgroups and hire direct reports, thereby decentralizing BL’s
formal structure and turning it into a quasi-divisional or M-form of organization.

**Formal structure.** One feature of BioTech Lab’s shifting formal structure was
that organizational membership was somewhat fuzzy, with many members having
affiliations to multiple organizations outside of the lab and its parent organization. “[Two
of the group heads] came as fellows but they worked out this really unique way of kind of keeping their foot in our door …. You know they were able to get these [outside] faculty appointments and still spend most of their time in our lab” (founder). A group head also noted, “People [in the parent organization] will share students and the postdocs will go back and forth. Also, all of the researchers in my group have joint appointments, in part because the mechanisms of funding are shared” (group head 3).

In addition, the subgroups themselves changed as the managers of those groups made choices about their careers. “The big three [subgroups] could become the big four or the big one. It wasn’t like this five years ago and I don’t know what it will be like five years from now. I only want to do it if they [group heads] want it” (founder). As these groups changed, the course of innovation within BL also changed. One group head noted:

The place has always been really innovative and it's still really innovative. It's you know perhaps different directions that are flavored now more by the specific interests of the kind of group managers. Now there are people who set agendas where before there was none. (group head 2)

As an indication of the changing formal structure, Table 2 presents a comparison of the disciplines represented in BL as of fall 2008 and summer 2010 across the different subgroups. “No group & other” refers to the BL members who are either (a) unaffiliated with any particular subgroup or (b) co-advised or co-sponsored by BL and other units within the parent organization; groups 1 – 4 represent the four main subgroups within the lab. Figures 3 and 4 present two-mode network depictions of these data. The figures show the range of academic backgrounds among the members at each point in time and how they are distributed across the subgroups in the lab. Thus, each circle represents a particular discipline, such as chemical engineering, and each square represents a major
subgroup (“none” refers to the set of members who were unaffiliated with one of the four main subgroups).

One important result of these changes that directly facilitated innovation was an increase in the depth and breadth of professional expertise found within the lab. A comparison of Figures 3 and 4 shows that the number of professional disciplines increased in all of the subgroups during the two-year period. The disciplines clustered in the middle of each network graph are those that were especially well-represented in BL. As the figures show, the number of central disciplines doubled from five to ten over the two years. More important, in looking at these figures, it is not readily apparent that they are describing the same organization. They demonstrate, therefore the significant degree of formal structural change in BL within a short period of time.

While the subgroups allowed a measure of diversification in BL’s innovation portfolio, the divisionalization of formal structure also placed some constraints on the possibility of collaborative research:

The [group structure] may make things tricky in terms of if I wanted to collaborate with someone in [group A’s] side of things or someone in [group B’s] side of things. That kind of has to be accepted by these middle management, if that’s what you want to call them. … I would say [collaboration between groups] doesn’t happen maybe as much as it should. (postdoc P535)

**Informal structure.** Changes in BL’s formal structure, as well as the high degree of turnover and growth in membership mentioned previously, brought about inevitable changes in the lab’s informal structure (i.e., internal social networks). Thus, the shifting informal structure is an implicit finding based on the turnover and growth in BioTech
Lab’s membership because these changes bring about concomitant and unavoidable changes in the relationships among individual lab members.

In addition, the informal structure appeared to be influenced by the formal structure. Data from the network survey conducted in 2008 provide a snapshot of the association between informal networks and the formal structure. Figure 5 presents the advice network based on the consolidated responses of lab members to questions about advice-giving and advice-getting ties (for survey questions, see Appendix C). Note that individuals give (or receive) advice; hence, advice ties are unidirectional. The arrows in Figure 5 point toward the advice giver and away from the advice receiver, so it indicates “whom one goes to” for advice. Bidirectional ties indicate that a given dyad gives advice to each other. An isolated node (not connected to other nodes) suggests the individual does not participate in the advice-giving network.

As the figure shows, the network is fairly dense, indicating that BL members have a large number of informal advice ties to each other. Blockmodeling analysis, however, indicates that these ties tend to be concentrated within groups, suggesting that formal structure influenced the informal relationships in BioTech Lab’s advice-giving network. Table 3 presents the results of the blockmodeling of tie density in BL’s advice-giving network shown in Figure 5. The table shows density of advice ties within and across five groupings: as with Table 2, “No group & other” refers to the BL members who are either (a) unaffiliated with any particular subgroup or (b) co-advised or co-sponsored by BL and other units within the parent organization; groups 1 – 4 represent the four main subgroups.
within the lab. As shown in Table 3, the density of intra-group advice ties was stronger within all five groupings as compared to the density of inter-group ties.

Further, BL’s informal structure affected the course of sustained innovation in the lab, because “the people that you like to hang out with are the people that you talk with the most, and the people that you end up working with” (postdoc P880). Conversely:

In science you know a lot of people seem to claim that all that’s important are people’s ideas. I think that’s completely false. If you are a brilliant person but you don’t know how to work with other people, you’re just toxic, that’s what you are, you are toxic. And no one will want to touch you or be near you or be around you and you will be a gnome or whatever you call, a hermit. In general people want to be treated with respect and want to receive credit for the work they do. And you do those things and you’re gracious about things, everyone wants to work with you, everyone wants to be involved. I think you know some projects will be non-starters or I would say at least you know, things won’t proceed as quickly as they could otherwise. Because I think everyone in here could generally probably tackle these projects on their own if they really wanted to because everyone’s very smart and very motivated. But any one of these projects could take me 10 years if I did them on my own. (postdoc P535)

In addition to encouraging or inhibiting collaboration between members, social networks facilitated the innovation process in other ways. For example, members frequently brokered connections to other researchers who had an expertise needed by another member. Also, social ties discouraged overlap and “patent poaching” because individuals with relationships to each other would be aware of each other’s projects and would avoid direction competition (field notes).

**Dimension 5. Fluid Organizing**

As indicated by the description of its flexible resources and shifting structure, BioTech Lab was a shape-shifting and highly adaptive organization. I term this process “fluid organizing,” and based on my data, identified three essential features that
constitute an initial definition of this concept. The first feature is a relatively high degree of change in organizational structure within a relatively short period of time. In the case of Biotech, the lab not only doubled in size (in terms of both personnel and funding) within a decade, but more importantly its divisional structure also changed as subgroups were added, and the size of those groups increased or decreased.

The second feature is frequent and rapid reconfiguration of resources to pursue extemporaneous opportunities. The combination of flexible resources and shifting structure contributed to a great deal of fluidity in the way BioTech Lab was organized. As one group head described it, “We’ve really kind of self-evolved” (group head 1). The evolution of BL depended to a large extent upon the founder’s and group heads’ willingness to allow redeployment of resources as well as changes in BL’s structure. The founder said, “The people and the funding come first. Then, I think everything in terms of how we would organize it after that would flow from just however that would make sense. I don’t want to constrain things.” As described previously, group heads anticipated that side projects would emerge. They encouraged members to pursue these and would use slack funding to support the development of promising emergent projects.

I also took on some projects when I was new here. I can’t recall my thought process at the time, but I was interested in making little chips that had thousands of different polymers on them. I had no reason to think that I could do it. I think in another lab they probably would have said, “What are you thinking, we can’t do that,” but I got the resources, put in the time, and we could do it. (group head 1)

The third hallmark of fluid organizing is a recursive relationship between resources and structure. In BioTech Lab, just as resources affected the organizational structure (as discussed above), so structure in turn affected the resources that BL acquired. As members developed professionally and established their own groups, these groups took
on lives of their own and ended up expanding BL’s financial resources, pool of internal human talent and external social capital. It is important to note that the fluid organizing in BioTech Lab was not limited to re-configuring team memberships, but also extended to restructuring the organization’s hierarchy and other structural relationships.

Fluid organizing can in one sense be conceptualized as a further distillation of the other aggregate dimensions that emerged from the data. In another sense it could be conceptualized as a consequence of the inter-relationships between BioTech Lab’s identity dynamics, flexible resources and shifting structure. Either way, BioTech Lab’s ability to organize fluidly and adaptively was a key factor in its consistent and long-standing record of innovation. This record has been maintained as BL has changed its structure and re-organized, grown and added resources. One member described BioTech Lab’s innovative impact in this way:

The thing is that you can have very you know small incremental innovations or you could kind of like really throw something out there and change the industry entirely or change how people think of things entirely. And so that's what I think the major strength of BioTech Lab is: the ability to do that. Innovation in this lab I think is kind of you come up with a new idea that's so revolutionary that it kind of jumps everything five years forward and you kind of get to skip all that in between crap. (postdoc P525)

A Grounded Model of Fluid Organizing for Sustained Innovation

The constituent themes and dimensions presented in Figure 2 represent a static depiction of the data structure. Figure 6 places these themes and dimensions in a process model that shows the dynamic relationships among these elements and how they individually and collectively contribute to sustained innovation with fluid organizing at its core. Analogically speaking, if the data structure of Figure 2 represents a photograph, the process model of Figure 6 represents a motion picture.
As shown by the encompassing band in Figure 6, the external context has an important influence on all aspects of our focal organization’s innovation process. This organization has porous boundaries, so external factors positively affect the resources available, as well as the potential innovations it pursues. This highly dynamic environment both pushes innovations out of the organization (as it introduces inventions to the market) and pulls innovations from it (as other market participants approach them with ideas). In this science-driven field, members feel the pressure of hypercompetition involving diverse players competing in several types of rivalries (e.g., scholarly, patenting, product). Although the competitive arena typically comprises other academics and a race for intellectual credit for ideas, members also feel pressure to develop and protect their intellectual property for purposes of commercialization. Thus, the competition involves two different logics operating simultaneously, an academic and a commercial logic, and both affect the internal processes of the organization.

These differing logics are blended and reconciled internally mainly via identity dynamics, which facilitate a variety of generative responses to the internal and external pressures. These dynamics, involving both organizational and professional identity elements as shown in Figure 6, are a key aspect of the concept of fluid organizing. The organizational identity values both academic and commercial endeavors and therefore incorporates both logics. How members reconcile these logics, however, is a matter of personal sensemaking that depends on the individuals’ professional identity beliefs. As indicated by the figure, there is a reciprocal relationship between the organizational identity and the professional identities of members. Values that are central to the
organizational identity (in this case for example, innovation with impact and multi-disciplinarity) influence the professional identities of members at the same time that the many professional identities collectively affect aspects of the organizational identity (e.g., increasing interdisciplinary research, and diversification of the organization’s areas of research expertise). Both forms of identity play important interactive and non-redundant roles in providing a “scaffold” (i.e., a temporary platform) that is subject to frequent change and which both enables and constrains innovation. This identity scaffold constitutes an important facilitator of fluid organizing because it influences what projects will be pursued, how resources are deployed, and the shape of the organization’s formal structure and the composition of the internal social networks. The interrelation between organizational and professional identity consists of a frequently-changing blend of individual professional aspirations guided by and united in a belief that members can solve the world’s biggest health problems. This merging of individual and organizational aspirations allows the organization, somewhat paradoxically, to remain an organized, coherent and effective system while simultaneously being able to re-organize in a fluid manner so that it can be agile and adaptive. At the individual level, the core organizational identity element of “innovation with impact” encourages members to aim high in their chosen areas of expertise, while members also become more interdisciplinary through their collaborations and other interactions in the organization. At the organizational level, the ambitious goal of doing something “huge” and the constantly changing and diverse multidisciplinary character of the organization’s human talent are two powerful forces fostering sustained innovation.
As also shown in Figure 6, flexible resources and shifting structure are the two other key aspects contributing to and constituting fluid organizing. Key elements of both the organization’s flexible resources and shifting structure are linked recursively, as shown in Figure 6. For example, human talent affects the amount of financial capital available to the organization because members are encouraged to be entrepreneurial in obtaining funding for their projects from various sources. Likewise, financial resources allow the hiring of additional employees, thereby affecting the composition of the organization’s human talent. Human talent also affects the organization’s social capital because former members of the organization tend to become alumni who continue to collaborate with current members of the organization. In addition, by drawing on its external ties, the organization increases its social capital and potential collaborators. Social capital in turn affects human talent because it is an important resource for identifying new recruits. Within the organization’s shifting structure, there is a recursive relationship between formal and informal structure. Formal structure affects the pattern of social ties within the organization, for example, by shaping advice networks. Conversely, informal structure affects formal structure. For example, individuals identify collaborators for themselves and for others through their social networks and the resulting collaborations can lead to the hiring of new members, the creation of new project teams and even new divisions, which changes the formal organizational structure.

The organization’s fluid organizing is skewed heavily in favor of flexibility, yet not everything changes. Two important stable elements are its organizational identity and its consistent emphasis on the core elements of its innovation strategy. These elements provide cognitive anchors for fluid organizing that are critical to sustained innovation.
Thus, my focal organization represents a case in which the strategy does not change, but the structure does – frequently and significantly. Around the two points of stability – organizational identity and strategy – there is an ongoing process of mutual interplay among identity dynamics, flexible resources and shifting structure – an interplay that enables highly fluid organizing, which allows the organization to innovate repeatedly and consistently.

This chapter has presented the findings related to my research question regarding the role of organizational identity in organizing for sustained innovation. As shown in Figure 6’s grounded theory model, I found that organizational identity, in concert with professional identity, facilitated fluid organizing which appeared to be a crucial factor in support of sustained innovation. The next chapter presents the grounded theory model that I developed while pursuing my second research question about professional identity development in BioTech Lab. The final chapter will discuss the contributions and implications of both grounded models.
CHAPTER 5. DISCUSSION OF FINDINGS FOR RESEARCH QUESTION 1

Identity Dynamics and Organizing for Sustained Innovation

Theoretically speaking, what does it take to produce the kind of sustained innovation that both organizational scholars and practitioners believe is so important to achieve in the post-modern era? The grounded theory model that emerged from this study indicates that a significant degree of flexibility and adaptability in the form of fluid organizing is central to continuous innovation. Furthermore, I found that some convergence of both stable and dynamic elements contributes to and constitutes the process – stability in the form of an overarching organizational identity (as manifested in this case in a “non-negotiable” organizational value of innovation-with-impact), and dynamism in terms of changing and diverse professional identities, as well as recursive interplay between flexible resources and shifting formal and informal organizational structure. Overall, my findings suggest two important contributions beyond the grounded theory model itself (which, I note, is not a linear sequential or stage model, but rather one involving recursive and dynamically interrelated elements). First, I expand upon and further develop the central notion of fluid organizing as it relates to innovation and organizational change. Second, I bring an identity lens to bear on the processes involved in organizing for innovation, which augments the bridge between the innovation and change domains. In addition, I also enhance the relatively small but important stream of multi-level research on innovation. More generally, the study helps us to develop a deeper understanding of social and cognitive processes involved in fluid organizing and its association with sustained innovation that might have some significant implications for designing innovating organizations of the future.
Fluid Organizing and Sustained Innovation

Fluid organizing emerged as a pivotal dimension in this study, and its key role required me to return to the literature to develop a better understanding of the concept in the existing literature before completing my analysis. The adaptable structures and shifting resource deployment I uncovered amounted to a form of flexible organizing that went beyond the traditional project-team or matrix-based types of organizational structure. As noted earlier, the idea of fluidity has been discussed in the literature on management and organization under various labels such as adaptability (Greenwood & Hinings, 1996), flexibility (Volberda, 1996), and “continuous morphing” (Rindova & Kotha, 2001). With the exception of the latter concept, researchers have tended to treat flexibility as a trade-off with efficiency or stability and have suggested that the key to competitive advantage in dynamic environments is to develop a pronounced orientation toward flexibility, with less emphasis on stability/efficiency (e.g., Eisenhardt et al., 2010). A “continuous morphing” perspective takes this notion of unbalancing toward flexibility to an extreme, suggesting that success in such environments requires constant change in many aspects of an organization’s form, including structure, resources, products and strategy (Rindova & Kotha, 2001). In this study, however, I observed a highly successful organization thriving somewhere in between an emphasis on either flexibility or stability, and perhaps for that reason, this type of organization provides a more tenable exemplar for other innovating organizations.

Unlike previous research, I found that efficiency and flexibility are complementary rather than competing or exclusive concepts and practices. An important aspect of this complementarity is the interplay between organizational and professional
identity, which facilitates a key practice I term as “guided autonomy,” which combines efficiency, stability and flexibility. My findings suggest that it is important to capitalize on the knowledge of internal human talent and external social capital – a notion that is reflected in the “guided” part of the term guided autonomy. In other words, organizational identity as manifested in strategy guides the organization’s human talent. Flexibility is reflected in the “autonomy” part of the guided autonomy concept and suggests that organizations that encourage members to undertake projects consistent with the organizational identity, keep slack resources available for opportunistic projects, and give members autonomy in choosing and championing projects help to enable sustained innovation. Guided autonomy thus offers an approach to reconciling the classic dilemma of balancing empowerment vs. control (Conger & Kanungo, 1988) because it enables simultaneous stability and flexibility in organizing.

The grounded theory model thus suggests that sustained innovation requires not only an ability to organize fluidly, but that organizational identity provides a necessary referent that provides some stabilizing anchors for the necessary fluidity. Teece, Pisano & Shuen (1997) among other researchers have indicated that “decentralization and local autonomy” allow organizations to transform and succeed in dynamic environments. The literature has been silent on the qualities of this kind of autonomy, however. The underlying assumption seems to be that if an organization hires talented people, then managers only need to get out of their way and good things will happen. My findings fill in some of the key elements of guided autonomy – most notably, the presence of professional identities that align with and are influenced by organizational identity.
In theorizing about the relationship between efficiency and stability, the management literature has implied that efficiency with stability derives from routines and institutionalized practices (Benner & Tushman, 2002; Eisenhardt et al., 2010), yet in this setting, routines were not a source of stability and efficiency. Furthermore, one of the few stable elements, the overall strategy (as captured in the core value of the organizational identity, “innovation with impact”), was conceptualized in abstract terms and therefore open to interpretation and expression in myriad ways. Interestingly, the strategy remained consistent over time, while the organization’s structure changed considerably (as most clearly revealed by the longitudinal social network analyses, which allowed me to “see” the dramatically shifting structure over a short time horizon). This finding suggests a potential refinement of the idea that structure follows strategy (Amburgey & Dacin, 1994; Chandler, 1962) to include the notion that a stable strategy in innovating organizations may require structural change rather than structural stability.

**Interplay of Organizational and Professional Identity**

Works on flexible organizations have either overlooked or downplayed the role of organizational identity in fluid organizing (see Schreyogg & Sydow, 2010). Yet, as Powell & Colyvas (2008) noted, identity is a key notion in understanding many organizational processes because organization members act based on who they are, rather than merely the choices they have. My focal organization’s deeply held identity referent allowed members to pursue diverse projects so long as they were seen as having high potential. At the same time, it served as a unifying notion to members and the grounds for organizational coherence. These findings suggest that organizational identity plays an important role in facilitating innovation – perhaps most especially when members have a
high degree of autonomy, such as scientists or other knowledge workers. The findings also suggest that a strong organizational identity is vital to fluid organizing more generally. One useful proposition available from my study is that a strong sense of organizational identity may become more necessary the more fluid an organization becomes. Regardless of how abstractly understood, an organizational identity provides a cognitive anchor for members when other aspects of what defines the boundary between the organization and the environment are in flux. In fluid organizations, the stability of organizational identity may serve as a surrogate for structural stability.

One other notable insight from my study is that innovation research should take into account both organizational and professional identity. Innovation requires heterogeneity of knowledge and rearrangement of knowledge into novel orders. To obtain the heterogeneity of knowledge required for innovation, organizations must accept the “whole package,” i.e., the people who embody that knowledge and their various sensemaking frames, including their professional identity. Knowledge is not disembodied, it comes as part and parcel of individuals who act according to who they are; what they “know” is only part of that. I found that individual organization members drew on their professional identity beliefs – who they were professionally, as well as their career aspirations – to make sense of the organization’s core identity element of “innovating with impact” and to decide what action would be in character with both identities. The combination of professional and organizational identity beliefs guided members in their research and project-selection decisions.

Work on person-organization fit suggests that even within traditional professions, such as accounting, there are differences between organizations related to organizational
identity and culture (Chatman, 1991). Research has tended to consider either professional
identity or organizational identity in some depth, but not both together in tandem. My
findings suggest that not accounting for both might miss some essential element of
organizing. Further, part of the identity dynamics in my research setting involved
recursive relationships between the organizational identity and the professional identities
of members. The organizational identity facilitated the development of more
interdisciplinary professional identities, even as the organizational identity itself was
affected by the multiple professional identities that it was encouraging and shaping.

A Multi-Level View of Sustained Innovation

Relatively few studies have adopted a multi-level perspective on intra-
organizational innovation (for a discussion see Gupta, Tesluk, & Taylor, 2007). My study
offers such a multi-level view of the processes that facilitated sustained innovation. The
grounded-theory model extends knowledge in this area by identifying and connecting
individual-, group- and organizational-level phenomena. At the individual level, three
critical factors emerged as important to organizing for sustained innovation: high-caliber
human talent, active “champions” who took ownership of a project, and personal
interpretations of the organizational value of “thinking big and writing large.” The first
two factors affirm what prior research has shown, but scholars have not yet addressed the
third factor in any depth – one that implicates both professional and organizational
identity in processes of sustained innovation, as discussed in the previous section.

At the group level, project teams tended to be organized along group lines (as is
common in innovating technology organizations), so the group became an important
focal point where individual and organizational factors converged and influenced the
course and pace of innovation. The bridging role of flexible group membership and structure in intra-organizational innovation has been understudied. My primary contribution here is to draw attention to the importance of group-level effects. Group managers can serve an important role in innovation by vetting ideas, allocating resources to projects, and redirecting or jumpstarting projects that are lagging, all as part of their role in focusing and championing work. Although a divisionalized structure can facilitate collaboration within groups, it also can shape the course of innovation in the organization as a whole because it tends to encourage intra-group collaboration at the possible expense of inter-group partnerships.

Several phenomena at the organizational level emerged as important to sustained innovation. Two in particular have not been thoroughly addressed by previous research. The first critical factor, as discussed in the previous section, is organizational identity. The second is a high level of turnover that actually facilitated a recursive relationship between structure and resources that was highly generative. Both formal and informal organizational structures shifted quickly and non-trivially as old members left the organization and new members entered and as interdisciplinary projects shifted collaborative connections over time. At the same time, membership was fuzzy. Current members frequently maintained affiliations with multiple organizations and past members continued to collaborate with the organization, thus serving as an important form of social capital that facilitated organizational innovation. March (1991) described turnover as a form of exploration, especially in turbulent environments, because it brings new ideas and methods into the organization. March warned, however, that turnover can also create a performance-impairing mismatch between organizational knowledge and
individual member knowledge. My findings suggest that the trade-offs between turnover’s benefits to exploration and its drain of the institutional memory are not inevitable, especially if current and former members stay connected and available. Overall, my findings suggest that strong cross-level dynamics among individual-, group- and organizational-level factors enable the kind of fluid organizing that contributes to sustained innovation.

Chapters 6 and 7 address my second research question regarding scientists’ professional identity development. In the final chapter of this dissertation, I will consider the collective implications of both sets of findings.
CHAPTER 6. FINDINGS FOR RESEARCH QUESTION 2

As presented in Chapter 1, my second research question is: “What are the distinctive features of scientists’ professional identity work in a multi-disciplinary context?” Figure 7 presents the grounded model of professional identity work based on my findings. I present these findings organized around two topics that constitute the research question: (1) the features of scientists’ professional identity work and (2) the influence of relational plurality and a multidisciplinary context on that work. In the model and in this Findings section, I show that scientists’ professional identity work involved seeking a personal (intra-individual) balance of tensions within constituent aspects of professional identity. Heterogeneous and multiplex relationships both conferred and confirmed aspects of identity and fostered the development of diverse professional identities that included some hybrid properties.

Features of Scientists’ Professional Identity Work

I found considerable evidence that informants in the early stages of their careers were going through a transitional period in which they engaged in intense professional identity work. This period was marked by a sense of tremendous growth, shifting professional identity and, for many, indeterminacy about career path. In general, the doctoral student and post-doctoral stages demarcated different phases of the early career stage. For doctoral students, professional identity work tended to be more exploratory. The words of one doctoral student sum up the difference:
I think postdocs try to refine exactly what they’re good at. I think that the PhD experience is a lot of times sort of random. You might have a sense for the field that you want to work in, but the exact direction is something that is refined whether through postdocs if you’re going to stay in academia or I think people in other fields, like business and industry, do similar things. (doctoral student P628)

Yet both doctoral students and those further along in their education and training reported being in transition. For example, a doctoral student said, “Who I am professionally is a very difficult question for me to answer at this point because my answer in my head has changed since I have been doing my research” (doctoral student P305). Similarly, a postdoc said, “I think that anyone in my position is probably going to go through shifts and changes just because that’s what you do when you’re a postdoc” (postdoc P881). One MD doing a research fellowship in the lab said, “I am not ready to spread my wings and fly. That is years down the road. If you would compare it to the development of a child, I think that I am walking now and starting to string together sentences that are coherent” (postdoc P724).

This sense of professional identity in transition was focused on developing the key constituents of professional identity that were the basis of how informants defined their professional identities. Before I address how they went about identity work, I first set forth three constituents of professional identity that informants seemed to find most salient.

**Constituents of scientists’ professional identity.** As shown in Figure 7, I found that professional identity content consisted of three primary content areas that I have termed expert knowledge, expert role and professional aspirations. Both predocs and postdocs tended to define professional identity in terms of these three aspects. Expert knowledge refers to “knowing what and how,” and the identity referents are based on
education and training. This includes possession of knowledge of a given academic
discipline or disciplines as well as skill in the techniques required for complex and
specialized tasks. An example of this type of professional identity self-definition is:

I’m a chemical engineer who is using engineering principles to tackle
medical problems and I think that summarizes it. … The way I think, the
way I tackle problems is through my chemical engineering training. It’s a
professional identity, not a job, because the job that I end up doing may
not be chemical engineering, but still I was trained as one. (doctoral
student P959)

For informants, the knowledge aspect of professional identity had nuances. For example,
one postdoc explained as it as having two levels: “Professional identity, there are two
levels of that. There is, what is your discipline? Either it is chemical engineering,
chemistry or whatever, and within that discipline, what is your sub-discipline?” (postdoc
P194).

Several informants reported that their professional identity was based strongly on
their undergraduate education. “Being a pharmacist is my professional home.
Undergraduate learning is home for me, my background. Whenever I have a problem, I
go back home,” said one postdoc with a PhD in polymer chemistry (postdoc
P084).

Another with a bachelor’s degree in aerospace engineering said:

Anybody that has a bachelor’s degree in engineering considers themselves
an engineer. No matter what you do after that, you're still an engineer. It’s
like people who have an MD calling themselves a doctor. It’s exactly the
same thing. … Engineers are kind of particular on that. If you have the
title engineer, they expect you to be an engineer, and if you don't have a
bachelor's degree in engineering then that means you haven’t taken all the
background stuff. It's probably presumptuous on our part that we can just
pick up biology along the way instead of having a four year degree in it
like other people, but it’s also almost impossible to just kind of pick up
engineering along the way. (postdoc P525)
In addition to education in a given discipline, informants also drew on their skills in various complex techniques as a basis for their professional identity. “I have learned a bunch of techniques that could be useful for biology. Like what I'm doing now is a lot of like micro-scale tissue engineering kind of thing,” said one postdoc. As another example, another postdoc reported having an expertise in in-vivo work, which entailed designing and executing experiments involving different types of laboratory animals (field notes).

Another important aspect of professional identity pertained to the expert role in which expert knowledge would be used. I use expert role to refer to the product or service that results from the professional work that makes use of one’s education and training. Thus, I use the term in an abstract sense in which it refers to the outcome of labor, not to the specific tasks or activities involved in producing that outcome. In general, I found that individuals defined themselves in terms of two types of expert roles: knowledge creator and value creator. The two roles represent ideal types at opposite ends of a continuum. In the ideal, the knowledge creator role produces new information that advances a scientific field. This knowledge may contribute purely to the scientific commons and may not have appropriable commercial value. On the other end of the spectrum, the value creator produces technology with commercial value that may or may not advance scientific knowledge generally.

The following quote exemplifies the professional identity of knowledge creator: “I think in the PhD program the only way you are going to be successful in that is if you ask for those interesting questions that no one has asked before because you are supposed to be developing new knowledge” (doctoral student P305). In contrast, here is how another doctoral student expressed the value creator identity:
I feel I will be more gratified by seeing the project that I’m starting have impact. If I see this project that I’ve started being, um five years from now, ten people working in different branches, that would be really nice. Rather than just getting it on paper. Oh, it sounds OK, good job. No. It has to be useful. (doctoral student P835).

Expert role was intimately related to the third aspect of identity content, professional aspirations. I use this term to refer to the future career and type of organization that individuals envision as the context in which they will apply their expertise. Professional aspirations may have been especially salient for this group because they were at the early stage of their careers. One postdoc described this way:

Part of the problem of being a postdoc is that that's not the end yet. It’s one step before the end, which is you know being faculty or working in industry or something like that. That’s kinda more how most of us see ourselves identifying ourselves. So saying I'm a postdoc isn't really an identity it's more like this is just kind of what I do to get paid but it's also like we don't get paid very well. So it's not like we like necessarily how we're doing or what we're doing. (postdoc P525)

I found a wide range of professional aspirations in this organization, including interest in traditional academic positions, industrial research and development, startups, and even investing (field notes). For example one postdoc said:

A faculty position is definitely my first choice because there’s two equal things. One is you are allowed to be creative and independent and you don't work on problems that are dictated by money. Well sort of it is because you get grants but you know what I mean. You get a little more freedom, or the most freedom intellectual-wise. (postdoc P226)

In contrast, another postdoc with an interest in industry said: “I want to be working with very early stage companies to move science projects basically that are maybe a lot earlier than where an established company wants to get involved. Getting to the point where an established company can do what they are good at” (postdoc P938).
In summary, informants tended to define their professional identities in terms of three primary types of content that included knowledge, role and aspirations, although the individuals I interviewed reflected considerable variation within these broad content areas. Professional identity work consisted primarily of finding a personal balance in each aspect of identity content. As described in the following section, this identity work involved grappling with the tensions inherent in each content area.

**Professional identity tensions.** Survey responses suggested the following dynamic tensions and tradeoffs in Biotech: solving big versus little problems, the value of basic versus applied science, and possessing proprietary versus shared knowledge. Professional identity tensions expressed by informants in their interviews reflected these tensions in various ways. Figure 7 shows the dimensions of the tensions surrounding the three areas of professional identity content. With respect to expert knowledge, the tensions concerned finding a balance between being a specialist versus being a generalist. For expert role content, the tensions involved locating oneself along with dimension of knowledge creator versus value creator. In the area of professional aspirations, the tensions related to finding a balance between the short term demands of current work versus the long term demands of a desired future position.

The tensions surrounding the development of specialized versus general knowledge manifested in two different ways. First, informants expressed uncertainty about whether to acquire “pure” disciplinary knowledge or to obtain some mix. Second, informants grappled with whether to learn many types of skills and techniques or to specialize in one aspect of work. For example, one doctoral student expressed the pros and cons of being a generalist:
I am not necessarily an expert in any one thing right now. I don't know if that is good. I mean I guess that is good because you sort of have a broad base so you can go to a lot of different departments but at the same time if you are in the chemical engineering department, what are you an expert in? How much polymers do you know? I know some polymers. I am not an expert. You know I know a little bit of this chemistry, but I am not an expert in it. You know I don't know if that hurts or helps you. (doctoral student P162)

Another informant described his shift from interest in being a generalist to being an expert.

When I came here I said ok I am a tissue engineer and I want generalize myself. So, I wanted to learn maybe a little bit about drug delivery and tissue targeting but then I understood that I need to be more focused. I can’t have one article on tissue engineering, one article on drug delivery because I can’t do everything yet. I need to make a name in something first. (postdoc P471)

A different set of tensions surrounded the question of expert role. These tensions concerned whether informants saw themselves in the role of knowledge creator versus value creator. This tension tended to manifest itself as indecision regarding whether to pursue a career in academia or one in industry and echoed the survey findings of tensions surrounding the pursuit of public versus private knowledge in the organization. One doctoral student exemplified this particular identity tension: “I think I am sort of open at this point. You know either working at sort of a start-up company or maybe go postdoc and faculty. You know sort of split right now” (doctoral student P162).

In developing their personal aspirations, informants sought to balance tensions between accomplishing work in the present and preparing for a desired future. A telling indication of the challenge and stress involved in balancing this tension came from an observation made by a research technician in the organization: “I think more opportunities would open for a lot of people if they started taking a little pressure off of
where they want to be and figuring out what they’re doing now. They want a paper out so badly, they just want to get something done just to get it done.” Indeed, several informants described the importance of “having something to show” for their time in the organization. For example:

If you’re trying to show that you’re progressing in your work then having two first author papers is probably more beneficial than having four like you know fifth author papers. That shows that you're kind of feeling around but you're not really leading anything, you're not designing the studies, you're not doing the majority of the work. (postdoc 525)

This professional identity tension was related to the tension hinted at in the survey regarding whether to focus on big versus little problems. Members were encouraged to work on extremely challenging projects, yet incremental problems were tempting to take on because they were more feasible to accomplish in a short time.

Individuals used various tactics to balance these three tensions. I describe three main tactics in the following section.

**Identity work tactics.** Informants used several tactics to balance the tensions involved in their professional identity development. Three main ones consisted of *ruling out, dual-focusing, and hybridizing*. One very common tactic used by several informants during this stage of professional identity development was ruling out, which I use to refer to a decision against one aspect of identity rather than a decision in favor of its opposite. For example: “So when I came to graduate school I think I really figured out that I do not enjoy basic research. And so that ruled out becoming a professor at a research university. And it has made me reconsider the pharmaceutical industry” (doctoral student P305). Ruling out allowed individuals in the early stages of their development to define the
boundaries of their professional identities and to narrow down their choices regarding knowledge, role and aspirations.

The second identity work tactic, dual-focusing, allowed informants to attend simultaneously to short term and long term aspects of professional identity development. This tactic tended to manifest through being involved in multiple projects that were intended to accomplish different aims. For example, informants described having “safety projects,” that assured they would meet program requirements (field notes). At the same time, they took on riskier, more ambitious projects that had high potential impact and if successful, might pole-vault them into more successful careers. By spreading their effort across low-risk, short-term projects as well as high-risk, long-term projects, individuals could make progress in their current work while also making progress toward their professional aspirations.

The third identity work tactic was hybridizing, which involved customizing a professional identity by adopting aspects of different types of “pure” professional identities. Individuals used this tactic to find a personal balance between the identity tensions involved in developing their expert knowledge. For example: “I would say maybe by the time I leave here, I would hope I would practice more like an engineer but still think more like a scientist. That is something that I am not sure if I will truly be able to do,” said one doctoral student (P258).

Other informants hybridized in terms of how they defined their expert role, blending aspects of both knowledge and value creation. For example:

I think it's important if you have scientific work that can really make an impact to go and develop it. Personally I am not interested in running my own company or things like that but if the IP is there and there is enough investment to do a start up that's its own entity then I could be in an
advisory role. But I wouldn’t be comfortable leaving academia to run a company. (postdoc P226)

Thus, hybridizing was a tactic that allowed informants to balance more than one type of identity tension.

To summarize my findings regarding the nature of professional identity work in BioTech Lab, I found that early career individuals experienced their professional identities as in transition. They defined their professional identities in terms of three main content areas related to knowledge, role and aspirations, and their identity work involved balancing the tensions within each of these realms. Informants used tactics such as ruling out, dual-focusing, and hybridizing to balance the tensions that they experienced in developing their identities. In the next section, I consider the role of relational plurality and a multidisciplinary context in the identity work that informants undertook.

**Influence of Relational Plurality and a Multidisciplinary Context**

An important aspect of my research question concerned the effect of a multidisciplinary environment and other aspects of relational plurality on professional identity development. I explored this by comparing the themes that emerged from my interviews of informants with information I collected about the organization’s social networks in the survey (see Appendix C for questions). The setting provided an opportunity to explore two aspects of relational plurality. First, I explored the multiplexity of relationships, which refers to the extent to which individuals have multiple types of connections with others. An example of a multiplex relationship would be one in which two people are friends as well as collaborators. I explored whether informants had multiplex ties across three types of social networks: friendship, advice and power. This aspect of relationship plurality is not limited to multidisciplinary
contexts. Second, I considered the influence of the multidisciplinary context by exploring heterogeneity as another aspect of relational plurality. Heterogeneity refers to the extent to which individuals affiliate with those who differ from them along a given dimension. The multidisciplinary nature of BioTech Lab’s human talent provided a situation in which relational heterogeneity in terms of disciplinary backgrounds could occur, but determining whether it actually existed was an empirical matter that I investigated.

**Relational heterogeneity.** As noted above, the BioTech Lab was highly multidisciplinary, with over twenty disciplines represented at the time of my social network survey. Informants attributed much of the organization’s success to this feature, as indicated by the following representative quote:

> If you ask me for one factor that makes this lab more successful, it is the variety of, the interdisciplinary work that we have and the variety of backgrounds, the diverse backgrounds of the member of the staff. That’s more important than funding. (postdoc P959)

I explored whether this diversity actually translated into heterogeneous affiliations in the organization. Figures 8, 9\(^2\), and 10 present the organization’s networks of friendship, advice and power relationships.

I separately analyzed the heterogeneity of these networks in terms of disciplinary background. In others words, I calculated the extent to which individuals in the organization affiliated with others who came from different disciplinary backgrounds. To provide a benchmark, I also calculated heterogeneity of affiliations across subgroups. Because collaborations tended to occur among individuals in the same subgroup, I would expect to see more affiliations between members of the same subgroup. Therefore, the

---

\(^2\) Figure 9 is identical to Figure 5, reproduced here for ease of comparison to the social networks presented in Figures 8 and 10.
degree of homogeneity or heterogeneity of relationships based on subgroup membership provides a comparison measure by which to gauge the discipline-based heterogeneity of relationships within the organization. Table 5 presents the results of my heterogeneity analysis of the three sets of social ties.

| Insert Table 5 about here |

In the table, column 2 presents the E-I index based on discipline, and column 3 presents the index based on subgroup members. The E-I index provides a measure of the extent to which members in a given category choose other members of the same category as a tie partner. A value of -1 would indicate perfect homophily or homogeneity, i.e., that people exclusively chose others like them for this type of tie. In contrast, a value of 1 would indicate perfect heterophily or heterogeneity, i.e., that individuals exclusively chose others different from them for this type of tie. A comparison of columns 2 and 3 indicates that there was relatively more heterogeneity of disciplinary ties compared to subgroup ties in all three networks. This suggests that the multidisciplinary context was indeed reflected in the relationships in the organization and that individuals chose to affiliate with others from different disciplinary backgrounds as friends, as sources of advice on professional matters and also as people who had the power to influence their opinions and actions.

Interviews with informants suggest the role played by these heterogeneous relationships in the professional identity development process. First, as *identity conferring* relationships, heterogeneous affiliations conferred diverse knowledge sets. For example, one doctoral student explained:

I am kind of pleasantly surprised that I've been able to get exposed to all these different skills. And I think it's becoming more and more necessary
as I look at some of the positions that are available in industry that they kind of want people who are able to move between different fields. (doctoral student P499)

The relationships also conveyed different models for acting in character as a professional, freeing individuals from the orthodoxy of disciplinary norms and values, as indicated by the following quote:

I wanted to come here because I knew I would have the freedom and the financial support to try experiments which may not be orthodox without any backlash or something. ‘Why are you trying this? It's not going to work.’ (postdoc P226)

In addition, heterogeneity provided diverse perspectives from which individuals received identity-confirming feedback in their professional identity work. Heterogeneous relationships provided affirmation of developing identity content, as in this example:

This has been learning a whole new [knowledge base], everyone in there is a chemist and they can go in there and work with polymers and get something relatively quickly and then I go in and I am starting at square one making lots of mistakes along the way. After a year and a half I am getting to the point where I am getting stuff done and I am getting excited about it. The frustration and stress is turning into excitement and it is becoming what I was hoping it would be. (postdoc P724)

In addition, heterogeneous relationships provided extensive opportunities for individuals to have their professional expertises affirmed. As one postdoc explained: “People explore ideas on an individual level, maybe groups of two or three people. And if they have an idea they find each other based on skill set. Like a polymer chemist will find a biologist and they will work together” (postdoc P268).

Further, the identity work tactics that I observed depended on relationships to be carried out. For example, ruling out depended on both personal experience and observation of others. Dual-focusing required collaboration with diverse individuals so that multiple projects could be carried on simultaneously, and hybridizing could only be
done in relation to the colleagues who provided resources for developing identity content that blended different types of professional identities.

**Relational multiplexity.** A comparison of the three networks in Figures 8, 9 and 10 shows that the friendship network is densest with a density measure of 0.1436 and a total of 734 ties. In comparison, the advice network has a density of 0.0661 and 338 ties while the power network has a density of 0.0499 and 255 ties. The network figures indicate that there are over twice as many friendship relationships as there are advice or power relationships. Figure 11 provides a visualization of the overlap in social ties. In this figure, the only ties depicted are multiplex, in terms of being friendship, advice and also power connections. Ninety-eight of the relationships between dyads have this type of multiplexity.

![Insert Figure 11 about here](image)

Multiplexity appeared to play a supporting role in professional identity work. These types of multi-faceted relationships facilitated the collaborations that were an essential aspect of the professional identity development in this organization. As noted above, collaborations gave informants opportunities for identity work through relationships that conferred and confirmed their identities. Multiplexity enriched these connections because the relationships could do “double duty,” simultaneously conferring and confirming informants’ professional identities. Several informants reported that their relationships began as friendships and then grew into collegial ones. Likewise, the professional relationships reinforced friendships. For example, one postdoc said, “Usually the people who I collaborate with I consider them my friends. First I see if I like them and then I decide if I want to work with them” (postdoc P766). Another postdoc
reported, “You definitely see things like that start to come out. There are the people that you are around, that you just sort of become friends with the people that you see based on shared experiences, seeing them for coffee every morning or whatever” (postdoc P881).

Friendship ties also encouraged the development of advice ties, as shown in this quote:

This person works across the hall and we're always you know talking and chit chatting and none of us needed anything from each other for a long time. But we knew what each other was working on. And then at one point working on an experiment she realized that there was something missing and she didn't know how to do that. She knew I had done some experiments and she came in and said okay can you help me with this? (postdoc P300)

Thus, multiplexity allowed individuals to find several types of identity-building and - affirming resources within the same relationships.

To summarize, my second grounded model focused in on issues pertaining to professional identity work among BioTech Lab’s early career scientists. Based on my findings, I developed a model of professional identity work that involves the balancing of tensions in three areas of professional identity, expert knowledge, expert role, and professional aspirations. Informants primarily used the tactics of ruling out, dual-focusing, and hybridizing to find that balance. I found that relational plurality was an important aspect of the professional identity work. Individuals drew on the heterogeneity of their relationships to both confer and confirm their professional identities, and heterogeneity influenced all three identity work tactics. Multiplexity enriched relationships so that the same bonds served multiple functions in professional identity development. I discuss the implications of these findings in the following chapter.
CHAPTER 7. DISCUSSION OF FINDINGS FOR RESEARCH QUESTION 2

Scientists’ Professional Identity Development in a Multidisciplinary Context

The second research question of my dissertation zoomed in on the professional identity work among BioTech Lab’s junior scientists. The grounded model of professional identity work (Figure 7) shows the associations among diverse relationships (that include both identity-conferring and –confirming ties), the tensions involved in solidifying professional identity content, and identity work tactics. My study and the grounded model contribute to a greater understanding of the undertheorized concept of professional identity of scientists and more generally, knowledge workers.

I found that early career scientists in the multidisciplinary context went through an intense phase of change and growth during which they experienced their professional identities as in transition. At this point in their careers, professional identity development consisted of adding and strengthening content in the areas of expert knowledge, expert role and professional aspirations. I shed light on the internal (or intrapersonal) aspects of knowledge workers’ professional identity development by documenting the identity tensions of specialist/generalist, knowledge creator/value creator, and current work/future work that they experience. I further expand upon the internal aspects by documenting the primary tactics they employ to balance those tensions: ruling out, dual-focusing and hybridizing. Evidence of identity tensions and identity work tactics among knowledge workers also extends what is known about these important aspects of identity construction and maintenance more generally by enabling comparisons with prior research on other occupational groups (e.g., Ashforth et al., 2007; Kreiner et al., 2006).
Heterogeneity and Multiplexity

I also found that relationships among individuals reflected the multidisciplinary environment, indicating that early career scientists established friendships with, sought advice from and were influenced by others from heterogeneous disciplinary backgrounds rather than segregating themselves into homogeneous groups along disciplinary lines. Further, I found considerable multiplexity, indicating that these heterogeneous affiliations often involved overlapping ties, providing a complex network of relationships as resources for professional identity work. These two forms of relational plurality (heterogeneity and multiplexity) provided early career scientists with diverse resource for professional identity work. First, relational plurality provided diverse identity-conferring resources by connecting individuals to multiple knowledge sets and modeling behavior consistent with different professions. Second, relational plurality confirmed identity by affirming both established and emergent aspects of that identity. Further, multiplexity fortified the identity-building features of ties by allowing the same relationships to serve as resources to both confer and confirm professional identity. Thus, I found that relationships and relational plurality supported and facilitated the internal processes of identity work. By connecting the relational aspect of early career professional identity work to the internal aspects, I bring together the literatures on professional identity, identity work, and social network analysis and answer calls for greater exploration of the relationships between these concepts (Ibarra & Deshpande, 2007; Ibarra et al., 2005).

Professional Identity Development and Innovation

In tandem with the grounded model of fluid organizing for sustained innovation, the grounded model of professional identity work suggests that the success and trajectory
of an organization’s innovative activities are deeply intertwined with the professional identity development of its knowledge workers. A budding scientist’s professional identity work affects the projects she chooses to work on, which in turn affects not only the course of her subsequent professional identity work, but also the project portfolio and course of innovation in the organization as a whole. This observation may be most germane in science-driven fields, although it is likely to have application in other fields, especially those that allow significant local autonomy to workers.

**Professionalization and the Formation of New Professions**

Finally, another potential contribution of this study concerns the roles of professional identity development and multidisciplinary contexts in the process of professionalization and the formation of new professions. Among the trends in professional work noted by Leicht and Fennell (1997: 228) was the “professionalization of everyone,” i.e., the likelihood that many white collar services would increasingly organize into forms resembling the traditional professions. My findings suggest some possible processes at the individual level that might contribute to professionalization and the establishment of new professions. For example, the identity work tactic of hybridizing involves drawing on existing professional identities to form a new one that combines elements of both. Hybridizing in tandem with relational plurality may provide a microfoundation (Powell & Colyvas, 2008) for a new professional institution, if the hybrid identity resonates with a social shift or unmet need. In support of this notion, informants spoke of trends in biotechnology education that reflected a pattern of 1) mentors educated in traditional disciplines; 2) protégés gaining multidisciplinary training as a supplement to their traditional education; and 3) institutions responding by
establishing interdisciplinary programs which serve to legitimatize the new discipline. Hybridizing and the other identity work tactics that I identified might be micro-processes underlying these macro-level shifts in professionalization, and future research might be fruitfully applied to investigating this possibility further.

Several other fruitful directions for future research follow from my study. First, my study focuses on the early career stage professional identity of knowledge workers, so one possible area for future research is professional identity work at other stages of career development and for other types of non-traditional professionals. These additional studies might identify other sorts of identity tensions and identity work tactics, as well as additional roles for relational plurality. Further, this study represents an initial foray into developing a model of the interplay of relationships and internal processes in professional identity development. More research is needed that combines social network data with informant reports of professional identity development. Triangulating the data sources will build a clearer picture of the role played by both the internal and external aspects of professional identity development. Some important questions remain unanswered. For example, a more detailed understanding of exactly how relational plurality influences development of areas of professional identity content would be a useful contribution. In addition, Ibarra and Deshpande (2007) have noted that relationships and identity are recursively related in that relationships affect identity and identity in turn affects relationships. In my study, I focused on how relationships and relational plurality affect professional identity, so another important and unanswered question is: How does professional identity affect relationships and relational plurality?
CHAPTER 8. CONCLUSION

In this final chapter, I highlight some of the primary implications of my two grounded theory models. By bringing an identity lens to bear on the problem of sustained innovation, the first grounded theory model suggests that organizational identity provides a necessary stabilizing force that counter-intuitively permits an organization to organize very fluidly. Organizational identity provides a cognitive anchor for members when other contextual features are in flux. Thus, it appears to play an important role in facilitating innovation, particularly when members have a high degree of autonomy, perhaps especially scientists or other knowledge workers. Further, the professional identities of these scientists play a crucial role by providing a counter-force to the stability of the organizational identity. Thus, both organizational and professional identity are important aspects of fluid organizing and sustained innovation.

In addition, both grounded models together indicate that scientists’ ongoing professional identity work is part and parcel of the type of sustained innovation that depends on multi-disciplinary collaboration. While carrying out an organization’s innovative projects, early career scientists experience a concentrated period of professional development that has profound implications for their own futures and also to a great extent determines the course of innovation in that organization. Thus, the success and trajectory of an organization’s innovative activities appear highly interconnected with the professional identity development of its knowledge workers.

Limitations

As a qualitative, inductive investigation of identity and organizing in an innovative, entrepreneurial academic laboratory, my dissertation provides rich,
descriptive data and offers the potential for theoretical insights. My approach, however, rests upon the interpretations and judgments of my informants and myself as a researcher, so it contains subjective elements. Further, my dissertation examines phenomena in a single exemplary organization, which might limit its transferability to other organizations and other fields. I would argue, however, that the concepts and their interrelationships that emerged in my focal organizations are likely to pertain to a broad spectrum of organizations, and is perhaps most relevant for understanding organizations employing elite knowledge workers or those pursuing technological innovation that requires interdisciplinary collaboration. These conditions, however, apply increasingly to several fields, and I believe that there is a basis for transferability of my findings to a broad set of organizations interested in achieving sustained innovation. Similarly, my grounded model of professional identity work rests on a single case study of junior scientists and might have limited transferability to other groups of knowledge workers. Many of the key issues facing scientists as they develop their professional identities, however, are likely to be faced by other groups of non-traditional professionals, such as challenges in developing professional identity content in a multidisciplinary environment.

In addition, there are potential limitations in the social network data I collected and analyzed. Kossinets (2006) suggested a threshold response rate of 70% to avoid the possibility of non-response bias in network data, and my social network data were under this threshold. Non-response bias might present challenges to rigorous hypothesis-testing based on social network data, which I am not doing herein. Therefore, these data are perhaps marginally adequate for rigorous hypothesis-testing; however, assuming the respondents filled out the survey accurately – and I have no reason to believe otherwise –
these data can provide insights into the patterns of social interaction in BL and might guide the development of theory and propositions about the role of social networks in innovation processes. These data are also useful for providing preliminary insights into the overall patterns of heterogeneity and multiplexity of relationships within BioTech Lab, as I have employed them herein.

**Concluding Comments**

Recently Corley and Gioia argued that management scholars should strive for greater “prescience” in their research, which they describe as “discerning what we need to know and influencing the intellectual framing of what we need to know to enlighten both academic and reflective practitioner domains” (2011: 23). In this study, I have presented two grounded models. The first, a grounded model of fluid organizing for sustained innovation emerged from my study of a highly successful organization. If sustained innovation is becoming increasingly important to organizational performance, what might my grounded theory suggest about successful organizations of the future? Fluid organizing was not my original focus, yet it emerged as a pivotal finding – one that might provide scholars the wherewithal not just to foresee, but perhaps to influence the structures and processes of future organizations. My study suggests that fluid organizing requires a facilitating alignment between the organizational identity and the professional identities of its members. It is possible that the more organizational interests align with members’ personal interests, the more autonomy can be afforded to them and the more their human capital can benefit the organization. An “optimally ambiguous” organizational identity that specifies a powerful core value while leaving room for
individual interpretation facilitates this alignment and provides the ideal conditions for guided autonomy.

In addition, this study suggests that identity dynamics are intertwined with the structural shifts and dynamic resources implicated in fluid organizing, which is not only conducive to, but perhaps increasingly necessary to sustain innovation as environments become more complex and competitive. Practicing managers currently might be unprepared to accept and implement the individual, group and organizational features that such fluidity entails. Yet my findings suggest that attending to the key concepts and interrelationships identified in the grounded theory model provides valuable insights into the hallmarks and organizing principles that hold potential for designing future organizations that are actually capable of the kind of fluid organizing that enables sustained innovation.

The second grounded theory of early career professional identity development offers some initial bridges between the literatures on professional identity, identity work, and social networks. This grounded model has several implications for practice, especially concerning the management of knowledge workers. First, it suggests that effective managers might benefit from being sensitive to the intense phase of professional identity development and identity tensions that early career knowledge workers may be experiencing. Second, managers should be mindful of the need that early stage professionals have for the tactic of dual-focusing as they attempt to balance these tensions. Dual-focusing might be increasingly salient as careers become increasingly protean and self-managed. Finally, manager may find it useful to provide support and appropriate roles for individuals with hybridized identities whose self-defined expertise
may not fit neatly into an existing category of professional labor. In the future, more conceptual and empirical work is needed to bring into clearer focus other aspects and stages of knowledge workers’ professional identity development, as well as the way in which these processes may contribute to the microfoundations of emergent professions.

In conclusion, I conducted qualitative inquiry into the questions: How is organizational identity related to sustained innovation? and What are the distinctive features of scientists’ professional identity work in a multi-disciplinary context? My findings suggest that organizational and professional identities, as well as scientists’ professional identity work are important features of a complex milieu that supports an organization’s ability to successfully innovate over an extended period of time. As a counterpoint to the existing literature, this dissertation demonstrates the generative role that identity can play in the innovation process. My hope is to lay a foundation for more research to provide a fuller depiction of the ways in which both organizational and professional identity relate to sustained innovation.
REFERENCES


Kosmala, K. & Herrbach, O. 2006. The ambivalence of professional identity: On

247-268.

Krackhardt, D. 1990. Assessing the political landscape: Structure, cognition, and power

Kreiner, G. E. & Ashforth, B. E. 2004. Evidence toward an expanded model of

Kreiner, G. E., Hollensbe, E. C., & Sheep, M. L. 2006. Where is the "me" among the
"we"? Identity work and the search for optimal balance. *Academy of


Lavie, D., Stettner, U., & Tushman, M. L. 2010. Exploration and exploitation within and

Lee, A. S. 1991. Integrating positivist and interpretive approaches to organizational


new product development. *Strategic Management Journal*, 13(01432095): 111-
125.


Journal*, 21(9): 875-896.


FIGURE 1
FACULTY VIEWS OF ACADEMY-INDUSTRY RELATIONS*

Figure 1: Typology of Faculty Views of Academy-Industry Relations

Professor A
Old-School

Academy threatened by commercialization

1

Professor B
Hybrid: Reluctant Entrepreneur

2

Academy & Industry are distinct

3

Professor D
Hybrid: Engaged Traditionalist

Academy & Industry overlap

4

5

6

Professor C
New-School

Academy not threatened by commercialization

*Reproduced from Owen-Smith and Powell (2001).
FIGURE 2
DATA STRUCTURE FOR RESEARCH QUESTION 1

1st Order Concepts

- Enables and constrains the organization
- Porous boundaries with external environment
- Reciprocity & extensive collaborations with external entities
- Competitive pressure to be first to publish and patent ideas
- Innovation pulled by as well as pushed to market
- Key referents: best lab in the world, innovation with impact, commercialize science
- Organizational identity provides general guide to member action
- Organizational identity influences professional identity development
- Professional identity work guides member action
- Diverse set of professional identities
- Accessible and responsive leadership
- Hire for raw talent as well as for expertise
- Collectively diverse and multidisciplinary
- Frequent turnover affects formal and informal structure
- Breadth and depth of external social capital
- Extensive alumni network provides resources
- Abundant financial resources
- Formal structure and internal social networks affected by source and size of funding
- Fuzzy organizational membership
- Shifting formal structure
- Formal structure affects direction of innovation
- Shifting internal social network
- Internal social network influences innovation
- Evolving organization
- Opportunistic and adaptive deployment of resources
- Recursive relationship between resources and structure

2nd Order Themes

- Parent organization
- Cross-boundary relations
- High-velocity environment
- Organizational identity
- Professional identity
- Human Talent
- Social Capital
- Financial Assets
- Formal Structure
- Informal Structure
- Flexible & Adaptive Organization

Aggregate Dimensions

1. External Context
2. Identity Dynamics
3. Flexible Resources
4. Shifting Structure
5. Fluid Organizing
FIGURE 3
BIOTECH LAB GROUPS AND PROFESSIONAL DISCIPLINES FALL 2008

FIGURE 4
BIOTECH LAB GROUPS AND PROFESSIONAL DISCIPLINES SUMMER 2010
FIGURE 6
GROUNDED MODEL OF FLUID ORGANIZING FOR SUSTAINED INNOVATION

EXTERNAL CONTEXT

IDENTITY DYNAMICS
- Organizational
- Professional

FLUID ORGANIZING

FLEXIBLE RESOURCES
- Human Talent
- Social Capital
- Financial

SHIFTING STRUCTURE
- Formal
- Informal (Social Networks)

SUSTAINED INNOVATION
FIGURE 7
GROUNDED MODEL OF PROFESSIONAL IDENTITY WORK

RELATIONSHIPS
Identity Conferring Ties ➔ Identity Confirming Ties

• Convey norms, attitudes, values
• Model “in character” behavior

• Affirm claims

INTRA-INDIVIDUAL

Professional Identity Content

Expert Knowledge

Expert Role

Professional Aspirations

Identity Conferring Ties:
- Specialist
- Knowledge Creator
- Current Work

Identity Confirming Ties:
- Generalist
- Value Creator
- Future Work

Identity Tensions
FIGURE 8
BIOTECH LAB FRIENDSHIP NETWORK 2008

FIGURE 9
BIOTECH LAB ADVICE NETWORK 2008
FIGURE 10
BIOTECH LAB POWER NETWORK 2008

FIGURE 11
MULTIPLEX TIES (FRIENDSHIP, ADVICE AND POWER)
### TABLE 1
**COMPENDIUM OF ADDITIONAL REPRESENTATIVE QUOTATIONS FOR RESEARCH QUESTION 1**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Aggregate Dimension</th>
<th>External context</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent organization</strong></td>
<td></td>
<td>“Because I was a professor at [this university], and based on its reputation, not my own, good researchers joined my lab. I simply placed ads in Science and Chemical and Engineering News” (archival materials)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“[This university] has so many lectures that actually expose you to lots of problems that exist in the clinic and as an engineer you say, ‘how can we solve these problems,’ and you think of an innovative way and you check. Let’s say that you came up with an idea, then you check, ‘did someone else try it already’ and if they did, can you do better? Do you have a better idea and if no one tried it then you are the first in the field. Today with so much science around, sometimes you see that someone approached it but they did not have the technologies to solve it” (postdoc)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“[This university] set up some annoying hurdles that basically makes it much more difficult to apply for [specific grant funding]” (postdoc)</td>
</tr>
<tr>
<td><strong>Cross-boundary relationships</strong></td>
<td></td>
<td>“There’s no walls as far as (the founder’s) concerned. People try to put walls up and he tries to break them down when that happens” (group head)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“One of the reasons the lab has been so successful is that they’ve been able to get outside funding and collaborators and corporate partners and that continued interest is just really critical to keep it moving” (group head)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I was a post-doc when I was here full time and now I’m a post-doc at a different lab that still collaborates with this lab. I’m primarily in the other lab now but it’s a lab of alumni from BioTech Lab. And so [the founder of the other lab] has a shared grant with [one of the group heads] and also has shared grants with [the founder]. And so I’m kind of intertwined in all that. They have a lot of facilities here that we don't have access to in the other lab, so I've kind of kept my appointment going so we can still come over here and do stuff” (postdoc)</td>
</tr>
<tr>
<td><strong>High velocity environment</strong></td>
<td></td>
<td>“The pressure is less from the biotech industry than from biotech academia. The academic environment is already pretty highly competitive, especially the topics that we’re involved in. So we tend to worry more about what our academic competitors are doing as opposed to the companies” (postdoc)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“To an extent, everyone here can’t be completely insulated from the biotech industry, because we’re trying to make stuff that will get to market and we’re being funded by pharmaceutical companies. So what’s great is that academia is somewhat separate from industry because we have a little bit more time to develop something. If we didn’t that would be horrible because nobody would develop things that they thought wouldn’t get done in five years. But, we have lots of competition with other university groups” (postdoc)</td>
</tr>
</tbody>
</table>
### TABLE 1 (continued)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Aggregate Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identity dynamics</strong></td>
<td>**Lab’s motto would be: Do the research with impact” (survey response)</td>
</tr>
<tr>
<td></td>
<td><strong>Lab’s motto would be: Where medicine, science and engineering meet for the good of humanity” (survey response)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Some labs, if you talk about doing translational science they view it as a negative; conversely, some labs if you talk about doing basic work, they might view that as a negative. I think here, anything flies, as long as it’s high impact. And impact is not measurable by how translatable it is. Impact is an important word. Impact is non-negotiable” (group head)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>“We’re all here to, in a way, just do impactful science at this multidisciplinary area” (postdoc)</strong></td>
</tr>
<tr>
<td><strong>Professional identity</strong></td>
<td><strong>And that stems from my background in synthetic chemistry. When I had originally been looking for post doc, I noticed there was kind of a gap, the need for new materials in this area. A lot of what’s been done in the field is a lot of recycling materials that have been used to do many, mainly minor modifications. Everything that’s been done up till now, the chemistry has been fairly straightforward, fairly simple. I think I could do some damage here. No one’s really investigated a whole lot of novel structures. I don’t know why. Maybe it’s just the fact that there aren’t that many chemists in the field. It was just kind of me as a chemist seeing that opportunity when I came here and I interviewed and talked with [group head] about it, and he was like, ‘Absolutely, you’re absolutely right, and yes we need to bring you in here, and yes we need to do these things.’” (postdoc)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>I’ve always had this viewpoint from very early on. As an undergrad in biology, I just always felt I’m going to try to pick up as many skills as I can so I can try to address problems that other people can’t” (postdoc)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>“I think this interest came when I started my PhD. I was trying to get my supervisor to do some biological applications but he just refused. But I really wanted to do it. It was like something born inside of me. Biology is what I want to do. This is something that really interests me. I cannot tell you why exactly but it's important to me and I feel I could have an impact.” (postdoc)</strong></td>
</tr>
</tbody>
</table>
TABLE 1 (continued)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Aggregate Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flexible Resources</strong></td>
<td></td>
</tr>
<tr>
<td>Human talent</td>
<td>“We would hire either great athletes regardless of whether we had a specific grant or not or we would hire the very best people [with a specific expertise] to do a particular grant” (founder)</td>
</tr>
<tr>
<td></td>
<td>“Let's say I met someone who was a physicist [not a directly relevant expertise] and really bright. If there was a way to know he or she was a genius, then I would [hire]. . . it is given that anyone who comes here is going to be intelligent” (group head)</td>
</tr>
<tr>
<td></td>
<td>“Everybody here is an expert in his own field.” (postdoc)</td>
</tr>
<tr>
<td>Social capital</td>
<td>“There's this enormous alumni network and everybody is somewhat connected or it's kind of like almost being in a fraternity. As soon as I got here I was all of a sudden meeting young faculty that I'd never met before. It was like, ‘Oh you work at BioTech Lab. I worked there five years ago…”” (postdoc)</td>
</tr>
<tr>
<td></td>
<td>“What will happen is he’ll get CVs usually from people from other universities that used to be his students. Then [the founder] sort of he has this network, he trusts this guy. If he thinks he's very good and we have a spot for him then okay we'll take him you know. So I think he relies a lot on his former students that are now faculty to evaluate talent at all these other universities and then send them his way, you know” (doctoral student)</td>
</tr>
<tr>
<td>Financial resources</td>
<td>“We just got our fifth round of NIH funding. … With these kinds of grants, there’s a lot of freedom in terms of what you can do. We have the flexibility to work on something else that we find interesting within the framework of what we wrote the grant for” (doctoral student)</td>
</tr>
<tr>
<td></td>
<td>“We always knew that it was a very exciting this technology that we were developing and we knew at one point or another it would end up being a company of some sort. But what happened was that as the technology was being developed it was getting a tremendous amount of press. … Where all of these things were happening, the VCs called us. They said, ‘What’s going on?’ Then they look at it; they’re not dumb; they know what they’re doing. If there’s something there that’s valuable, they take it, if there’s not, they don’t take it. And now you have almost an oversubscribed round of financing” (group head)</td>
</tr>
<tr>
<td></td>
<td>“So the [foundation] put out this proposal where they said we want to have us apply for a $5 million grant, and then we wrote this grant and got $5 million. Then the CEO of the foundation came to us and said that $5 million wasn’t enough for what he was asking us to do and said, ‘Will you take more money?’ So I’m actually sending the letter proposal to get another $2million. But we also asked them to give money to the company that we started to sort of fast track into the clinic” (group head)</td>
</tr>
</tbody>
</table>
TABLE 1 (continued)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Aggregate Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Shifting Structure</strong></td>
</tr>
<tr>
<td><strong>Formal structure</strong></td>
<td>“[BioTech Lab] is no longer a monolithic structure. There are three groups at least… I wasn't here like ‘in the beginning,’ but I've been here [for fifteen years]. I was actually the first person to have such a group” (group head)</td>
</tr>
<tr>
<td></td>
<td>“We have people who kind of are intermediate level management who have their own postdocs and graduate students and technicians who answer directly to them. And we set the scientific direction for them and we get our own funding and so on and so forth and we occupy space. That just did not exist when I came here and that's a really big difference” (group head)</td>
</tr>
<tr>
<td><strong>Informal structure</strong></td>
<td>“I have a good feeling for who’s doing what. … So oftentimes if people have a question about something, they will ask me where I think they could go for it. And so, I think it’s just because I talk to people and I ask people what they’re working on” (postdoc)</td>
</tr>
<tr>
<td></td>
<td>“I went to our lab and everyone knew that everyone I talked to I asked them if they knew about adhesive powder gels and just adhesives in general. And one of the guys who recently came to the lab worked with adhesive hydro-gels in the past and powder gels and they have similar chemistry to them. Marine mussels stick to rocks and stuff. So by talking to him he's like, ‘Oh you should try these.’ This chemistry works really well under water and it works so well that mussels can stay stuck to rocks and waves are crashing on them in the water. If he weren’t here I wouldn’t be working on … the project probably wouldn't exist.” (postdoc)</td>
</tr>
<tr>
<td></td>
<td>I think that the reason I talked to [a postdoc] [when I was new] is that … we were in the same space. But he wasn’t one that [the founder] identified to talk to, and I think that was because [he] was pretty new himself. [He] and I started working together” (group head)</td>
</tr>
<tr>
<td></td>
<td>“I work with a bunch of people that have a background in particle delivery and in chemistry. Mostly I think when we met it's people who were by my bench or next to me in my office…. I'm talking to people and getting to know them and then I decide if I want to collaborate with them or not. . . . For me it's more important that I can work with them [than that they have a particular expertise]” (postdoc)</td>
</tr>
<tr>
<td><strong>Flexible and adaptive organization</strong></td>
<td>“I don’t want to limit [how things are organized]. I basically want everybody to sort of find their way and do the thing that makes them feel happy” (founder)</td>
</tr>
<tr>
<td></td>
<td>“I don't think of the lab as an organization with a higher goal. I think it's just made of many individuals and maybe they share the same goal maybe not. I think it's like constant change. Fluidic” (postdoc)</td>
</tr>
<tr>
<td></td>
<td>“The first thing is you kind of pick an organizational structure that works given the people you have and the money you have. To me it is not a constant. How we organize it depends on the people and the funding” (founder)</td>
</tr>
</tbody>
</table>
### TABLE 2
DISTRIBUTION OF PROFESSIONAL DISCIPLINES ACROSS BIOTECH LAB GROUPS FALL 2008 & FALL 2010

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical Chemistry</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Applied Physics</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Biology</td>
<td>1</td>
<td>--</td>
<td>1</td>
<td>2</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>4</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Biochemical Engineering</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Bioengineering</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Biomedicine</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Biomedical Engineering</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>--</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>3</td>
</tr>
<tr>
<td>Biotechnology</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>Biotechnology Engineering</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cellular Biology</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Chemistry</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>1</td>
<td>--</td>
<td>3</td>
<td>3</td>
<td>--</td>
<td>2</td>
<td>--</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>--</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Ecology</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Genetics</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Medicine</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Molecular Biology</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>Molecular Medicine</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Materials Science</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>--</td>
<td>1</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Nanotechnology Engineering</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Neuroscience</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Oncology</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>1</td>
<td>2</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Physiology</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Polymer Chemistry</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>No Group &amp; Other</td>
<td>Group 1</td>
<td>Group 2</td>
<td>Group 3</td>
<td>Group 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<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>No Group &amp; Other</td>
<td><strong>0.099</strong></td>
<td>0.036</td>
<td>0.023</td>
<td>0.018</td>
<td>0.070</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>0.062</td>
<td><strong>0.160</strong></td>
<td>0.036</td>
<td>0.021</td>
<td>0.024</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>0.053</td>
<td>0.071</td>
<td><strong>0.286</strong></td>
<td>0.019</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>0.053</td>
<td>0.029</td>
<td>0.029</td>
<td><strong>0.129</strong></td>
<td>0.022</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 4</td>
<td>0.070</td>
<td>0.012</td>
<td>0.000</td>
<td>0.000</td>
<td><strong>0.500</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Densities of within group ties appear in bold.

---

3 Densities of within group ties appear in bold.
<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Demonstrative Quotes</th>
</tr>
</thead>
</table>
| Experience of Identity Work| Sense of growth, shifting identity, and indeterminacy | The thing is really now, being a graduate student and sort of close to graduation, I’m in a state where I am deciding what’s to go on after. It’s hard for me to define myself professionally at this point. (doctoral student)  
During my PhD, my research was driven mainly by fundamental understanding. Currently, I work less on fundamentals because the ultimate goal is to apply it and that goal supersedes the fundamental understanding to some extent. In a way, that also represents my personal shift from pure sciences to the applied sciences. (postdoc) |
| Identity Tensions          | Being a specialist versus being a generalist     | I think there's a risk. I guess I don’t know because I haven't done it yet, but I would think that you apply for a faculty position and you have an expertise in a certain thing. Whereas a lot of these interdisciplinary things it’s sort of like I know a lot of different things. (doctoral student)  
My specialty is working with nano-materials, and surface chemistry. And I would say now that I am sort of at the interface between that stuff and working with biology and sort of like the cell level and branching into the in-vivo area. So, it’s an interesting place to be cause I feel like I know a little bit about a lot of things, but I sometimes don’t feel like I’m the greatest expert on anything. (postdoc) |
| Expert role                | Creating knowledge vs. value                      | When I first came in my plans as far as my career were probably less certain. I think I was you know hesitant as to whether I would kind of pursue an academic career path and kind of go on to try to be a faculty member somewhere or whether I would kind of go into industry. (doctoral student)  
I think initially when I came in I had one concept of what shooting for the stars was. I guess I only viewed it as being a really top faculty member; that’s the only way to be really successful and then, now there’s just so many other ways. (doctoral student) |
| Professional aspirations   | Focusing on current work vs. the desired future  | I did have to kind of teach myself a lot of kind of basic things I needed to know for this project. Mainly because a lot of the skills that were needed for this project I thought would be useful for me to have and these are routinely done in both industry and for people that are in biotechnology. (doctoral student)  
The reason I came here is because I wanted to be in a place where I could think of my own projects and develop my own thing. Because that’s really what you need to succeed as a faculty person later on. (postdoc) |
<table>
<thead>
<tr>
<th><strong>Identity Work Tactics</strong></th>
<th><strong>Ruling out</strong></th>
<th>Negating potential paths rather than proactively selecting a particular path</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identity Work Tactics</strong></td>
<td><strong>Dual-focusing</strong></td>
<td>Using multiple projects to attending simultaneously to short and long term professional development</td>
</tr>
<tr>
<td><strong>Identity Work Tactics</strong></td>
<td><strong>Hybridizing</strong></td>
<td>Customizing by adopting aspects of different types of “pure” professional identities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Identity Work Tactics</strong></th>
<th><strong>Identity Work Tactics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identity Work Tactics</strong></td>
<td><strong>Identity Work Tactics</strong></td>
</tr>
</tbody>
</table>

**TABLE 4 (continued)**

<table>
<thead>
<tr>
<th><strong>Identity Work Tactics</strong></th>
<th><strong>Ruling out</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identity Work Tactics</strong></td>
<td>Negating potential paths rather than proactively selecting a particular path</td>
</tr>
</tbody>
</table>

There are so many career paths, that I am still deciding which way to go, but one of the things I can tell you is that I have already decided not to do academia. (doctoral student)

I can’t say for sure what I will be, but I can tell you what I won’t be, and I will not be an industrial scientist. (postdoc)

**Identity Work Tactics**

<table>
<thead>
<tr>
<th><strong>Identity Work Tactics</strong></th>
<th><strong>Dual-focusing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identity Work Tactics</strong></td>
<td>Using multiple projects to attending simultaneously to short and long term professional development</td>
</tr>
</tbody>
</table>

My dissertation research kind of split into two projects. I would say one of them kind of falls more in line with that kind of ambitious goal. Whereas the other one is maybe more of an evolutionary thing rather than something totally revolutionary. It’s my safety project so I’ll have something to show for my time here. The ambitious one is my own project. If it’s successful then it will really be something new and would be something that would kind of advance the field. (doctoral student)

As part of my fellowship training in critical care I have to produce an academic finished product. Some people in my position go on to have research careers others don’t. In the process some do basic science, which is what I choose, and others do clinical research. It is a big undertaking and because of that it is a risky project in that the duration of the project is probably longer then the duration of my fellowship training. That’s the one that I’m most passionate about but then I have a second one that is sort a low risk but high yield project that assures I will fulfill requirements for graduation. (postdoc)

**Identity Work Tactics**

<table>
<thead>
<tr>
<th><strong>Identity Work Tactics</strong></th>
<th><strong>Hybridizing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identity Work Tactics</strong></td>
<td>Customizing by adopting aspects of different types of “pure” professional identities</td>
</tr>
</tbody>
</table>

I am still trying to adjust to the idea of the difference between a scientist and an engineer. Everything that seems more fundamental I would say I grab it from my undergraduate training as a chemist. But things that are more practical that are about application, those would come from my training here in materials science. (doctoral student)

Entrepreneur is probably the closest that I feel comfortable with but then what stops me from saying it is that I have never started a business that I can point to and say that I started that. In the meantime I just don’t know what to call it. Call me an aspiring entrepreneur. Professionally I don’t feel like I am a scientist but it is probably the description of myself in the broadest sensed that I feel most comfortable with. Because I feel more comfortable with scientist over entrepreneur because I feel like there has been some validation as a scientist. As an entrepreneur I haven’t got a track record. Yet I don’t feel comfortable saying that professionally I am a scientist. Does that make sense? (postdoc)

I would describe myself as a clinician because that is what my experience is in, but I follow that with that I am a budding scientist. At some point I would tell you that I am a scientist and a clinician. (postdoc)
<table>
<thead>
<tr>
<th>Relationships</th>
<th>Diversity of organizational context</th>
<th>I feel that even more so than my grad school, I’m more in a bigger mix of different disciplines than I have ever been and I love it. (postdoc)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Being here exposed me to things that I didn’t even know that exists. You are really exposed to so much and to different approaches. Science, broader science, things that I wasn’t aware of as a PhD student. (postdoc)</td>
</tr>
<tr>
<td>Identity conferring</td>
<td>Convey knowledge, norms, attitudes, values related to professional identity</td>
<td>I’m definitely inspired greatly by people like him. It would be great if I could be like that, but I don’t want to copy anyone. I try to take elements that I like from different people and try to incorporate into who I am. In terms of consistently producing results, I don’t need another role model. I can stop at my advisor. (doctoral student)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I am surrounded by a bunch of brilliant people that are knowledgeable in fields that I know very little about so one of my goals is to basically soak up as much of that knowledge as possible. (postdoc)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I feel like there is always a little bit more pressure to take an academic position. If you want the admiration of your peers and the people that you respect and look up to. I mean so when they, I understand why the so important to people here because that’s what they do. So of course that’s where they, that’s their circle. It’s hard to step away from that because these are the people that you look up to. (postdoc)</td>
</tr>
<tr>
<td>Identity confirming</td>
<td>Affirm aspects of professional identity</td>
<td>I find that the PhD’s that I work with, although they think that it is funny that I am not as good as them with chemistry and the like they are equally curious about what insight I can give to them on a clinical problem. A lot of what they work on has clinical relevance and I can over lunch talk about the relevance and they benefit knowing what it is like on the other side. And just to even hear that all this time that I spend in the lab on this one small project has relevance to human condition. (postdoc)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I sometimes don’t feel like I’m the greatest expert on anything. But then you know someone comes up and asks you a question and you think it’s silly because everyone knows that, but they don’t. So you realize you know more than you think. (postdoc)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I did well as a graduate student but nothing you know superstar. I came here and I thought am I gonna sink or swim? I’ve been here two and a half years and I’ve realized that I can swim with the best of them. (postdoc)</td>
</tr>
</tbody>
</table>
TABLE 5
E-I INDEX MEASURE OF HETEROGENEITY IN SOCIAL NETWORKS

<table>
<thead>
<tr>
<th>Social Network</th>
<th>Discipline</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friendship</td>
<td>0.6894</td>
<td>0.0027</td>
</tr>
<tr>
<td>Advice</td>
<td>0.6864</td>
<td>-0.1657</td>
</tr>
<tr>
<td>Power</td>
<td>0.7176</td>
<td>-0.0275</td>
</tr>
</tbody>
</table>

4 E-I index ranges from -1, indicating homogeneity, to 1, indicating heterogeneity.
APPENDIX C
SOCIAL NETWORK SURVEY QUESTIONS

Communication Network

With whom do you regularly (i.e., at least once per week) communicate? The interaction might be in person, via email or telephone, but it is direct and one-on-one between you and the other person. Place a check in the space to the left of each name of someone with whom you regularly communicate.

Friendship Network

Whom do you consider a personal friend of yours? In answering this question, think about people with whom you would enjoy socializing and who would also enjoy socializing with you, if both of you had time to do so.

Advice-getting Network

Whom would you typically approach for advice on important work-related decisions, for example, decisions regarding project selection or career- or profession-related matters? In other words, whose opinion or advice have you sought or would you seek for a work-related decision you had to make that was important to you personally?

Advice-giving Network

Now, we would like to know who comes to YOU. Who typically would approach you for advice on important work-related decisions, for example, decisions regarding project selection or career- or profession related matters? In other words, who has sought (or would be likely to seek) your opinion or advice when that person had to make a work decision that was important to him or her personally?

Power Network

Who in BioTech Lab has the power to influence your decisions and actions about lab-related matters? The people you check for this question are people who are capable of persuading you to adopt their opinion and perhaps to take action that they recommend. The person may or may not be someone to whom you report. They may or may not be people to whom you go for advice or who come to you for advice.
APPENDIX D
ORGANIZATIONAL IDENTITY SURVEY QUESTIONS

Question 1

Below are a series of fill-in-the-blank sentences. Please complete the sentence, “BioTech Lab is __________” three times however you think is most appropriate. You might want to think of adjectives or phrases that answer the question, “Who is BioTech Lab as an organization?” On the second line for each sentence, please explain your answer in more detail. Hint: Think about BioTech Lab in terms of those qualities that best define BL’s “organizational identity” – those features that are most core or central (i.e., the essential or defining hallmarks of who BL is), distinctive (i.e., those hallmarks that most distinguish BL from other labs) and enduring or continuous over time (i.e., hallmarks that are long-term characteristics of BL). Think about BioTech Lab as a whole, and not in terms of specific individuals or groups. Also, please answer in terms of how BioTech Lab is now, rather than as how you might ideally like it to be.

Please try to think of three descriptions, but if you get stuck, you may move on.

1) BioTech Lab is … ________________________________________________________

On a scale of 1 (not at all) to 5 (to a great extent), how widely shared is this description among the researchers in the BioTech Lab?

1                 2            3           4                         5
Not at all shared                           Shared to a great extent

2) BioTech Lab is … ________________________________________________________

On a scale of 1 (not at all) to 5 (to a great extent), how widely shared is this description among the researchers in the BioTech Lab?

1                 2            3           4                         5
Not at all shared                           Shared to a great extent

3) BioTech Lab is … ________________________________________________________

On a scale of 1 (not at all) to 5 (to a great extent), how widely shared is this description among the researchers in the BioTech Lab?

1                 2            3           4                         5
Not at all shared                           Shared to a great extent

Question 2

If BioTech Lab had a motto, what do you think the most accurate or appropriate statement of that motto would be?
APPENDIX D (continued)

Question 3

Think about the project that you are working on in BioTech Lab. (If there is more than one project, think about the most important one, or the one on which you spend the majority of your time). How does your project relate to the descriptions and motto of BioTech Lab that you provided above?

Strongly agree  Somewhat agree  Unsure  Somewhat disagree  Strongly disagree

Please explain your answer in more detail:

Question 4

In your opinion, how is BioTech Lab different or distinctive from other labs of its kind?

Question 5

In your opinion, how is BioTech Lab similar to other labs of its kind?

Question 6

“Innovation with impact” has been described as an important goal or aspiration of the BioTech Lab. Do you agree or disagree that this is an important goal or aspiration of the BioTech Lab?

Strongly agree  Somewhat agree  Unsure  Somewhat disagree  Strongly disagree

Please reflect for a moment on how you would interpret the phrase “innovation with impact” and then briefly answer the two questions below:

What does the word “innovation” mean to you?

What does the word “impact” mean to you?

Question 7

Imagine that it is 10 years in the future. Describe one extremely ambitious goal that the BioTech Lab might have achieved within those 10 years. The goal might be less than 100% certain. In fact, it might only have a 50 to 75% probability of success, but it is one that you believe is important and achievable.
APPENDIX E
INTERVIEW PROTOCOL

Work roles, relationships, and innovation

1. How long have you been in BioTech Lab?

2. Briefly, what did you do before you came to BioTech Lab? How was your previous experience similar to and different from your experience at BioTech Lab?

3. Briefly, please describe the main project with which you are involved.

4. Do you consider your project to be innovative? Could you elaborate on that? [Follow up if not mentioned in response: What is the ultimate benefit that you hope will come from this project?]

5. How did the idea for this project come about? What convinced you and your collaborators that it was worth pursuing?

6. What is your role in this project? What do believe are your most significant contributions to the project?

7. How would you describe your collaboration process on this project? [Prompts: For example, are you and your collaborators co-creating? Are you exchanging information? Are you testing each other’s ideas? Are you experts in different areas and work independently on project issues that are specific to your area of expertise?]

8. To what extent would you describe the project as interdisciplinary or multidisciplinary? How would you describe the disciplinary backgrounds of the researchers involved?

9. Do you and your collaborators ever speak “different scientific languages”? Put another way, has it ever been a challenge in BioTech Lab to work with people who have disciplinary backgrounds or domains of expertise that differ from yours? If so, can you give me any examples? How did you manage to understand each other and successfully collaborate?

10. What specific work processes have contributed the most to the success of your collaborations?

11. What specific work processes have inhibited the success of your collaborations?

12. Are there any creative tensions or disagreements? If so, how would you describe them? [Prompt: For example, tensions over what ideas to pursue, what methods to use, who gets the recognition, what counts as an accomplishment.

13. Do you have any responsibilities or roles in BioTech Lab that are not project-specific? If so, how would you describe them?

14. Are your friends inside BioTech Lab the same people with whom you collaborate or are they different people?
15. How would you describe who you are professionally?

16. How much does your work define you as a person? That is, would you describe [answer to question 15] something that you DO or is it something that you ARE?

17. [If disciplinary background is not provided as part of the answer to question 15 above] In what field were you educated or trained?

18. How important is [answer to question 17] to who you are professionally?

19. Where do you see yourself professionally in five years? In 10 years?

20. Has being in BioTech Lab changed who you are professionally or where you see yourself in the future?

Organizational identity referents and strength

21. Does BioTech Lab have a common sense of purpose? If so, how would you describe it?

22. Does BioTech Lab have a clear and distinctive vision? If so, how would you describe it?

23. For this question, I will give you some short descriptive phrases.\(^5\) If used to describe BioTech Lab, how strongly do you think most lab members would agree or disagree with the description? Please choose one of the following responses for each: strongly disagree, somewhat disagree, neither disagree nor agree, somewhat agree or strongly agree.

<table>
<thead>
<tr>
<th>Applied science orientation</th>
<th>Fun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic science orientation</td>
<td>Impersonal</td>
</tr>
<tr>
<td>Clusterized</td>
<td>Influential</td>
</tr>
<tr>
<td>Collaborative</td>
<td>Innovative</td>
</tr>
<tr>
<td>Competitive</td>
<td>Large</td>
</tr>
<tr>
<td>Disneyland for academics</td>
<td>Open environment</td>
</tr>
<tr>
<td>Diverse</td>
<td>Prestigious</td>
</tr>
<tr>
<td>Efficient for solving big problems</td>
<td>Resource rich</td>
</tr>
<tr>
<td>Efficient for solving little problems</td>
<td>Sink or swim</td>
</tr>
<tr>
<td>Entrepreneurial</td>
<td>Supportive</td>
</tr>
<tr>
<td>Frontier of science</td>
<td></td>
</tr>
</tbody>
</table>

\(^5\) Descriptive phrases were drawn from responses to previous survey (see APPENDIX B, Question 1).
CURRICULUM VITAE
Aimee L. Hamilton

ACADEMIC POSITION

Assistant Professor 2012
Department of Management
Daniels College of Business, University of Denver, Denver, CO

EDUCATION

Doctor of Philosophy (PhD), Business Administration 2012
Concentration: Management and Organization
Smeal College of Business, The Pennsylvania State University, University Park, PA

Master of Business Administration (MBA) 1990
Yale School of Management, New Haven, CT

Bachelor of Arts (AB) magna cum laude 1983
Concentration: Psychology and Social Relations
Harvard College, Cambridge, MA

DISSERTATION

Identity, Fluid Organizing and Sustained Innovation
Committee: Dennis Gioia (Chair), Raghu Garud, Glen Kreiner, Wenpin Tsai, and Susan Strauss

PUBLICATIONS


