1-1-2005

Academic capitalism and doctoral student socialization : a case study.

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ACADEMIC CAPITALISM AND DOCTORAL STUDENT SOCIALIZATION: A CASE STUDY

A Dissertation Presented

by

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Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF EDUCATION

May 2005

Education

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DEDICATION

To my supporting family and loving fiancé.

ACKNOWLEDGEMENTS

Words become short to express my gratitude and admiration for Prof. Berger as an outstanding scholar, advisor, and mentor. Today, his work as my mentor and advisor has been rewarded through the honors and successes that I have received. I also want to extend my gratitude to my committee members for their thorough feedback and dedication. And I want to thank the School of Education and the EPRA Department for their support.

I want to thank the Lumina Foundation and the Association for the Study of Higher Education for the 2004 ASHE/Lumina Dissertation Fellowship Award. This fellowship provided me with funds to conclude this dissertation and with valuable mentoring and networking opportunities for my career.

I also wish to thank all individuals who provided me with thoughtful insights; in particular, I want to thank Juan Pablo Fernández. Also, I want to thank the participants of this study for their time and collaboration.

Lastly but not least, I want to thank my parents, fiancé, family members, and friends for their support and encouragement.

ABSTRACT

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MAY 2005

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At the turn of the 21st century, research universities are increasingly seeking funds in the private sector through grants, contracts, industry-university partnerships, and commercialization of research (academic capitalism). As industry-academia partnerships grow, cultural tensions are likely to occur as the result of fundamental differences between business and academic values. Given that graduate school provides anticipatory socialization to the academic profession, this trend leads to important questions about the changing nature of these professions, including: How are graduate students coping with conflictive cultural messages as they are socialized in environments where both industry and academia coexist? Moreover, successful socialization is a strong predictor of doctoral retention; therefore, socialization patterns in departments heavily involved with industry open questions about doctoral attrition. The purpose of this study is to focus on the socialization of graduate students to investigate the effects of academic capitalism on the anticipatory socialization to the academic profession and doctoral retention. The overall methodology is a case study of an academic department engaged with high levels of academic capitalism and the main sources of evidence are doctoral students. Ethnographic interviewing and analysis was used to obtain the participants' cultural domains of knowledge around academic capitalism.

Given previous studies, a remarkable finding of this work is that the majority of the students could not see any negative effects of industrial funding and are very satisfied with the opportunities that it offers to enrich their training. Leaving behind the dichotomy of business versus academic values, these students see partnerships with industry as a way to achieve the traditional outcomes of the academic profession. The cultural knowledge that these students might bring to their entering institutions reflects an integration of traditional academic values with new perspectives brought by academic capitalism. In addition, the findings of this study suggest that this department provides socialization opportunities to graduate students that are known to be strong predictors of doctoral retention. This study reinforces a utilitarian perspective in which industry, government and academia associate in productive collaborations to generate knowledge, transfer technology to society, and educate the future generation of scientists. However, more studies are needed in departments with different levels of funding and prestige in order to determine the extent of the implications of academic capitalism across different academic contexts.

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CHAPTER 1

INTRODUCTION

Statement of the Problem and Significance of the Study

A series of powerful factors are shaping American higher education as it heads into the 21st century (e.g. Altbach, 1999; Clark 2002; Kerr, 2002; Newman & Courtier, 2001; Slaughter & Leslie, 1997). For Kerr (2002), these new forces include new electronic technologies that enable novel forms of teaching such as distance learning; the DNA revolution, which brings new ethical challenges; new demographic realities like the increase of minorities and the challenges faced by universities when attempting provide social mobility for these groups; changes in the age distribution of people enrolling in colleges and universities; contention over traditional epistemologies due to postmodern inquires about objectivity and the nature of truth; and the globalization of the economy, which implies global competition for the quality of scientific research and skill levels of the workforce. Burton Clark (2002) adds to these factors the challenge that universities face in order to keep up with the international growth and dispersion of knowledge that have been promoted by computer technology.

Another significant shaping force in higher education is the escalating competition among universities and colleges for students, faculty, funds, and prestige. This type of competition has increased in the last decades and has been triggered by decreasing state and federal financial support for higher education (Geiger, 2002; Newman & Courtier, 2001; Slaughter & Leslie, 1997). This competitive movement is characterized by market-driven forces, but differs from the classical free-market behavior found in the broader business environment due to unique factors such as prestige and segmentation in higher education (Geiger, 2002). Prestige is both the cause and the effect of obtaining and retaining good students, good faculty, and ample financial support. For example, good students are both consumers, who are attracted to prestigious institutions of higher education, and a source of prestige to those institutions. Universities and colleges are highly segmented by students'

abilities, cultural preferences, and academic programs. Thus, competition occurs among relatively similar institutions. Some examples of these phenomena include the increasing use of merit-based student aid to attract better students and the explosion of programs to attract non-traditional students (Newman & Courtier, 2001).

Other sources of competition come from more sophisticated and demanding students as well as from rating systems such as that of *U.S. News and World Report*, which exacerbate the competition among institutions for better students. In this market-driven arena, students have become consumers by applying to several institutions and attending the ones offering the best package according to their individual needs (Geiger, 2002). The rapid growth in the number of competitors—such as for-profit institutions—has also contributed to the accelerating competition among colleges and universities. Similarly, there has been an explosion of online courses and degrees offered by traditional institutions as well as by for-profit and virtual universities, giving students a choice from the traditional 3,600 institutions to over 5,000 (Newman & Courtier, 2001).

Geiger (2002) identified the following five main causes responsible for the intensification of market-driven competition in higher education in the last two decades. The first reason is the privatization of knowledge through partnerships with industry for the purpose of technology transfer and the engagement in commercial activities such as patenting, providing venture capital, and creating business incubators in fields such as engineering and biotechnology; other forms of privatization are represented by universities' selling their logos, signing exclusive agreements for example with soft-drink companies, and privatizing operations. The second cause is a managerial revolution prompted by fiscal pressures, regulatory burdens, and the availability of managerial expertise. As a result, administrative efficiency has become increasingly important in higher education through operations such as strategic planning and managerial control over academic governance. Third, reductions in state and federal support have resulted in a greater emphasis on tuition increases, gifts, endowments,

and sales of services as sources of revenue. Similarly, the competition for research federal funding has significantly increased (Newman & Courtier, 2001). Fourth, the increase in geographic market integration resulting from technological advances has allowed universities to widen their market more broadly in order to reach students and resources nationally. Finally, the fifth cause refers to the explosion in federal and private student financial aid that has increased fourfold and fivefold between 1980 and 1995 respectively.

The cumulative effects of the forces listed above, in conjunction with greater U.S. competition in the global economy, have contributed to unprecedented changes in higher education that have resulted in the growth of "academic capitalism," especially in science and engineering. Academic capitalism has been defined as the engagement in market-like behaviors on the part of faculty and universities related to the competition for resources in the form of grants, contracts, partnerships with industry, endowment funds, and spin-off companies (Slaughter & Leslie, 1997). Academic capitalism was stimulated in the 1980s through a series of legislative acts that allowed universities to commercialize research from federal funds and partner with industry in common ventures leading to the development of specific products that would be competitive in the global market. Since then, executives of large corporations, heads of universities, and political leaders have developed research and development (R&D) policies and organizations whose aim is to promote the advancement of science and the transfer of technology to society in global economies (Slaughter & Rhoades, 2004). Consequently, university-based research with close ties to industry nearly doubled between 1980 and 1990 (Zusman, 1999); by the 1990s, there were roughly 1,000 university-industry research centers at more than 200 U.S universities (Slaughter, Campbell, Hollernan, & Morgan, 2002).

These initiatives have fostered entrepreneurialism in science and engineering fields through a variety of interdisciplinary centers and partnerships with the private sector around new technologies derived from disciplines such as materials science, optics, and cognitive science. At the turn of the 21st century, the number of universities involved in commercial

ventures has increased eightfold and the number of university patents has increased fourfold (Slaughter et al., 2002). Moreover, some of the traditional non-profit institutions have created for-profit subsidiaries or partnered with for-profit firms and adopted other forms of commercialization by outsourcing and through high executive salaries (Newman & Courtier, 2001). Academic capitalism has also been fostered by significant changes in the nature of scientific research due to the development of new fields, techniques, and projects involving hundreds of researchers and billions of dollars—a phenomenon that has been dubbed "big science" (Zusman, 1999). The life sciences provide a clear example: before fundamental breakthroughs in molecular biology and genetics, life scientists in universities were mainly conducting basic research and industrial laboratories were at the forefront of applied research. The new developments in these fields, combined with academy-industry partnerships, have given rise to an emerging biotechnology industry hosted mainly in research universities but with heavy involvement by private sector firms. Thus, academics in these fields have become part of a larger technological community involved in commercial activities (Powell & Owen Smith, 2002).

Under this scenario, research universities have also become a source of national wealth-development through applied research rather than primarily a means for the liberal education of undergraduates and the production of warfare research (Altbach, 1999; Gumport, 1999; Slaughter & Rhoades 2004). However, academic capitalism is not a uniform phenomenon across higher education institutions. This unevenness is primarily due to the unequal distribution of R&D funds among universities and colleges. Zusman (1999) reported that the top 50 research universities in 1995 accounted for 60% of the R&D academic expenses and the top 100 for 80%. The distribution of funds across disciplines has been stable—though uneven—over the last two decades. For example, faculty in engineering receive 79% of university-industry funding (Zusman, 1999); around 54% of federal funds go to the life

sciences, 16% to engineering, 11% to physical sciences, and only 6% go to the social sciences and the humanities (Gumport, 1999).

A number of scholars have stated that the public good of higher education is being compromised as universities focus on more economic and private goals, undermining the public trust in academic institutions and resulting in less public support (Kezar, 2004; Powell & Clemens, 1998; Salamon, 2002; Slaughter & Rhoades, 2004). Therefore, a new conceptualization of higher education in light of academic capitalism is necessary in order to rescue its democratic legitimacy in the new economy. In fact, recent works have characterized higher education according to utilitarian perspectives in which individuals belong to complex networks that collaborate to meet societal needs while maximizing private benefits. From this perspective, it is assumed that academic work can productively coexist with industry without abandoning traditional academic values (Etzkowitz, Webster, & Haeley, 1998; Kezar, 2004; Mowery & Ziedonis, 2002; Stokes, 1997). This study provides additional empirical evidence about the impact of academic capitalism on higher education as well as insights into the discussion about the new vision of higher education in the new economy.

The American professoriate is being shaped simultaneously by the social, political, and economic contexts of academic capitalism, especially in disciplines aligned with the market. A number of studies have documented changes in the academic profession due to partnerships with the private sector (e.g. Campbell & Slaughter, 1999; Powell & Owen Smith, 2002; Seashore Blumenthal, Gluck, Soto, & Wise, 1989). More specifically, empirical studies have discussed potential difficulties in having contractual arrangements that accommodate industry and university needs when both parties have different objectives and cultures (Gumport, 2002; Mendoza & Berger, 2005). On the one hand, faculty members have usually conducted basic research for non-commercial reasons, and their rewards system is based on priority of discovery rather than on stock options or royalties. On the other hand, corporations are motivated by profits as well as by the challenges of product development and market risk. In addition,

university administrators are eager to promote relationships with industry in fields where research has the potential to generate research funding, income, and prestige; this creates further tension with faculty members that are reluctant to engage in for-profit venues (Hum, 2000; Mendoza & Berger, 2005).

Research consistently demonstrates that the three areas where the greatest conflicts emerge when faculty members are involved in the commercialization of research are: secrecy versus access of knowledge, publishing versus patenting, and contested ownership of intellectual property (see e.g. Campbell & Slaughter, 1999; Gladieux & King, 1999; Mendoza & Berger, 2005; Slaughter , Archerd, & Campbell, 2004). In addition, empirical studies have shown that academic capitalism consumes important resources of the academic profession such as loss of time for basic research, time spent by academic support personnel, loss of teaching and teaching-preparation time, secretiveness and confidentiality, departure of faculty and staff to client organizations, prestige and salary differences between faculty involved in commercialization of research and faculty who are not, and in some cases monetary losses due to legal fees and product liability (Campbell & Slaughter, 1999; Lee & Rhoads, 2003; Slaughter & Leslie, 1997).

This study assumes that other effects of academic capitalism on the academic profession include potential shortages, in terms of both quality and quantity, of future academics and scientists as a result of direct industrial influence on research conducted in higher-education settings. The anticipatory socialization with industry representatives during graduate school could potentially affect the quality of the training of future faculty members and scientists, given the overemphasis on product development. On the other hand, talented graduate students, who socialize with industry representatives, might be persuaded to follow non-academic careers, thus fostering a shortage of talent in the pipeline into the academic profession.

Graduate education in science and engineering has been impacted in mixed ways by academic capitalism. Slaughter et al., (2002) studied the impact of academic capitalism on science and engineering graduate students involved in research while committed to contracts with industry and found points of tension around the following themes: 1) the secrecy that is often demanded by corporations when students' research has commercial potential; 2) the withholding of graduate students' publications to enable patenting; 3) the authorship of intellectual property, given that graduate students usually deal with foundational work that has the potential for discovery; 4) the labor of graduate students as cheap or even free; and 5) the overemphasis on applied research and its implications on the quality of graduate training. These effects might influence the socialization of doctoral students and have significant implications to issues of retention (Golde, 1998; Tinto, 1993).

The impact of academic capitalism on graduate education and the academic profession can be framed under organizational culture perspectives. The following section reviews an organizational culture framework developed for this study and the way it relates to this impact.

Academic Capitalism as a Reshaping Agent of Culture in the Academic Profession

Organizational culture is the shared set of values, beliefs, meanings, assumptions, and understandings that determine behavior in organizations; socialization processes are the mechanisms by which culture is transmitted to new members of a given organization (Schein, 1985; Van Maanen, 1976). Membership in the academic profession is the result of a socialization process that starts in graduate school continuing throughout the first years' experiences by former students as faculty members (Tierney & Rhoads. 1993). New members contribute to the cultural reshaping of an organization (Louis, 1980; Van Maanen, 1976). Therefore, if future faculty members are socialized differently in graduate school from their senior faculty peers, cultural tensions may occur as junior faculty negotiate their membership in the academic profession. Thus, future faculty members whose socialization has been influenced by industry representatives in graduate school and are successfully socialized to the academic

profession, despite cultural struggles in the socialization process, could bring cultural changes to academia (Tierney & Rhoads, 1993). In other words, due to fundamental differences between industrial and academic cultures (Gumport, 1999), cultural changes might be induced in the academic profession through the socialization process of new faculty members who have been socialized with industry representatives during graduate school.

By assuming that the culture acquired during graduate school by future faculty members shapes the future character of the academic profession according to socialization theories. The significance of this study is clearly stated in Gumport's quote (1999),

> To the extent that graduate education functions as professional socialization, the professional work now modeled for students is often dependent on productivity criteria tied to other-than-scholarly agendas, which inspires us to ask, For what kind of profession are graduate students being prepared? (p. 418)

Given that graduate education is the anticipatory socialization of future faculty members, more research is needed to understand how the academic profession is being shaped as graduate students are socialized in non-traditional academic settings, as is the case when graduate students are involved in projects through partnerships between academics and industry representatives in applied fields where research has commercial value. If cultural change leading towards a more businesslike culture is taking place in departments heavily involved in academic capitalism, this could have significant implications for the future direction of basic research, graduate education, and the system of rewards and recognition in these departments. Inequalities in terms of material and symbolic rewards might widen between fields involved in academic capitalism and those that are not. In addition, socialization processes are key factors of doctoral attrition. For example, a series of works on doctoral attrition have demonstrated that involvement with the program is a strong predictor of doctoral retention. Involvement is achieved through socialization processes related to funding in the form of assistantships as well as through relationships with advisors, faculty, and students (Girves & Wemmerus, 1988; Golde, 1998; Tinto, 1993). Therefore, this study aims to contribute to the knowledge regarding

the impact of academic capitalism on the socialization of graduate students and the anticipatory socialization to the academic profession.

In order to better grasp the dynamics of socialization processes, this study uses sensemaking as a framework to understand how new members—in this case, graduate students in their academic departments—learn the culture of an organization (Weick, 1995). Sensemaking is the process by which people, in order to preserve cognitive integrity, make retrospective sense of actions and events that stand out from a general background of daily actions and events through cognitive processes guided by their beliefs (Festinger, 1957; Weick, 1995). Sensemaking is considered a social process because it occurs through communication between members as well as through common activities (Weick, 1995). New members in organizations are within a new environment where surprises emerge when their expectations are not met. Therefore, they become involved in intense sensemaking in order to account for those surprises (Louis, 1980). As their sensemaking evolves and they learn the culture of their new organization, new members encounter fewer surprises. However, given that sensemaking is a social process, newcomers have the potential to reshape the shared meanings in the organization they are entering as they interact with its other members (Louis, 1980; Van Maanen, 1976).

Following this line of argument, as potential future members of the academic profession, graduate students who are socialized in departments heavily involved with academic capitalism, may bring a series of beliefs and internalized meanings that may affect both their sensemaking to cope with surprises and the culture of the organization they are entering. Therefore, graduate education might play a significant role in the reshaping of the academic profession in light of academic capitalism.

Cultural studies provide a powerful framework in which to create more efficient organizations by providing a clear understanding of actions, behaviors, decision-making processes, communication patterns, and goals (Tierney & Rhoads, 1993). Graduate students in academic departments heavily involved with academic capitalism might experience cultural

surprises when their assumptions based on traditional academic values contrast with managerial values brought by industry representatives. If these cultural surprises interfere with the proper socialization of graduate students, academic capitalism might be a factor of doctoral attrition (Golde, 1998). Given the lack of knowledge about the impact of academic capitalism on the socialization of graduate students and its potential implications for the academic culture, this study aims to investigate the cultural knowledge acquired through the socialization processes of graduate students in departments heavily involved with academic capitalism to determine the degree to which their cultural knowledge has values associated with academic capitalism. Also, this study aims to investigate the impact of academic capitalism on the socialization of graduate students in light of the literature related to doctoral attrition.

Research Questions and Overall Methodology

The central research question of this study is: How do high levels of academic capitalism within academic departments influence the socialization of doctoral students? According to the theoretical framework, this research question is addressed through the following secondary research questions: What are graduate students' expectations about their departments' values, norms, and expectations of entering students? What type of surprises do entering graduate students face as they become members of their departments? Which of these surprises are related to academic capitalism? What factors influence the type of surprises graduate students encounter? What are the cues that graduate students pick up in their sensemaking process that reflect elements of academic capitalism in the departmental culture? How do socialization experiences in environments heavily involved with academic capitalism influence graduate students' career aspirations and expectations? How do socio-demographic characteristics such as gender, age, race, ethnicity, and foreign status influence graduate students' socialization in light of academic capitalism?

The overall methodology used is a case study of an academic department with a high level of academic capitalism at a Research I University where the units of analysis were

doctoral students at various stages of the program, from first-year graduate students to advanced doctoral students beyond candidacy. A series of ethnographic interviews (Spradley, 1979) with participant doctoral students were conducted in order to obtain participants' cultural paradigms around academic capitalism (as defined by Spradley, 1979). Then, common themes across participants' cultural paradigms were identified in order to determine potential differences that might indicate cultural and socialization shifts as graduate students advance through their program. Finally, basic document analysis was conducted in order to glean useful information about the context and the experiences of graduate students.

Definitions

There is a number of key concepts embedded in this study that are important to define. These include: Academic capitalism, academic profession, academic culture, faculty socialization processes, resource dependency, academic rewards systems, and sensemaking.

- **Academic Capitalism**

Slaughter & Leslie (1997) define academic capitalism as the new competitive environment in which universities strive for external monetary resources. Many of these specific market-oriented activities involve university partnerships with private industry, especially in science and engineering, through research grants, licensing patents and, in some cases, the formation of new firms. This competitive market for private research funds has induced market-like behaviors among faculty.

- **Academic Profession**

A profession represents an occupational community of people who engage in similar types of work, share common values and beliefs, and have a common sense of identity (Tierney & Rhoads, 1993; Van Maanen & Barley, 1984). The academic profession is the profession of college and university faculty members and refers to the general array of common characteristics that constitute the profession of academics. For Becher (1989), the academic profession is homogeneous given its similarities across disciplines and institutions. However,

the academic profession has also been described as a profession of subprofessions represented by the various disciplines (Bess, 1977). Ruscio (1987) reconciled these two views by noting that, although segmentation and fragmentation are characteristic of the academic profession, a set of overarching values exists across academic subprofessions.

- **Academic Culture**

  Kuh & Whitt (1986) define culture in higher education as:

  > The collective, mutually shaping patterns of norms, values, practices, beliefs, and assumptions that guide the behavior of individuals and groups in an institute of higher education and provide a frame of reference within which to interpret the meaning of events and actions on and off campus. (p. 13)

This definition of academic culture is based on previous definitions of culture as the social or normative glue based on shared values and beliefs that holds organizations together by conveying a sense of identity, facilitating commitment and stability, and guiding behavior (Pascalle & Athos, 1981; Smircich, 1983).

- **Faculty Socialization Processes**

Socialization is defined as the process through which new members acquire the culture of a given organization (Van Maanen, 1976). Faculty socialization occurs in two stages: anticipatory and organizational. In the case of the academic profession, the anticipatory stage takes place in graduate school, where future faculty members as graduate students anticipate the roles and behaviors they must enact as faculty members and begin to acquire the values, norms, attitudes and beliefs of their disciplines. The organizational stage occurs during the former students' first years as faculty members. In this period, individuals come into contact with the organizational culture of their employing campus and begin a process of compromise between their anticipatory socialization and the organizational culture. If successful socialization occurs, faculty members will master the culture and academic skills necessary to attain tenure (Tierney & Rhoads, 1993).

- **Resource Dependency**

The main postulate of resource-dependency theory is that the internal behaviors of members in organizations are shaped by the actions of external agents as providers of resources. Organizational resource dependency is a function of the importance of resources to the organization (such as funds, faculty, and students), the degree of discretion the organization has over resources and their use, and the existence of alternative revenues (Pfeffer & Salanick, 1978).

- **Academic Rewards Systems**

Belcher and Atchison (1976) define professional rewards in terms of the ways in which members of organizations receive rewards that provide them with job satisfaction as a result of making contributions to their organization. Some of these rewards include recognition, achievements, personal growth, advancement, and interpersonal relationships with peers, superiors and subordinates as well as competence, responsibility, and status. Various employee groups value rewards differently. Historically, academics have valued prestige and symbolic rewards such as peer-reviewed publication and the intrinsic satisfaction of teaching, discovering and disseminating knowledge.

- **Sensemaking**

Weick (1995) defines sensemaking in organizational settings as the ongoing thinking process of individuals aiming to create order and make retrospective rational accounts of the situations in which they find themselves. As a result of sensemaking, individuals develop cognitive scripts to predict event sequences and outcomes as well as to guide behavior.

CHAPTER 2

LITERATURE REVIEW

Introduction

In the last two decades, higher education has been experiencing, in the form of academic capitalism, one of the most significant progressive sets of changes since its inception (Altbach, 1999; Slaughter & Leslie, 1997). As a result, graduate education and the academic profession have faced a series of challenges that have been particularly acute in research universities and in the fields of science and engineering. The new challenges brought by academic capitalism have fostered new expectations and relationships with industry, government, and administrators, for faculty members and graduate students, as well as changes in norms and values within the academic profession. A number of studies have documented the impact of academic capitalism on faculty members in disciplines where academic capitalism is significant (e.g. Slaughter & Leslie, 1997; Campbell & Slaughter, 1999; Powel & Owen-Smith, 2002), but only one study has investigated the impact on graduate students (Slaughter, Campbell, Hollernan, & Morgan, 2002). Thus, given the significant role of graduate students as potential future faculty members and skillful workforce in the global economy, there is a need for more knowledge regarding the ways in which academic capitalism affects graduate education.

This chapter reviews the development of academic capitalism and its impact on the academic profession and graduate education. The first part discusses the emergence of academic capitalism from a historical perspective, followed by the implications for the public good of higher education. Then, the chapters continues with a discussion on the general challenges that academic capitalism has brought to higher education, the academic profession, and graduate education within specific organizational and professional contexts. Finally, this chapter includes a section of the impact of academic capitalism on the organizational culture at the departmental level, with emphasis on the socialization processes of the academic profession

and graduate education. It concludes with a discussion about issues reported in the literature regarding graduate training as academic capitalism is being shaped in research universities.

The Emergence of Academic Capitalism

The historical review presented in this section relies heavily on the works by Geiger (1986; 1993; 1999; 2002), who has extensively investigated the historical development of research in American universities.

American higher education has been continuously evolving since its inception. Some of the significant changes undertaken by higher education include the adaptation in 1636 of the English and Scottish models of higher education to the unique circumstances of the American colonies through the foundation of Harvard University. In the late 1800s, came the next significant change, the implementation of the German secular model to the American higher-education system. Throughout the nineteenth century, American universities were mainly teaching institutions; only the wealthier among them were able to provide faculty with resources (such as lower teaching loads, up-to-date laboratories, and large libraries) to conduct research. Usually, only professors with an exceptional reputation would be sought by several institutions and given research professorships (Geiger, 1986). However, given the high costs of research, these privileged universities needed external funds that usually came from philanthropic organizations and, in some cases, from the government through scientific bureaus promoting research mainly in agriculture and engineering according to identified national needs.

In the 1860s, the introduction of the Morrill Land-Grant Act challenged the traditional role of colleges as enterprises for the education of the nation's leaders by including service to society as part of their core mission through agricultural, medical, legal, engineering, and other applied programs (Brint, 2002). By the 1890s, the number of higher-education institutions expanded significantly, and by 1910 the number of enrollments swelled in the largest institutions, partly because of the assimilation of women into higher education. At this point in time, a set of standards was adopted to define the American university (Geiger, 1999). By

World War I, higher education was unified under a single pattern in terms of admissions, credit-hours, and majors (Geiger, 1999).

Before World War I, industries had well-established laboratories of applied research while basic research was mainly conducted in universities. During the war, extraordinary technological progress was made thanks to the successful collaboration of academic and industrial scientists. As a result, once hostilities were over, The National Research Council (NRC) was created to coordinate the scientific organizations that emerged during the war. The NRC was above all a network that brought together academic, industry, and government science. It represented the merging of basic and applied research as well as the acting research force after the war, setting the new landscape of the American science for the decades to come (Geiger, 1986). After World War I, the ideology of American science foresaw the advancement of knowledge led by the partnerships between industry, academia, and philanthropic foundations. However, the clear distinction between the roles of industry and academia continued: basic research was mainly conducted in universities and applied research in industrial laboratories.

Philanthropic foundations were major stakeholders in the American scientific endeavor between the two wars and in the expansion of university research. These foundations also fostered the formation of units within universities and facilitated research through postdoctoral fellowships and direct support. In general, the main forms of external funding received by research institutions from donors consisted of capital inputs to physical infrastructure (such as endowments used for both teaching and research), capital with specific aims (such as the formation of specialized institutes dedicated to research), and funds directly intended to aid research (Geiger, 1986). By the second decade of the twentieth century, the need for research became an important aspect of universities' missions and universities responded by implementing mechanisms such as lowering teaching loads, sabbatical leaves, revolving research funds, and graduate assistants.

By the 1920s, the American universities defined by the new standards had at least five departments led by faculty members with doctorates and at least one professional school (Geiger, 1999). However, early in the 1920s, the major philanthropic foundations concentrated their research funds on a few institutions. These foundations were focused more on the support for research driven by the belief that students should not be subsidized beyond scholarships and loans to the needy. Moreover, donors had specific preferences for certain institutions and research areas (Geiger, 1986). Things change by the late 1920s, when philanthropic support to graduate students grew, both in public and in private institutions, and, as result, graduate education enrollments rose significantly, allowing considerable flexibility in the handling of teaching loads and therefore improving research opportunities to faculty members. Industrial research also grew substantially during the 1920s; some industrial laboratories even conducted both basic and applied research. Graduates from universities were actively recruited by these industrial laboratories, and some industries promoted fellowships to increase scientific manpower in areas that were important to them. In addition, some professors consulted with corporations in exchange for contracted funds for their departments.

Corporate donations to higher education were commonplace in the 1920s. Some donors were very specific about their donations and usually enlarged areas of the university that they considered essential to the American society. The character of these donations was essentially pragmatic in that university researchers were granted funds to work in areas of interest to corporations (Geiger, 1986). This trend of corporate research support to universities in the 1920s generated a growing concern that the proliferation of industry-sponsored research was threatening the vitality of basic research in academia, given that university research was regarded as disinterested inquiry whereas corporate research was not. Back then, university leaders were expressing the same concerns as those of today regarding corporations' vested interest in the research they support (Geiger, 1986).

Federal investment in applied research rose during the 1930s, leaving the involvement of the federal government with basic research almost non-existent. However, during this decade, the top research universities made substantial commitments to sustain the research enterprise with "hard" budgetary allocations. Thanks to this efforts, American research reached parity with that of the leading scientific nations of Europe. Despite the effects of the Depression, universities' commitment to research was enhanced and promised to continue due to the rapid pace of scientific advancement and the latent competition between institutions. During the last half of the 1930s, external funds for university research expanded at a consistent rate. However, the cost of science was increasing at an even bigger pace, and thus donations were becoming inadequate for the demands of research. However, at the end of the 1930s research universities enjoyed a strong infrastructure, developed during the 1920s, as well as abundant graduate assistants who were willing to work for low salaries during the Depression (Geiger, 1986).

Interaction between research in industry and research in universities began in World War I. Industry originally looked to universities as sources of scientists to staff its own laboratories. However, by the 1940s a different kind of relationship emerged as the central paradigm of research ties between universities and industry. This new relationship was based on the large and successful firms in technology-based industries like chemistry, pharmaceuticals, and telecommunications looking to university research as theoretical knowledge that would supplement and enrich their own internal investigations (Geiger, 1986).

President Roosevelt directed the Office of Scientific Research and Development (OSRD) in 1944 to advise him on how the wartime government experience in sponsoring scientific research could be applied after the cessation of hostilities. Vannevar Bush, the director of OSRD, was convinced of the need for a permanent means for assuring the cooperation of the federal government and the civilian community but with the condition that the autonomy of science would be protected. Above all, Bush was concerned with protecting

basic research from national politics and industrial utilitarism. The report by Bush demanded by President Roosevelt was crystallized with the creation in 1950 of The National Science Foundation (NSF), whose main mission was to support basic research and graduate education and to appraise the impact of research upon industrial development and general welfare. The inception of the NSF marked the beginning of a new relationship between the federal government and the nation's universities. In fact, it became the foremost patron of research universities (Geiger, 1993).

Federal grants became more significant during World War II as the government contracted massive amounts of university research. These collaborations started with the Manhattan Project, which created the atomic bomb and where civilian scientists were hired by the government as directors of major divisions working with representatives of the armed forces. Most of these researchers spent their contract time in laboratories outside their universities (Geiger, 1986). After the war, there was a general dissatisfaction with the concentration of war research in a handful of firms and universities. As the Cold War emerged, university leaders were concerned with the federal sponsorship of research around issues such as lack of support for basic research, time commitments of faculty contracted by the federal government, increasing dependence on research funds, and domination of federal research interests. In sum, in a continuum axis of disinterested-interested research, postwar academic research was located at the disinterested end, federal contracted laboratories were at the interested end, and research centers, institutes and bureaus were somewhere in the middle (Geiger, 1986).

Despite the efforts of Vannevar Bush to protect basic research, unrestricted foundation grants became increasingly elusive after World War II, given the rise in the 1950s of the Cold War, which called for an U.S. commitment to develop the hydrogen bomb and to plan for a vast rearmament plan. This pressing national interest mobilized a network of scientists engaged in defense-related research, and thus federal research support became scarce unless it was related

to a national interest. The emergence of the federally dominated research under the pressures of the Cold War vastly increased the amount of funds available for university research. However, most of the available funds were programmatic, which was in opposition to the traditional uncommitted nature of university research.

Foundation support to universities in the 1950s was mainly directed at the medical and health sciences, a variety of activities to strengthen universities (such as graduate and postdoctoral fellowships, physical plant endowments, and libraries), and support for the social and behavioral sciences. In fact, in 1948 the 200-inch refracting telescope at Mount Palomar was the last Big Science project sponsored by The Rockefeller Foundation. In the 1950s, the Ford Foundation entered the scene of sponsored research, tripling within a few years the combined efforts of the Rockefeller Foundation and the Carnegie Corporation. Nevertheless, since then most of the sponsorship for expensive and extensive research projects has been in the hands of the federal government and targeted to those universities that already had substantial research capacity before World War II. However, any university with an extensive program in engineering and physical science could achieve some participation in federal funding (Geiger, 1993).

When the Soviet Union launched Sputnik I on the 4th of October 1957, the U.S. government realized that they were in a race for space against the Russians. As a result, the government founded the National Aeronautics and Space Administration (NASA) a year after. NASA quickly became another federal agency with significant involvement in university research, and by 1968 the federal support increased even more, with more emphasis on basic research. After Sputnik, federal policies encouraged greater dispersion of research funds among universities. At this time, the political argument used by the NSF to protect basic research was based on the notion that basic research was necessary for national security and to stay ahead of the Russians. Therefore, the growing federal support through the NSF and NASA during the 1960s fostered the golden age of research universities that led to the odyssey of Apollo XI

(Geiger, 1993). At this time, almost every field in higher education experienced a shortage of teachers and researchers. Those with doctorates found employment easily, and universities reduced teaching loads in order to retain faculty members. University budgets also grew substantially; access to research funds increased significantly in all fields; some professors founded institutes and research centers; the federal government fueled research in technical fields to keep up with the demands of the Cold War; and top universities became national leaders in science and technology (Kerr, 2002).

The GI Bill induced the biggest growth in enrollment ever seen by higher education, challenging universities' capability to accommodate a massive influx of new pupils and a generation of students less committed to academic values (Altbach, 1999). This growth, which was particularly rapid in the 1960s, fostered the proliferation of a diverse system of institutions, from community colleges to four-year institutions to research universities (Altbach, 1999).

By the 1970s, the golden age of American higher education began to end due to population shifts, inflation, and government fiscal deficits. As a result, funding for academic research started to decrease as global markets began to emerge (Altbach, 1999; Slaughter & Leslie 1997). Additionally, the ideology in support of basic research started to vanish as access to higher education became the main concern in the baby-boom age. During this decade, unlike the 1960s, the federal government decided to aid instruction and students more than scientists. However, the level of support for research during this decade was sustained (although it stopped growing). In the 1970s, Americans won the race to space, and research was not longer concentrated in just fifteen universities thanks to intermediary organizations such as the NSF. There was no longer a shortage of graduate students, faculty members, or researchers. Now the priority was to attend to the education of the baby-boom generation with drastic reforms on campuses (Geiger, 1993).

In addition, the student movements of the 1970s demanded universities to account for their responsibility to society, including research useful for the public well-being. In other

words, the post-Sputnik faith in basic research was discredited in the 1970s, whereas values of egalitarianism and social justice proliferated. Therefore, research universities in the 1970s faced a decline of support for graduate students, with questions raised about the quality of graduate education, and the market for junior faculty members became stagnant. Many faculty members no longer received research support, and equipment was aging to the point of inadequacy. As a survival strategy, departments started to specialize in order to show their relative strength and to compete for increasingly shrinking research support. Departments also admitted to be moving toward applied research as a way to attract sponsors. This marked the beginning of an unprecedented relationship with industry and a drift away from the paradigm that flourished in the 1960s based on faith in basic research (Geiger, 1993). As a result, in the mid-1970s industry-funded research started to increase.

At the height of the biotechnology boom of the 1980s, universities found themselves in a global economical context where American industry was loosing competitive ground. Since universities needed funds, both sectors were in need of each other. Economic competitiveness and technology transfer became the cornerstones of an emerging consensus on university research. This imperative toward the commercialization of research induced a drift in the direction of more practical work (Geiger, 1993).

During the 1980s, markets became increasingly globalized, and funding to postsecondary education continued to decrease as faculty members and universities moved toward greater participation in the market (Altbach, 1999; Slaughter & Leslie, 1997). In addition, the U.S. government encouraged the cooperation of industries with universities, in order to bridge funding gaps and cope with global competitive markets by introducing a number of laws—starting with the Bayh-Dole act of 1980—that allowed universities to participate in profit making by starting spin-off businesses and generating profits from patents (Campbell & Slaughter, 1999).

Throughout the 1980s and 1990s, science and engineering fields became more entrepreneurial and involved with technology. Leaders of large corporations, heads of universities, and political leaders developed policies and organizations to promote the growth of centers and institutes that involved partnerships between academia and industry around new technologies such as materials science, optics, and cognitive science (Gumport, 1999; Slaughter & Rhoades, 2004). Some examples include the Business-Higher Education Forum, the Government-University-Industry Research Roundtable, and the Advanced Technology Programs housed in the Department of Commerce. Additionally, the NSF started to develop industry-university cooperative research centers (Slaughter & Rhoades, 1996).

The 1990s marked a new era for higher education triggered by the consolidation of multiple competitive markets in the world such as Japan, Hong Kong, and Europe bringing a new type of competition for the U.S. that differed from the previous tensions with the Soviet Union and its allies in the Cold War (Miller, 1999). International competition and multinational corporations became the driving forces in the American economy. To keep pace with global competition, the U.S. federal government shifted the attention from basic and military research to civilian technoscience in order to meet the new demands of global economies. As part of this new strategy, new laws were introduced to enhance universities' participation in for-profit ventures. Under this scenario, higher education became an important source of national wealth-development through applied research rather than primarily a means for liberal education of undergraduates and warfare research. Subsequently, state leaders have stimulated programs around innovation through industry-government-academia partnerships led by industry, held together by government, and serviced by universities (Slaughter & Leslie, 1997).

At the turn of the 21st century, there is a variety of evidence suggesting that universities are key agents in the global economy as research centers for the development of competitive products and as training institutions of skilled labor for the global economy (Slaughter & Leslie, 1997). Unlike the industrial society of the past, most of the discoveries and applications of the

post-industrial revolution have been made by scholars. Often, these new technologies (such as computers and telecommunications) are developed through partnerships with the private sector. These technologies allowed executives to manage their corporations overseas and to monitor the global trade in equities, bonds and currency, making it possible for multinational corporations to emerge as the central organization of the global economy (Slaughter & Leslie, 1997).

Society expects higher education to prepare the workforce of today's corporations, which has to be more highly trained and educated than in the industrial society. Workers now, under a flexible volume of production, are subject to constant decision-making and need substantial knowledge, in contrast to the repetitive assembly-line situation of the Ford era. Moreover, product innovation depends heavily on university-educated personnel, and persons with advanced degrees almost always fill managerial positions (Campbell & Slaughter, 1999). Despite the significant role of higher education in the global economy, federal and state funding have been steadily decreasing in the last few years, pushing-higher education institutions to seek other sources of revenue in order to survive. Figure 2.1 illustrates the historical decreasing trend of federal R&D funding as a percentage of the total R&D funding in the U.S. from the 1950s to 2000. These patterns of higher education seeking new sources of revenue have been the key factors at fostering academic capitalism.

Academic Capitalism: A New Landscape

Historically, the states have had the basic responsibility for American public higher education, primarily through operating support and faculty salaries for public systems of colleges and universities. The federal government has been the primary funding agent for student aid and research grants, although it has also sponsored military academies and a few institutions serving special populations (Altbach, 1999; Geiger, 1999). In general, the federal government provides particular kinds of support to meet perceived national objectives and thus, as a patron of higher education, it expects from its investment in research high returns in terms of products that would contribute to the national wealth. Similarly, states, as patrons of public

higher education, expect their funds to be used primarily in teaching and training of the future workforce (Braxton & Berger, 1996).

Universities receive R&D funding from a discretionary federal budget, which is what is left after mandatory (entitlement) spending, military spending, and the payment of interest on the national debt. Thus, federal funding for R&D has to compete with other national needs such as interstate highways, national parks, environmental protection, and housing. By the mid-1990s, this discretionary federal budget was down to 17%, excluding defense. In addition, in the 1990s there was a growing skepticism in Congress around university research due to a number of frauds and ethical problems, to the point that some universities were required to return millions of dollars in questionable billings (Geiger, 1999). The cumulative effects of ongoing fiscal constraints to public support are forcing higher education to compete increasingly for both federal and state funds—which also have shrunk due to tax cuts (Altbach, 1999; Zusman, 1999). At the turn of the century, the Clinton administration developed a R&D plan meant to support projects with clear potential for commercial applications and job creation which fostered more competition for funds among universities and favored specific applied fields. These trends are likely to continue, and universities will be asked to do more with less, to identify comparative advantages, to consolidate efforts with other research institutions, and to articulate more clearly how research contributes to societal goals (Gladieux & King, 1999).

As state and federal funding decrease, higher education has sought to reduce costs by freezing hires and physical-plant renovations, encouraging early retirements, replacing full-time faculty with part-timers, increasing tuition fees, and privatizing services such as housing (Slaughter & Leslie, 1997). In addition, the new policies developed in the 1980s to promote technological innovation and intellectual property management shifted federal funding for research from block grants toward grants consistent with specific goals of the global market. As a result, higher-education institutions were forced to change their resource-seeking patterns to reach the newly available R&D funds through grants, contracts, and research commercialization

(Campbell & Slaughter, 1999). In other words, public universities respond to external forces of globalization by maintaining and expanding revenues critical for the organization through market-like behaviors in times when state funding is more and more scarce (Campbell & Slaughter, 1999). Therefore, institutions of higher education are increasingly relying more on private sources as state and federal support shrinks.

These changes faced by higher education in the last few decades demonstrate the growing dominance of academic capitalism (Slaughter & Leslie, 1997):

> Individual professors' freedom to pursue curiosity-driven research was curtailed by withdrawal of automatic funding to institutions to support this activity and by the increased targeting of R&D funds for commercial research. Faculty and institutions were pushed toward academic capitalism by policy directives and by shifts in the resource mix. And some faculty and institutions turned eagerly to academic capitalism, viewing it as an opportunity to exercise entrepreneurial skills, as a means to capture resources, or as a strategy for a prosperous future. (Slaughter & Leslie 1997, p. 62)

Today, students have become consumers, colleges have turned into vendors, and research is being commercialized in applied fields, marking a new era in higher education as an entrepreneurial institution (Chait, 2002). In light of these market-like behaviors, higher education is going through a philosophical shift. The following section discusses this shift and some of the most salient implications of the emergence of academic capitalism for the public good of higher education.

The Impact of Academic Capitalism on Higher Education

Historically, there have been a series of societal expectations regarding the role of universities as responsible for social mobility, instruction, credentials, promotion of liberal education, protection of academic freedom, preservation and advancement of knowledge, and cultivation of intellectual pluralism and academic values (Gumport, 2002). In theory, scholars pursue knowledge for its own sake; however, this historical review has shown what Damrosch (1995) describes as academic economy. Damrosch states that scholars in reality are subject to

political and economical pressures even in the purest fields of inquiry because the truth is that his or her department has certain expectations according to the interests of the consumers. Slaughter and Rhoades (2004) argue that, in fact, the research activities of scientists and engineers are profoundly influenced by external markets. Over the past few decades, resource constraints on universities have given rise to academic capitalism focused on vital resources and dynamic markets in order to deliver in response to those societal expectations. Thus, in the last decade, universities have had to face the harsh realities of market forces and design competitive strategic plans on the organizational, normative, and political front for their survival based on privatization, reduction of costs, enhanced efficiency, and commercialization of research (Brint, 2002; Gumport, 2002).

Universities were meant to be primarily teaching institutions, and thus students were the principal consumers. However, only one-third of revenues and expenditures in modern research universities relate to tuition; the remaining two-thirds have to do with the production of knowledge. The principal consumers of knowledge since the 1950s have been governmental agencies and business. Therefore, research universities are increasingly accommodating to the needs of these consumers according to economic forces of corporate profit, especially in those disciplines, such as engineering and biotechnology, that are aligned with the market. Moreover, the federal government is still, by a ratio of approximately ten to one, the principal source of external support for and consumer of academic research (Slaughter & Rhoades, 2004). In this landscape, the orientation of federal funding agencies has increasingly turned toward commercially relevant research, and industry representatives now sit on many review panels for allocating federal grants.

Slaughter and Rhoades (2004) propose that universities are just one more type of non-profit institution engaging in commercialization in an age where commercial activity has substantially increased in non-profit organizations. These institutions "want the best from both worlds—the protection and continued subsidies of the public sector, and the flexibility,

opportunities, and potential revenue streams of the private sector" (p. 330). However, achieving both is not straightforward: for example, only thirteen institutions generated two-thirds of all the income generated from patenting, which indicates that the majority of universities do not see significant returns.

However, many proponents of academic capitalism argue that it makes universities more responsive to the influence of the market and facilitates their adaptability and survival (Brint, 2002). Supporters of academic capitalism have identified benefits such as additional sources of support for research, access to a broader range of talent from the private sector, and more rapid development and transfer to society of useful products such as vaccines (Brint, 2002; Miller, 1999). In sum, for many faculty, legislators and administrators, commercialization of research is a contribution to economic growth, which is in accordance with higher education's legitimacy as a social good (Campbell & Slaughter, 1999). The following section further discusses some of the implications of academic capitalism for higher education as identified by scholars in the field.

An Epistemological Drift in Higher Education

Becher (1989) argues that universities are going through "An epistemic shift [...] as the disciplines adapt to external forces based on utility" (p. 142). Moreover, Elzinga (1987) refers to two main causes of this epistemological drift: 1) the continuing pressure of mandating science in line with political and bureaucratic decision-making institutions and 2) the pressure of market forces at a time of emerging technology clusters like microelectronics, biotechnology, and advanced industrial materials. In the same vein, Gumport (2002) uses the concept of institutional logic (drawn from neo-institutional theories) as a framework for the epistemological shifts that higher education is experiencing due to academic capitalism.

Neo-institutional theories assert that every organization responds to an environment shaped by other organizations' responses. Thus, organizations modify their characteristics according to their environment. DiMaggio and Powell (1983) state that organizations will

transform in ways that resemble each other if they are influenced by the same environment. In the same vein, diverse environments will lead to diverse organizations. DiMaggio and Powell (1983) coined a name for this process that forces one unit to resemble others facing the same environmental forces: institutional isomorphism. There are three types of institutional isomorphism: mimetic, normative, and coercive.

Mimetic isomorphism occurs in times of uncertainty when organizations mimic peer organizations that have been successful. This is the case when technologies are poorly understood, goals are ambiguous, or circumstances are critical. Normative isomorphism occurs through professionals across organizations who share a set of common norms. Coercive isomorphism refers to the formal and informal pressures exerted on organizations by other organizations upon which they are dependent and by cultural expectations in the society within which organizations function. The environment generated by academic capitalism has fostered a coercive isomorphism where Research I universities have adopted managerial values and entrepreneurship. This coercive isomorphism in Research I universities has gradually replaced bureaucracy and professional competence represented by the normative isomorphism of the academic profession in universities.

Institutional logic refers to institutional practices and symbolic constructions that shape the organization's principles (Friedland & Alford, 1991). Institutional logic usually has historical roots and is subject to change according to institutional isomorphism. On the one hand, universities' social logic is based on a range of societal expectations such as mass education, citizenship, knowledge preservation and advancement, inherent worth of ideas, original scholarship, inquiry (including basic and applied research), long-term goals and investment in future generations. On the other hand, universities' industrial logic is based on market forces, contribution to society via economic growth, development through skill training and research applications, revenue generation and commercialization, applied research, educational services and short-term goals (Gumport, 2002).

This coexistence of multiple logics at the same time is generating tensions over conflictive practices in higher education (Gumport, 2002). In fact, a number of studies have documented tensions generated from the coexistence of social and industrial logics in higher education (e.g. Campbell & Slaughter, 1999; Gladieux & King, 1999; Mendoza & Berger, 2005; Miller, 1999; Slaughter & Leslie, 1997). For example, administrators are increasingly behaving like managers resulting in more control over the work of faculty members and in faculty members' loss of autonomy and ownership of intellectual discoveries (Campbell & Slaughter, 1999; Mendoza & Berger, 2005). The following quotes address some of these tensions:

> [...] critics find universities becoming the playgrounds of corporate sponsors adapting their programs to fit business needs and increasingly at the service of corporate sponsors of research. These portraits give rise to the uneasy sense of a transition from public-serving social institutions to industrial institutions, and from collegial to corporate enterprises. (Brint, 2002 p xi)

> Academic capitalism is sometimes met with confusion or resistance at the department level, as was evident in our analysis of department heads and faculty in science and engineering. Heads responded unevenly to the possibilities of entrepreneurial activity. In some cases, they seemed unsure of what to do strategically or of how their department could possibly fit within the current agenda of their institution. In some other cases, heads were resistant to the push from central academic managers for more entrepreneurial activity and engagement with business in the area of research. One of the fault lines within academic capitalism is that there are often disjunctures between where presidents, provosts, and others senior academic administrators want to take an institution, and the commitments and interests of significant numbers of faculty within the institution. (Slaughter& Rhoades, 2004 p. 333)

Implications for the Charter between Higher Education and Society

A number of scholars have stated that the public good of higher education is being compromised as universities shift away from social responsibility and towards more

economically oriented private goals (Gumport, 2002; Kezar, 2004), "manifesting itself in less public support for state and federal resource allocations to postsecondary education" (Slaughter & Rhoades, 2004, p. 334). Therefore, a new conceptualization of higher education as a public good is necessary in order to rescue its democratic legitimacy in the new economy (Kezar, 2004; Slaughter and Rhoades, 2004).

Slaughter and Rhoades (2004) have characterized the new economy as one that needs educated workers and consumers and treats knowledge as raw material that can be owned as products or services. Under this scenario, universities play an essential role as producers of knowledge and educated workers and consumers. However, the configuration of state and federal resources has changed, providing colleges and universities with fewer unrestricted public funding and encouraging them to seek out and generate alternative sources of revenue. According to Slaughter and Rhoades (2004), these new configurations and boundaries change our conception of what "public" means because academic institutions are not seeking for-profit venues and aim to maintain their status while entering the marketplace at the same time. In other words, academic capitalism does not involve "privatization"; it rather entails a redefinition of public good.

The discussion of higher education as public good is not new in the literature and has concentrated on the dichotomy between communitarian and neo-liberal models. Recent work has characterized higher education according to a utilitarian perspective, emphasizing not moral values but consequences to society and how individuals pertain to complex networks that collaborate to meet societal needs while attempting to maximize their own individual benefit. Within a utilitarian perspective, the charter between higher education and society becomes a blend of communitarism and neo-liberalism (Kezar, 2004; Powell & Clemens, 1998; Salamon, 2002).

Slaughter and Rhoades (2004) have developed a theory of academic capitalism in agreement with a utilitarian perspective. According to their theory, faculty members, students,

administrators, and industry representatives are actors, who act independently towards opportunities in the new economy. These players form organizations that bring the private sector into the university by negotiating between non-profit public and for-profit private domains. Moreover, Slaughter and Rhoades (2004) propose that academic capitalism is a new mode of producing research that "has not replaced the old one, but coexists with the old, which remains the principal site for the production of undergraduate and graduate education" (p. 204).

As faculty members engage with the private sector, scholars have questioned how the values and norms of science fare in this arena. Slaughter and Rhoades (2004) synthesize this literature into five main viewpoints: 1) Mertonian: the values of science—openness, communalism, lack of interest, and organized skepticism—are different from the values of commerce (Merton, 1957); 2) Critical: science has always served industry and the military (Melman, 1982; Foreman, 1987; Leslie, 1993); 3) Social-constructionist: the Mertonian perspective neglects the day-to-day negotiations of individual scientists to secure resources and the complex array of policy strategies in which scientists collectively participate to access and influence external communities relevant to their research (Callon, 1986; Dasgrupta & David, 1987); 4) Entrepreneurial: science is not value-free and accommodates both market and academic values (Cohen & Wash, 2002; Owen-Smith & Powell, 2001); and 5) The "commons": the common good is best served by non-market values (Bollier, 2002; Heller & Eisenberg, 1998).

Except for the social-constructivist and the entrepreneurial viewpoint, these positions tend to place Mertonian values in opposition with entrepreneurial values. Even the entrepreneurial approach places Mertonian values as the ideal. However, many scholars assume that academic work can productively coexist with industry without the abandonment of Mertonian values (Branscomb, 1997; Etzkowitz, Webster, & Haeley, 1998; Mowery & Ziedonis, 2002; Stokes, 1997), mainly because of three reasons: science has always been involved with the economy through applications; science is essential for the information age;

and academic and market values can coexist if the public good is reconceptualized into economic prosperity. This position has the critique that universities may end up pushing too hard for the commercialization of research (Thursby & Thursby, 2002), with potential significant implications for the quality of research (Henderson, Jaffe, Trajtenberg, 1994) and for changes in the culture of academic research (Powell & Owen-Smith, 1998). Nonetheless, a number of case studies indicate that academic values are in flux. In some cases, faculty members simultaneously hold Mertonian and entrepreneurial values, showing a blend of both academic and business values in today's academic culture (Etzkowitz, et al., 1998; Owen-Smith & Powell, 2001; Powell & Owen-Smith, 1998; Rhoades & Slaughter, 1991; Slaughter & Rhoades, 1990).

Through a utilitarian perspective, academic capitalism could become a force to enhance social benefits. Also, revenues from entrepreneurial activities could be targeted to social welfare, for example by increasing access to underserved populations. Right now, biotechnology is where most academic capitalism is happening, but there are other areas yet to be exploited—such as green science and environmental research—that could potentially bring significant benefits to both industry and the public good. Also, academic institutions could foster local niches attending to local issues and opportunities that could benefit both the institutions and their surrounding communities (Slaughter & Rhoades, 2004).

In any case, the discussion of the new charter between higher education and society is still developing, and there are calls for more empirical evidence in order to better comprehend the implications of academic capitalism for higher education and be intentional in the definition of the new charter between society and higher education (Kezar, 2004). Until now, a number of studies have shown that academic capitalism has significant implications for the direction of research and academic freedom, the academic profession, and graduate education. The following sections discuss some of these.

Implications for the Direction of Research and the Free Dissemination of Knowledge

The scientific community has expressed worries about the federal government's tendency to favor R&D targeted to products with commercial potential because federal funding, focused on bottom-line results and economic competitiveness, affects basic research with no obvious commercial appeal but that could bring greater returns in the long term (Becher, 1989; Gladieux, & King, 1999). Federal support for basic research has become selective, and the criteria of selection are ultimately tied to an industrial economic policy or a social-policy agenda (Becher, 1989). In other words, basic research that can rapidly be exploited or that holds potential for future technological markets tends to be favored while preventing other research from reaching the market; this is due to the fact that universities are not selecting what products to patent according to societal values or needs (Slaughter & Rhoades, 2004). Nevertheless, in some fields such as engineering and biotechnology the line between applied and basic research is not clear anymore, which diminished the tensions regarding the balance between applied versus basic research (Becher, 1989; Slaughter & Leslie, 1997). Moreover, recent studies have indicated that the increasing association between industry and academia has obscured the boundary between basic and applied research even further in these fields (Slaughter , Archerd, & Campbell, 2004).

The hindering of research information to protect the for-profit interests of sponsors is another important implication of academic capitalism (Gladieux & King, 1999; Campbell & Slaughter, 1999; Slaughter et. al., 2002). Private sponsors invest in applied research aimed to commercialization through patents, which demand secrecy according to patent law. However, secrecy is at odds with the public demands of higher education to disseminate knowledge and with the academic community of scholars, whose traditional form of knowledge dissemination is publication in peer-reviewed journals. In fact, there have been conflicts over intellectual property between faculty members, administrators, industry representatives, and graduate

students, leading to court cases and resignations of faculty members (Aguilar, 2000, Grimshaw, 2001; Marcus, 1999).

Implications for the Academic Profession

Academics in the various disciplines organize their lives in relation to the intellectual tasks in which they are engaged:

> The attitudes, activities, and cognitive styles of groups of academics representing a particular discipline are closely bound up with the characteristics and structures of the knowledge domains with which such groups are professionally concerned. (Becher 1989, p. 20)

Powel & Owen-Smith (2002) portray the image of the postmodern life scientist at a research university in his quote:

> The traditional view of the university researcher as a dedicated and disinterested, though passionate, searcher for truth is being replaced in the life sciences by a new model of the scientist-entrepreneur who balances university responsibilities and corporate activities in the development of new compounds and devices designed to both improve human health and generate revenues for the investigator, the university, and investors. (p 108)

The above illustrates the new character that academic capitalism has brought to the academic profession, especially in those disciplines aligned with the market.

Slaughter and Leslie (1997) explain faculty members' engagement with academic capitalism through resource-dependency theory, which is based on the premise that internal behaviors of organizational members are understood through the actions of external agents. In the case of higher education, the external agents are the policymakers who aim to cope with global economic competition and are thus forcing higher education to compete for new sources of resources targeted to specific areas of R&D in applied fields. Since most faculty members teach and many perform public service but fewer win competitive research funds from government or industry, research is the activity that differentiates universities, where elite departments are defined in terms of excellence in scholarship and originality in research (Becher, 1989). Thus, research funds bring material gain and prestige to universities and push

them to engage in academic capitalism. In resource-dependency theory, faculty members will turn to academic capitalism to maintain research resources and maximize prestige. Becher (1989) portrays the significance of prestige to faculty as:

> It is sometimes argued that research endeavor is sustained by a concern for the disinterested pursuit of truth and spiced with the joy, which comes from a new discovery or an enhanced understanding. Whether or not this is seen as a matter of pious but unsubstantiated belief, another more direct motivating force is identified by many who have given careful thought to the issue: namely the need to earn professional recognitions. On this view, the main currency for the academic is not power, as it is for the politician, or wealth, as it is for the businessman, but reputation. (p. 52)

Becher (1989) offers an alternative framework for addressing the increasing tendency of faculty members to engage in academic capitalism. Becher distinguishes what individuals in groups do—operational mode—and what their values, aspirations and loyalties are—normative mode. In the case of academics, on the one hand, the peer group represents the academic community in its normative mode, where the predominant concern is to establish standards, assess merit, and evaluate reputations. On the other hand, partnerships with the private sector represent its operational mode, whose focus is on the development and commercialization of knowledge. In this framework, tensions between industry and social logics are represented by the interconnections of the normative and operational modes where knowledge developments with industry are tested against professional norms. The normative and operational modes are interdependent: significant changes in one will tend to be reflected in changes in the other (Becher, 1989). For example, academics are expected to foster and disseminate basic and applied knowledge as part of their social mission—normative mode. However, some of the direct implications of industry-university partnerships—operative mode—documented in the literature include overemphasis in applied research and secrecy of knowledge (Gladieux & King, 1999; Campbell & Slaughter, 1999; Slaughter et al., 2002).

Empirical studies have shown that faculty members believe that the collaboration between government, industry, and academia brings benefits to the latter, such as providing faculty with opportunities to do research, contracts to fund students, networking for future funding, and equipment gains, as well as recruitment of faculty and staff from clients, services contributed by project personnel, spillover to research and teaching, and employment opportunities for students (e.g. Slaughter & Leslie, 1997; Slaughter et al., 2002; Slaughter & Rhoades, 2004). According to these studies, faculty members perceive that the collaboration between government and industry through centers dedicated to fundamental research is very beneficial because these structures allow long-term and big projects, which is what academics prefer.

Faculty members nowadays have a clear sense that the boundary between academia and industry has changed. For many faculty members, the "wall" between industry and academia is not present anymore, which opens the possibility to a host of opportunities but also to surprises and even to dangerous situations for the integrity of the academic profession (Slaughter et al., 2004). For example, federal funding, which was very prestigious in the past, is losing its value, and faculty members are now interested in funding regardless of source because federal grants have become more competitive while industrial grants are becoming more widely available and easier to obtain (Slaughter et al., 2004). In any case, participants in these studies agree that long-term research sponsored by federal grants is more desirable and that industry is less willing to invest in such long-term projects. The following quotes reflect some of these perceptions:

> In the past, involvement with industry was "dirty" or polluting; in the present, federal grants continue to be regarded highly, but funding is increasingly valued regardless of the source. (Slaughter et al., 2004, p. 159)

> The highly prized, abundant, and unrestricted federal funds of the past have become less highly prized, not only because of their relative scarcity, but also because of their decreases in intrinsic monetary value as measured by the ability to fund graduate-student workers and by the amount

> of time required to administer them. (Slaughter et al., 2004, p. 135)

Similarly, Slaughter et al. (2004) report that faculty members believe that basic research in the past was more valued than applied research but that now there is a movement to attend to industrial demands. In other words, basic research is still considered important, but the boundary between basic and applied is not as clear as it used to be. However, differences in these perceptions exist across disciplines: participants from professional schools—like those in medicine and engineering—believe that basic science is important but that the purpose of research in their fields is useful applications. Other studies have documented a significant effect of academic capitalism in the fostering of a hierarchy based on prestige and salary differences between faculty members involved in the commercialization of research and faculty members who are not. As a result, those faculty members who are left behind tend to have heavier teaching loads, as well as lower salaries and prestige (Campbell & Slaughter, 1999; Slaughter & Leslie, 1997).

Financial changes have also affected the way academics distribute their time. Given that they see their greatest potential source of additional revenues in grants and contracts with the government and the private sector, faculty members in research universities and applied fields are spending any marginal time in writing proposals, patenting, and developing and maintaining relationships with potential donors: in other words, in market-like activities. Over time, faculty members end up spending a significant amount of time acquiring an expertise to recognize the commercial value of their science, locating commercial partners, and negotiating contracts (Slaughter & Leslie, 1997).

According to Slaughter et al. (2004), the three areas where the greatest disputes emerge between academia and industry are publishing versus patenting, secrecy versus access, and contested ownership over intellectual property. In addition, these points usually create tension between faculty and their institutions as administrators attempt to generate revenues from the

research carried out by faculty members (Mendoza & Berger, 2005). Studies demonstrate that faculty members consider publishing more valuable than patenting despite the pressure by university administrators to generate streams of revenue from the commercialization of research (e.g. Campbell & Slaughter, 1999; Gladieux & King, 1999; Mendoza & Berger, 2005; Slaughter et al., 2004):

> An associate professor of physics communicated a similar hierarchy: Patents were "like icing on a cake. You have to have the cake first." And research was the cake. (Slaughter et al., 2004 p. 141)

According to Slaughter et al. (2004), one of the reasons for faculty members' reluctance to patent is the perception that the chances of making significant monetary profits from a patent are slim. Moreover, younger professors cannot afford long waits on publishing. In this study, some professors thought that, in some instances, industry was seriously blocking the free flow of knowledge, including new discoveries. However, sometimes the stakes are high when faculty members have developed long-term and elaborate relationships with industry that forces them to maintain knowledge secret. Despite this, the majority of professors believe that it is possible to publish and patent simultaneously; this is especially true for established faculty with long-term programs. Also, a way in which professors deal with secrecy of knowledge is by removing confidential data from theses and publications. These professors were convinced that this practice did not compromise the integrity of the science, which suggests that, despite industrial contracts and universities' policies to control faculty behavior, faculty members seem to be able to manipulate the situation in order to protect their integrity as researchers. For the most part this is possible because, after all, faculty members are the experts and their sponsors or employers do not know enough to regulate them (Slaughter & Rhoades, 2004).

Several scholars have expressed their worries about the time spent by faculty members in academic capitalism and away from their labs, students, and university service (Gumport, 2002; Kerr, 2002; Milem, Berger & Dey, 2000; Slaughter & Leslie, 1997). For example, Lee & Rhoads (2003) show that faculty members who use external funding for their research tend to

be less committed to teaching than faculty members who do not, and that large research institutions that generate and expend the most research dollars are especially prone to neglect undergraduate instruction. Kerr (2002) suggests that there seems to be a point of no return after which research and consulting become so absorbing that faculty members can no longer concentrate on undergraduate instruction. In the same vein, Milem, et al. (2000) found that faculty members at all types of institutions are spending more time on research and less on advising and counseling students. Milem et al. expressed their concern about this finding, given the ample evidence that supports the importance of out-of-class contact with faculty members as a key positive source of influence on student outcomes (e.g., see Astin, 1977, 1993; Feldman & Newcomb, 1969; Pascarella & Terenzini, 1991).

Implications for Graduate Students

The number of doctorates rose from 239 in 1900 to 9,733 in 1960 (Griggs, 1965). However, the growth of earned doctorates has never been as dramatic as it was during the 1960s, when the number of earned doctorates grew to 29,498 in 1970 (National Research Council, 1986). Throughout the 1980s and 1990s, the number of doctoral graduates was stable at around 31,000 per year and 44,000 per year respectively (Fagen & Wells, 2000). Despite the significant grow of doctoral graduates since the 1960s, research pertaining to graduate education started to appear only in the mid 1970s. Malaney (1988) reviewed the literature on graduate education from the mid 1970s to the mid 1980s and concluded that, by far, the most prolific area of research in that period was the matriculation of graduate students, followed by the prediction of success and performance, gender differences, and graduate assistants. Other studies published at that time tackled issues about standardized tests, employment, minorities, anxiety, attitude towards research, attrition, faculty-student interaction, and departmental characteristics and administration (e.g. Cartter, 1976; Duncan, 1976; Furst & Roelfs, 1979; Herbert & Holmes, 1979; Toombs, 1977; Valdez, 1982).

During the last decade, research on graduate education has mainly focused on issues of retention and attrition (i.e. Girves & Wemmerus, 1988; Golde, 1996; 1998; 2000; Lovitts, 1996; 2001; Nerad & Miller, 1996; Tinto, 1993 minorities and gender (i.e. Curtin, 1997; Leslie, McClure, & Oaxaca, 1998; Sax 2001), adequacy of graduate programs for the challenges of professional careers (i.e. Astin, 2002; Gaff & Pruitt-Logan, 1999; Golde & Dore, 2001; Haworth, 1996; LaPidus, 1998), admissions, accountability, outcomes and assessment (i.e. Baird, 1996; Bilder & Conrad, 1996; Hagedorn & Nora, 1996; Haworth, 1996), and demand (i.e. Golde & Fiske, 1997; Syverson, 1996), as well as phenomenological studies aiming to understand the experience of graduate students (i.e. Anderson, 1998; Fagen & Wells, 2000; Golde 2000, Mendoza, 2004). However, it is surprising that, although most doctoral students have held assistantships, little research has been conducted regarding this area. Moreover, most of the research on graduate assistantships until now has been in the area of teaching assistantships, despite the fact that the majority of funding goes to research assistantships: For example, of all doctorate recipients in 1983, 40%—and 70% in the physical sciences and engineering—received research assistantships (Hauptman, 1986).

Results from the National Association of Graduate-Professional Students (NAGPS) survey (Fagen & Wells, 2000) and Golde (1998) demonstrate the relevance of adequate funding in doctoral persistence. According to these studies, graduate education in science is linked with the research enterprise and availability of funds sponsored by the government or industry. Therefore, students tend to be more satisfied with funding in science and engineering because there is more funding available in these fields (Fagen & Wells, 2000; Golde, 1998). Today, industry-sponsored research, which supports a significant portion of the research assistantships in science and engineering, and graduate education have become a main goal for universities in the top tier. Moreover, institutions in the lower tiers are trying to emulate top-tier research universities where research funds have become a professional imperative for faculty members (Gumport, 2002). As was narrated above in the historical development of academic capitalism,

this trend began in the 1970s as the political economy shifted from one of welfare and warfare to neo-liberal committed to global market competition through investments in corporate productivity and university-industry collaborations.

This new social-economic arena has brought changes to graduate education; graduate students have become valuable labor for industry representatives in those fields where academic capitalism is significant (Slaughter et al., 2002). Graduate students possess valuable research skills that help them meet the new demands of the global market, and, as a consequence, industry representatives have supported graduate students through assistantships (Slaughter et al., 2002). From a professor's perspective, the exchange of graduate students consolidates his or her relationship with the corporate sponsor for future contracts that will enhance his or her prestige and resources. In other words, "Graduate students [as tokens of exchange] were the faculty members' "gifts" to industry; industry's gifts to the faculty were resources for research, ranging from equipment to money, which was most often attached to the support of graduate students" (Slaughter et al., 2002, p. 285).

The influence of academic capitalism on graduate students is relevant to Sanford's concern, expressed back in 1976, regarding the change in the nature of graduate education. Sanford noted that the motivation of graduate students and faculty members was less purely intellectual and more professional in a more and more competitive environment, and that students were being seen more as resources than future intellectual leaders. More recently, Gumport (1999) expressed similar concerns:

> A less visible and potentially more profound transformation concerns the way in which changes in federal sponsorship of research and graduate education have accompanied changes in the nature of student/faculty relationships during research training, especially for students in sciences. While the historical ideal entailed a student working "at the bench" with a mentor, sponsored research is now the central medium for supervision and collaboration. (p. 418)

According to Gumport (1999), academic capitalism has fostered this tendency even more as faculty members have become more like project managers and administrators than mentors and students are being supervised in a more directed manner, treated as employees and technicians rather than apprentices. However, Slaughter et al. (2004) indicate that professors in their study understood that graduate students were cheap labor but valued them primarily as apprentices and future colleagues. Today, academic capitalism is inevitable in sciences and engineering, where most of the research is conducted through research groups and expensive equipment (Slaughter & Leslie, 1997). In this context, it is critical for the student to connect with a sponsored research group as soon as possible. This burden can discourage students, especially if they are not attracted to the research groups with funds, to the point that some science students report having enrolled in the wrong department (Golde, 1998). Therefore, additional empirical evidence is needed in order to comprehend the implications of academic capitalism for student-advisor relationships and student involvement with a research group, given that both are considered strong predictors of doctoral retention (Golde, 1998).

Slaughter et al. (2002) conducted the only empirical study yet designed to analyze the impact of academic capitalism on graduate students. However, other studies focused on faculty members have found evidence of impact on graduate students as well. Some of the greatest concerns found in these studies refer to the adequacy of training of graduate assistants who are working with industry representatives (e.g. Campbell & Slaughter, 1999; Gumport, 1999; Slaughter & Leslie, 1997; Slaughter et al., 2002). For example, Gumport (1999) portrays the type of research in which graduate students are now involved in short-term projects under private grants with less leeway for mistakes and that demand more competition and pressure to produce better results.

The adequacy of graduate programs is a topic that has been investigated in many other contexts but not in that of academic capitalism. In general, there is a growing concern regarding the quality of training of future faculty, as Gaff and Pruitt-Logan (1999) express:

> We have never really prepared graduate students to become college professors. Traditional doctoral study is designed to give graduate students the capacity to conduct original research. This is a necessary but insufficient condition for faculty success. (p. 77)

A number of scholars have stated that traditional doctoral programs are not training faculty for the challenges of today's academic profession (e.g. Astin, 2002; Golde & Dore, 2001; LaPidus, 1998). The modern academic profession encompasses a series of tasks beyond teaching and scholarly research such as curriculum design, student advising, service, and getting financial support through grants and contracts. In addition, faculty members have to learn the complexities of running modern academic institutions—strategic planning, student and faculty recruitment, financial aid, fundraising, and budgeting—to be able to contribute to their role in shared governance (Birnbaum, 1989). Other important areas of the academic profession that are not included in traditional doctoral curriculums are academic freedom, tenure, and the idea of a liberal education (Golde, 2000). Finally, another fact reflecting the inadequacy of graduate training for future faculty is that only 102 universities produce 80 percent of the faculty hired in a diverse collection of 3,500 institutions with different missions, types of students, expectations from faculty, and cultures (Gaff & Pruitt-Logan, 1999). The NAGPS survey reflected similar results: 62% of the respondents reported having received insufficient guidance to prepare them for non-academic careers and 30% reported insufficient guidance for academic careers; only half of the respondents said they were encouraged to gain additional skills through internships and coursework outside their program (Fagen & Wells, 2000).

Going back to the results reported by Slaughter et al. (2002) on the impact of academic capitalism on graduate students, the involvement of graduate students with applied projects sponsored by industry might undermine the need for basic research in their training. In fact, professors in this study consider basic and fundamental research essential for doctoral training, though these concerns are less evident in applied fields such as engineering or medicine. Therefore, as a way to protect the quality of graduate training, some of these faculty members

say they prefer graduate students to work with industry in challenging problems that could make fundamental contributions to the field.

Other arguments found in the literature against graduate training through industry partnerships include the type of values indirectly transmitted by applied projects. For example, graduate students involved in industry-sponsored programs might be less likely to be encouraged to think about problems that benefit the public or problems that are unlikely to result in profits. As a result, graduate students might be likely to be committed to a new culture of science and research that promotes profit-making and benefits elite universities and multinational corporations (Gumport, 1999).

Other issues documented in empirical studies regarding graduate students and academic capitalism are intellectual property secrecy and potential intellectual exploitation (Campbell & Slaughter, 1999; Slaughter et al., 2002). Graduate students are knowledgeable, bright and inexpensive labor, and can therefore be targets of potential exploitation. For example, graduate students usually engage in the creative process of product development, and, in some cases, their doctoral dissertations are alternatives to patents. Under these circumstances, faculty members can face three types of conflict: when the professor realizes potential profits from his or her research involving graduate students; when the professor is both the owner of a corporation and the advisor of a dissertation project; and when faculty members use federally subsidized graduate-student labor for work on projects that were intended to become private profit-making (Martin & Siehl, 1983). Secrecy is at the heart of the first and second type of conflicts, especially in cases when students' dissertations are part of a major breakthrough that could bring profits. The third conflict is manifested between the professor and the public because the professor has the potential of making profits using students subsided by the federal government.

As disclosure and patenting increase, concern has grown about the timely publication of graduate students' work (Slaughter et al., 2002). If the corporation that is financing a student is

pursuing a patent out of his or her research, the student might have to wait until the patent is issued before he or she can submit the dissertation; this may mean a wait of one to three years (Gumport, 1999; Slaughter et al., 2002). In an extreme case, graduate students might not be even able to talk about their research experience when applying for jobs or show a record of publication due to secrecy demands from sponsors. In the early 1990s, after a number of cases were reported about patenting procedures affecting students' careers, some university representatives issued a series of guidelines preventing students' dissertations to be delayed more than six months. Despite these efforts, faculty members still see the withholding of publication as a problem for graduate students' dissertations because these are by definition public (Slaughter et al., 2004).

One final issue attached to the commercialization of research involving graduate students is the fair distribution of revenues to inventors. There have been disputes over ownership of intellectual property and distribution of benefits between professors and students (Grimshaw, 2001; Marcus, 1999). Gumport (1999) illustrates these cases:

> Clearly, tensions are heightened in university-industry collaboration: while the exploitation of students for a faculty member's academic advancement is historically grounded in the university research system, it is another matter for a professor to profit financially from a student's work on a commercial venture. (p. 419)

Nevertheless, for graduate students eager to work with industry patenting could represent an opportunity for networking, experience, and credentials whereas, for a student who wants a more academic type of career, publication delays represent a serious obstacle and a betrayal (Slaughter et al., 2002). In any case, the impact of academic capitalism on graduate education raises questions about the purpose of graduate training. Whether graduate academic institutions are educating graduate students to become industry leaders, researchers or faculty members, more research is needed in this area to clarify the mission of graduate training in the global economy.

As reviewed, the changes to faculty and graduate students due to academic capitalism occur in specific organizational and professional contexts. The following section discusses these differences across disciplinary boundaries.

Academic Capitalism in Organizational and Professional Contexts

The Kolb-Biglan classification of disciplines (Kolb, 1981) serves as a general map to situate the different contextual disciplines in higher education. This framework places most of the disciplines within a continuum of a two-dimensional plane, with one axis being applied-pure and the other being soft-hard (Figure 2.2). At the hard-pure end are located the natural sciences and mathematics; at the pure-soft, the humanities; at the hard-applied, engineering; and at the soft-applied, social professions (Becher, 1989). Both hard-pure and hard-applied disciplines are expensive and depend heavily on external funds, which opens the way for political and commercial intervention. This intervention usually has an emphasis on work considered useful at the expense of other areas of inquiry whose direction is determined by predominantly epistemological considerations (Becher, 1989).

As it was discussed above, given the current global economy and its impact on federal funding policies, the need for funds in these fields has forced faculty members to engage in market-like behaviors (Slaughter & Leslie, 1997). As a result, the less seemingly applied sciences run the risk of decreasing support while the applied fields run the risk of being manipulated by external sponsors. Elzinga illustrates this point by saying, "In any case is the tension between utility and freedom, between steering and serendipity" (1987 in Becher, 1989, p. 167). On the other hand, pressures for funding are noticeably less intense at the end of the soft-pure domain that "deals with inapplicable, largely atheoretical knowledge, involving the study of the particular rather than the general and the search for empathetic understanding rather than causal explanation" (Becher, 1989 p. 146). Soft-applied disciplines are also susceptible to non-academic influences through industrial sponsorship and consultancy and by government

and state agencies that tend to promote certain types of research related to their political agendas (Becher, 1989).

Major research and graduate-oriented universities, particularly medical schools, have been the main organizations to benefit from shifts in federal funding. According to the National Science Foundation, around 80% of federal support for R&D has been highly concentrated on just a hundred of doctorate-granting institutions. Similarly, within research universities, disciplines such as engineering, agricultural sciences, and applied basic sciences gain the largest share of R&D funds (Slaughter & Leslie, 1997).

These disciplines benefit not only from federal funding but also from industry representatives willing to form partnerships with faculty members attracted by such federal funding and research opportunities with commercial potential. In sum, those organizational and professional contexts close to the market—research universities, certain disciplines—have the highest federal and private financial support and potential for revenues from commercialization of research. For example, life scientists have found a niche in the market through fields such as biotechnology, which have gained strong political support (Zusman, 1999). Roughly 54% of total private and public expenditures for academic R&D go to the life sciences. Today, the commercialization of research in the life sciences is not only an accepted activity but also a key part of some research universities' mission (Powel & Owen-Smith, 2002).

Government preferences in promoting certain fields bring prestige and resources to the favored disciplines; thus hard-pure fields tend to enjoy the highest prestige. In general, hard disciplines have more prestige than soft ones, and pure disciplines more than applied fields (Becher, 1989). Similarly, each discipline has its own concept of success as a vehicle for prestige. In technical fields what counts for success can be discovering or inventing a product, while in the social sciences consulting activities are highly regarded. Nonetheless, in most disciplines credit is earned by publishing in peer-reviewed journals (Becher, 1989).

Significant differences in terms of norms and practices exist across the hard-soft and applied-basic spectrum of types of research as defined by Becher (1989). However, despite these differences, the academic profession possesses a set of common values across disciplinary and institutional boundaries (Kuh & Whitt, 1986). In the same vein, reward structures in the academic profession are based on prestige and symbolic recognitions such as publications and awards. On the other hand, industry representatives hold values according to business and managerial models of product development, efficiency, risk-taking and monetary rewards. Thus, even in those fields that by the nature of the discipline itself are closer to industrial interests and needs, there are significant differences between these disciplines and industry.

As graduate students have been increasingly involved in research assistantships sponsored by the private sector, concerns have also increased regarding the cultural socialization processes of graduate students who are socialized in departments heavily involved with industry and work in projects with commercial aims (Campbell & Slaughter, 1999; Gumport, 1999; Slaughter et al., 2002). Given the relevance of socialization processes to graduate students in light of academic capitalism, the following section reviews a theoretical framework for this dissertation based on cultural socialization and sensemaking perspectives.

Organizational Culture and Academic Capitalism

Organizational culture has become one of the most active arenas of scholarly and practical research as an interpretative framework that captures what is not included in formal documents and procedures (Peterson & Spencer, 1990). Cultural perspectives, which are based on phenomenological traditions, have been useful in approaching the complexities of organizations where uncertainty and ambiguity are common features (Kuh & Whitt, 1988). Similarly, cultural perspectives have been proposed as lenses through which the non-rational character of organizations becomes clear and even manageable (e.g. Dill 1982; Masland 1985; Tierney, 1988).

The numerous approaches and typologies found in the literature for understanding and studying organizational culture can be grouped generally under four broad categories: 1) geospatial, which looks at the physical structure of organizations; 2) traditions, myths, artifacts, and symbolisms; 3) behavioral patterns and processes such as routines and ceremonies; and 4) espoused versus embedded values and beliefs (Peterson & Spencer, 1990). This study mainly focuses on the values and beliefs acquired by graduate students in science and engineering through socialization processes in light of academic capitalism.

The following sections develop a conceptual framework beginning with an overview of organizational culture applied to higher education and continue with a discussion of academic culture in light of academic capitalism. Then, a description of socialization processes with emphasis on sensemaking is presented with the goal of understanding the dynamics of socialization processes and its potential influence on doctoral attrition and cultural changes of the academic profession due to faculty members who socialize throughout graduate school in departments where industry-sponsored research is significant.

Organizational Culture in Higher Education

Organizations are social constructions (Blumer, 1969; Burke 1966; Mead 1934; Schutz, 1970) with formalized structures such as policies, rules, and decision-making committees, but, just as importantly, they have informal codes and expectations shared by organizational participants (Wanous, 1992). These shared understandings and the processes used to develop them constitute what is known as organizational culture (Tierney, 1988). Smircich (1983) defined culture as the social glue, based on shared values and beliefs, that holds organizations together. In general, culture serves four general purposes: 1) it conveys a sense of identity; 2) it facilitates commitment to an entity; 3) it enhances the stability of a group's social system; and 4) it is a sensemaking device that guides and shapes behavior.

Some of the properties of culture identified by Schein (1985) are observed behavioral regularities, norms, values, the philosophy that guides an organization's attitudes and actions

towards employees or clients, rules for getting along in the organization, and the way in which members of an organization interact with those outside the culture. Though it is dynamic and continually evolving, organizational culture is nevertheless stable enough to be identified. A certain level of perpetuation of the dominant norms and values gives stability to organizations in order to maintain their basic structures through turbulent times, as has been the case in higher education (Kuh & Whitt, 1988).

Schein (1985) developed a framework based on the premise that the essence of culture is the tacit assumptions and beliefs that influence the way a group of people think and behave. Schein's framework for culture includes three levels: artifacts, values, and basic assumptions and beliefs. At the first and most superficial level, artifacts are the symbols representing the underlying culture: rituals, norms, formal and informal rules, routine procedures, customs, folkways, myths, ceremonies, interaction patterns, signs, and language. Values are the widely held beliefs about goals, activities, relationships, and feelings. The third and deepest level corresponds to the unstated basic assumptions and beliefs at the core of a culture that are taken for granted and are difficult to identify. However, Trice (1985) argues that ceremonials consolidate an amalgam of cultural forms and thus offer a prominent window through which different levels of organizational culture can be viewed.

Following the above definitions and characterizations of organizational culture, Kuh & Whitt (1988) draw from the works of Allaire & Firsirotu (1984), Becher (1984), and Clark (1970) to provide a framework for analyzing the culture in higher education. This framework is a four-layered analysis that portrays culture in institutions of higher education as a dynamic system shaped by the interplay of these cultural layers. The four layers in question are: the external environment that surrounds a given higher education institution, the institution itself, subcultures within the institution, and individual actors.

The external environment layer is characterized by the continually evolving nature of colleges and universities according to the interactions between conditions in the external

environment and the needs and concerns of groups within the institution (Tierney, 1988). The institutional layer refers to the different cultures present across types of higher-education institutions. Some elements involved in institutional culture include size and type as well as institutional mission, leadership, and symbols used to communicate values (Kuh & Whitt, 1998). For example, evidence suggests that department chairs' beliefs regarding the importance of teaching and research in faculty rewards differ by type of institutions (Fairweather, 1993). In fact, research is valued the most at research universities, whereas in liberal arts colleges the highest value is given to interaction with students (Clark, 1987).

Numerous subcultures operate within higher education institutions and correspond to the third layer of Kuh & Whitt's framework (1988). Administrators, faculty, and students are the three most predominant subcultures in higher education. In addition, there are subcultures within these groups, such as discipline-based among faculty, professional among administrative staff, and minority associations among students (Tierney, 1988). Another example is the case of subcultures within disciplines formed around people with different views about the discipline, as it might be the case between clusters of professors who are more entrepreneurial and who hold values that differ from their colleagues' views (Slaughter & Leslie, 1997). Conflicts and tensions between subcultures are common, as is the case between administrators and faculty when administrators tend to hold a managerial (Rice, 1986) or utilitarian (Etzioni, 1961) culture in opposition with faculty members' core values of discovery and dissemination of knowledge through autonomy and academic freedom (Mendoza & Berger, 2005; Peterson & Spencer, 1990). Individual actors, such as presidents and heads of departments, also shape the culture of a group. In sum, all agents participate in the construction of a culture, and in some cases some individual actors have a significant influence on shaping a given unit's culture. Some individual factors to consider in the shaping of a culture include demographic characteristics such as age, gender, race, and ethnicity (Kuh & Whitt, 1988).

Schein (1985) offers a suitable framework to understand subcultures within subcultures. According to Schein, culture exists in "any size of social unit that has the opportunity to learn and stabilize its view of itself and the environment around it" (Schein, 1985, p. 8). For example, if a group of people have shared a significant number of important experiences in responding to problems imposed by the external environment or by internal conflicts, such common experiences will probably encourage the group to develop a similar view of the institution and their place in it. In addition, the values system of a group may differ from that of the host culture, providing further bonding for that group. Schein identified at least three types of subcultures that could exist in a dominant culture: enhancing, which adheres to the institution's core values more than the rest of their members; orthogonal, which accepts the core values of the institution and has another set of values that does not conflict with the core values; and counterorthogonal, which opposes the core values of the institution.

Discipline-based and departmental subcultures are the primary source of faculty identity and expertise (Becher, 1984). Elements of disciplinary subcultures include assumptions about what is to be known and how, about the tasks to be performed and standards for effective performance, and about patterns of publication, professional interaction, and social and political status (Becher, 1984; Clark, 1984). Some scholars assert that differences across disciplines have greater impact than similarities among faculty members (Becher, 1989). Moreover, Bowen and Schuster (1986) found that differences among faculty members were more related to the discipline than to the type of institution. Faculty culture is also influenced by the degree of commitment to a discipline or to an institution: for example, faculty members are considered cosmopolitan if they have a stronger commitment to the discipline and local when they exhibit a strong commitment to their institution. Similarly, faculty culture can be affiliated to traditional or emerging paradigms that might affect the norms about how to conduct research. In sum, Becher (1989) illustrated the nature of the academic profession as a multitude of academic tribes and territories of a widening array of disciplines and specialties.

Despite the cultural differences within disciplines, departments are the main structure of higher education and their culture is what faculty members identify with in the first place (Becher, 1989). In addition, there is an overarching core culture of the academic profession based on the concepts of academic freedom, individual autonomy, production and dissemination of knowledge, collegiality, collegial governance, service to society through the production of knowledge, and education of the young (Clark, 1980; Kuh & Whitt 1986; Morril & Speed, 1982; Ruscio, 1987). This general academic culture provides a general identity to scholars (Clark, 1984).

Academic capitalism might be fostering shifts in the culture of the academic profession especially in those disciplines where partnerships with industry are significant. In other words, some faculty members participating in academic capitalism might move away from values such as altruism and public service toward market values according to the individual faculty member's culture as shaped by the interplay of organizational, disciplinary, and individual subcultures. Slaughter and Leslie (1997) state that,

> For academic scientists, priority of discovery was the goal and publication the means through which new knowledge was shared in a timely fashion. . . . In contrast, patents were the coin of the realm in the world of commercial science, where rewards were pecuniary and the incentive to divulge new information quickly was not as potent. (p. 183)

Issues regarding intellectual property secrecy provide a clear example of the incompatibility between the academic and industrial cultures. For private sponsors, secrecy of new knowledge is essential for their survival in the competitive market through patents. At the same time, secrecy is in contradiction with academic traditional value of knowledge dissemination, where academic publishing is encouraged to be free and fast in order for new results to be shared with the community of scholars (Merton, 1957).

Rewards structures constitute another area where most of the differences between industry and academic cultures exist. Historically, academia has looked at discovery,

publication and prestige as the profit, not the monetary rewards that come with patents. In reality, the main attraction of monetary revenues to faculty members is that it provides them with resources to conduct more research (Mendoza & Berger, 2005; Slaughter & Leslie, 1997). In other words, the academic professional engages with a community of practice whose activity has meaning in itself, not just in the output or profit that results from it. Professions such as academia provide intrinsic motivations as well as the glories of high status and power. In particular, the academic profession is abundant in resources of intrinsic motivation through the fascination of research and the enchantments of teaching (Clark, 1987).

The studies by Agrawal and Henderson (2002) and by Mendoza and Berger (2005) illustrate the significance of reward systems in the involvement of faculty with entrepreneurial activities. In order to address the degree to which patents filled by faculty members are representative of the amount of knowledge transferred to society, Agrawal and Henderson (2002) conducted a study of faculty patents in the Electrical and Mechanical Engineering Departments at the Massachusetts Institute of Technology (MIT), which holds most of the patents filed by universities. Most of the faculty members surveyed estimated that patents account for less than 10% of the knowledge transfers from their labs. Moreover, only 10–20% of the faculty in this study patent their discoveries at least one time per year over a period of 15 years, and nearly half of the faculty has never patented, in contrast to 60% of the faculty who publish in any given year. Finally, for those who patent, their patents represent only 7% of the total knowledge produced. Similarly, Mendoza and Berger (2005) conducted a study to explore the differences across intellectual property (IP) policies among nine research universities as potential sources of influence on faculty engagement in for-profit research ventures according to existing models of faculty role performance and achievement. According to this study, faculty members continue to be driven by the traditional rewards of the academic profession and are willing to engage in patenting if it does not interfere with the traditional academic norms and rewards such as publishing and conducting basic research. Despite the increasing trend in

higher education to commercialize research, these results suggest that faculty members involved in for-profit endeavors are still a minority, and that, in the case of those who are involved in patenting, patents represent a small portion of their total research. Similarly, Campbell and Slaughter (1999) argue that faculty members approach industry-sponsored research as professionals who strive to maintain norms such as rationality, impartiality, and objectivity rather than allow themselves to be influenced by potential financial gains.

This perspective agrees with the study by Slaughter and Leslie (1997), in which faculty members involved in commercial ventures did so not for individual monetary benefits but to seek money for their unit, do science, and serve the common good. Nevertheless, some faculty members in this study revealed that their new focus in commercialization of research was somewhat at odds with the traditions, status, and prestige systems of their research universities. Slaughter and Leslie concluded that only well-established faculty members were willing to engage in technology transfer. For these faculty members, creating knowledge for profit did not contradict their commitment to altruism and public service. Instead, they saw the market as a mechanism for the distribution of their discoveries to society. However, faculty members engaged in commercial ventures interviewed by Slaughter and Leslie (1997) understood that if they were to maximize the rewards from technology transfer they had to acquire market and business skills. Following Schein's framework, faculty members who decide to go down the entrepreneurial path foster an orthogonal subculture within their disciplines, holding values from both the business and the academic cultures.

The sections above present a general overview of organizational culture perspectives applied to higher education with emphasis on the influence of academic capitalism on the academic profession. However, in order to gain a deeper understanding about organizational culture, it is important to examine the dynamics of culture and how it is transmitted to new members in an organization. In any organizational setting, dominant values and norms are transmitted to new members through socialization processes, as is the case in academic

disciplines (Becher, 1989; Tierney & Rhoads, 1993). Faculty members' identification with a particular discipline is developed by means of a socialization process that starts in graduate school and continues throughout their first years as junior faculty members (Bess, 1977; Clark, 1984; Freedman, 1979; Tierney & Rhoads, 1993). During this socialization process, faculty members internalize the canons of the specialty, the symbolic meanings of professional activities, their intellectual traditions and style, and their language, folklore and patterns of relationships (Becher, 1989). The following section discusses socialization processes in academia and the effects of academic capitalism on doctoral socialization and the early socialization stages of potential future faculty members during graduate school.

Organizational Socialization, the Academic Profession, and Doctoral Education

Tierney and Rhoads (1993) define organizational socialization as a "ritualized process that involves the transmission of culture" (p. 21) through a mutual adaptive process between the organization and individuals. During socialization processes individuals acquire the values, attitudes, norms, knowledge, and skills needed to exist in a given organization (Merton, 1957). For new members, socialization is the process of learning what is important and expected in their entering organization (Schein, 1968). Socialization processes occur both formally and informally (Tierney & Rhoads, 1993). Formal socialization relates to activities specifically designed for new members by leaders in the organization, while informal socialization refers to more laissez-faire experiences where the norms of the organization are learned through trial and error.

Formal socialization is explicit and includes faculty development programs as well as promotion and tenure processes. However, most of the time, socialization occurs informally. Informal socialization is difficult to observe and analyze since it can occur through informal contacts such as informal conversations with senior faculty members over coffee or by observing the actions of faculty in leadership positions. For example, young faculty members learn how to act in meetings from the behavior of older colleagues; junior faculty members may

always hear their peers talk about the importance of publishing while never mentioning service, which would contribute to the notion that service is not as valued (Tierney & Rhoads, 1993).

Based on the work of Van Maanen (1976), Tierney and Rhoads (1993) offer a framework for understanding faculty socialization. This framework consists of two stages: anticipatory and organizational. Anticipatory socialization occurs during graduate school, where individuals learn attitudes, actions, and values about the faculty group in his or her discipline and the profession at large. The organizational stage occurs as faculty members embark on their academic careers and build upon the anticipatory socialization of the recruit. During anticipatory socialization, "as young scholars work with professors, they observe and internalize the norms of behavior for research as well as supporting mechanisms such as peer review and academic freedom" (Anderson & Seashore-Louis, 1991, p. 63). For example, faculty members learn from mentors and peers in graduate school about how to interact with students and colleagues, as well as about the types of journals and books to read and conferences to attend. The organizational stage has two phases: initial entry and role continuance. During the entry phase, individuals go through the formalities of the recruitment and selection process and early stages of organizational learning starting upon employment. The continuance role begins once the new member is formally established in the organization.

The organizational socialization stage is usually framed by the experiences during anticipatory socialization because individuals learn during their training what it means to be a member of an organization. However, this learning might be at odds with what he or she ultimately finds at the chosen institution (Tierney & Rhoads, 1993). Therefore, the organizational socialization stage might reaffirm what a new faculty member learned during the anticipatory socialization if his or her graduate school and entering setting hold similar cultures and structures; otherwise, the entering organization will try to modify the new faculty member's qualities (Tierney & Rhoads, 1993). For example, according to Tierney and Rhoads, a new faculty member who has been trained in a research university and goes to a liberal-arts college

could have socialization mismatches at the organizational stage given the differences in teaching and research values at both types of institutions.

Braxton and Berger (1999) found that faculty adjustment to the role of teaching or research depends on the prevailing expectation of the institutions they are entering, regardless of discipline. This trend might be explained by faculty members' self-selection into the type of institution that best fits their abilities and preferences. In similar ways, institutions select applicants according to institutional expectations. On the other hand, academic disciplines vary in the level of consensus their members show in terms of theoretical orientations, research methods, and questions to be advanced in the field. For example, physics is a high-consensus field and education a low-consensus field. Based on this classification of disciplines, Braxton and Berger also found that faculty in high-consensus fields tend to adapt more to their entering institutions than faculty in low-consensus fields. This finding suggests that faculty in high-consensus fields face less ambiguity in making decisions regarding research topics, methods, and curriculum than do faculty in low-consensus fields.

According to Tierney and Rhoads (1993), new faculty members are likely to shape the understandings and responses to the task demands and performance requirements of the discipline and entering institution. For example, new faculty members who want to pursue research in areas that would reflect their backgrounds might be able to introduce new research areas such as Native American, African American, or Women's studies. These examples illustrate the essential role of graduate education in the socialization process of future faculty members and the character of the academic profession, as new recruits bring new values and perspectives.

Graduate students go through two socialization processes simultaneously, one related to the academic profession and the other to their status as graduate students (Golde, 2000). There are four tasks to be accomplished during this dual socialization process: 1) intellectual mastery, 2) learning the realities of being a graduate student, 3) learning about the academic profession,

and 4) integrating oneself into the department (Golde, 1998). In the same vein, Tinto's theory of doctoral persistence (1993) reflects graduate students' socialization process and has the same structure as Tierney and Rhoads's framework of faculty socialization.

According to Tinto, graduate education consists of three fundamental stages: transition or adjustment, attaining candidacy or development of competence, and completing the research project. During the first stage individuals seek to establish formal and informal membership in the academic and social communities of the university. The second stage leads to doctoral candidacy and entails the acquisition of knowledge and the development of competencies deemed necessary for doctoral research. At this point, social experiences become part of students' academic experiences and vice versa. These two stages correspond to Tierney and Rhoads's faculty socialization stages of initial entry and role continuance (1993). The final stage extends to graduation and reflects the nature of the individual abilities and the role that individual faculty members play as mentors and advisors. During this stage, the student has completed his or her socialization as doctoral student, and the anticipatory socialization to the academic profession takes place (Tierney & Rhoads, 1993, Tinto, 1993). According to Tinto's theory, persistence at this stage highly depends upon the socialization experiences with the student's advisor and the immediate research community.

Tinto's perspective (1993) supports what other authors have said about doctoral socialization. Girves and Wemmerus (1988) demonstrate that the role of the advisor is critical during doctoral socialization, both as role model and as primary socializing agent in the department, by establishing the standards and norms of performance and behavior. For example, academic integration is more important than social integration in doctoral programs because social integration occurs through academic tasks (Girves & Wemmerus, 1988; Lovitts, 1996). Thus, relationships with advisors seem to be more important in doctoral completion than relationships with peers, although peers are important as a source of the tacit knowledge that students must acquire to survive and thrive in the culture of the department (Corcoran & Clark,

1984; Sullivan, 1991). In other words, Girves and Wemmerus (1988) found that involvement with the program is a direct predictor of academic progress. In addition, they found that involvement is also a function of financial support, students' perceptions of their relationship with faculty, the number of faculty who interact with each student, and assistantships, all of which promote faculty-student relationships and socialization among graduate students.

In learning the culture of an organization during socialization processes, new members develop culture-specific schemes to interpret everyday events and respond with appropriate behaviors (Berger & Luckman, 1966; Schutz, 1964;). The development of such cognitive schemes by new members is guided by a process known in the literature as sensemaking (Louis, 1980; Weick, 1977). Therefore, given the significance of sensemaking in socialization processes, the following sections discuss sensemaking and the development of cultural cognitive schemes by newcomers in organizations.

Sensemaking in Organizations

Organizational culture guides sensemaking in organizations (Ott, 1989). Based on previous studies of cognitive sensemaking (Morgan, Frost, & Pondy, 1983; Weick, 1977), Weick (1995) defines sensemaking in organizational settings as the ongoing thinking process of individuals with the goal of creating order and making retrospective rational accounts of the situations in which they find themselves. As a result of sensemaking, individuals develop cognitive scripts to predict event sequences and outcomes (Louis, 1980; Weick, 1977). If the outcomes of a given situation occur as the scripts predict, then sensemaking is not evoked; however, when scripts do not predict the outcomes, individuals' cognitive integrity is threatened (Festinger, 1957), producing a state of tension that calls for a need to restore equilibrium (Lewin, 1951); in these situations, individuals must develop explanations to make sense of the unpredicted events or outcomes (Scott & Lyman, 1968)—sensemaking.

The substance of sensemaking is found in vocabulary: "Sense is generated by words that are combined into the sentences of conversations to convey something about our ongoing

experience" (Weick 1995, p. 106). However, words never map a situation exactly, and this causes the process of sensemaking to be never ending. According to Weick (1995), a cue in a frame is what makes sense. Usually, frames tend to be past moments of socialization and cues present moments of experience. In other words, the substance of sensemaking is embedded in cues, frames, and connections between the two. Therefore, the process of sensemaking is an effort to tie beliefs—frames—with actions—cues.

As an illustration of sensemaking, Weick (1995) appeals to the analogy of the task of cartography, in which cartographers have to represent a new terrain without a pre-determined order. What cartographers map depends on how and where they look and what they want to represent. They also use several modes of projections to make this representation. Thus, for any terrain, there is an indefinite number of maps. Similarly, sensemakers have to convert the terrain of reality into an intelligible world in order to make sense of their experiences. When viewing sensemaking as cartography, many maps are possible for a given terrain. However, the terrain for sensemakers is even more complex because it is always changing, and thus the sensemaker has to capture some momentary stability in order to create sensemaking maps. Another distinctive feature of sensemaking is that, unlike cartography, it is mostly social. From this perspective, individuals do not live in a wider reality and act in relation to it, but create images of a reality in part to rationalize their actions. In other words, "individuals realize their reality by 'reading into' their situation patterns of significant meaning" (Morgan et al., 1983, p. 24). During the process of sensemaking, people discover their own inventions imposed in their world by their own beliefs.

Weick (1995) provides the following characteristics as a rough guideline for the inquiry into sensemaking. These characteristics suggest what sensemaking is and how it works.

1. *Grounded in Identity Construction:* Individuals' identities are formed and modified according to how they believe others view the organization to which they belong by projecting their identities into an environment and observing the consequences. Therefore,

individuals are interested in preserving a positive image of their organization. Members are even willing to alter the sense they make in order to preserve a positive image. In this way, events in organizations are given meaning (e.g. that it promotes self-enhancement, efficacy, and consistency). Controlled and intentional sensemaking is triggered by a failure to confirm oneself. Thus, sensemaking occurs to preserve a consistent and positive self-conception. Individuals act according to their own identity, which has embedded the identity of the organization. In other words, individuals act in behalf of the organization and as the organization itself. The meaning of a situation depends on the identity an individual adopts in dealing with it or what the person represents. People try to simultaneously react and shape the environment they face. They take the cue for their identity from the conduct of others, but also they make an effort to modify such conduct.

2. *Retrospective:* People are always aware of what they have done and not of what they are doing. Actions are known only when they are completed. People use the outcomes of past history to interpret more recent events. However, most of the time these stories are reconstructed differently depending on whether the outcomes are seen as good or bad. For example, if the past story is perceived as bad, the reconstruction will emphasize the errors and flaws. In other words, the past is reconstructed knowing the outcome, and this alters the actual chain of casual events. Meaning is given to the kind of attention that is paid to a situation in relation to past experiences. There are many possible meanings, and the process of sensemaking synthesizes all these through reduction of equivocality. Clarity of values helps during this process. Once a feeling of order, clarity, and rationality is achieved, sensemaking stops.
3. *Enactive of Sensible Environments:* People create their own environments, and these environments constrain their actions. Therefore, there isn't an objective, fixed environment independent of people because people are part of the environment; there are no outcomes but, rather, relationships with the environment. For example, when two people meet,

neither of them can influence the other because both influence each other at the same time; in reality, they become something different, and this process begins even before they meet, during the anticipation of meeting. Sensemaking embodies the concept of enacting, which has an emphasis on noticing. For example, an object exists independently of our cognition; however, we enact it by noticing it or bracketing it. Thus, to notice or bracket an object or situation gives character to such a thing or situation according to what the individual confronts. Therefore, there is a creation of objects or situations in sensemaking according to their social relationships. Sensemaking creates a social world that constrains actions and orientations. Actions create meaning; however, actions can be controlled, constrained, inhibited, abandoned or redirected. However, those modified actions also create meaning without having direct physical consequences on the environment.

4. *Social:* People in organizations make decisions in the presence of others or with the knowledge that they will have to be implemented, understood, or approved by others. Therefore, sensemaking is never an individualistic process.
5. *Ongoing:* Sensemaking never really starts because people are always in the middle of projects that make sense after completed: they extract cues from a continuous flow in order to make sense. The reality of flow becomes apparent when there is an interruption, which typically invokes an emotional reaction followed by sensemaking (that is why sensemaking is infused with feeling). Past events are reconstructed in the present to give explanations to past events not because they look the same but because they feel the same.
6. *Focused on and by Extracted Cues:* Sensemaking interprets what the cues mean in a given frame. What an extracted cue will become depends on the context that affects what is extracted as cue in the first place; moreover, context affects how such a cue is interpreted.
7. *Driven by Plausibility Rather than Accuracy:* Having an accurate map is less important than having some map that brings order to the world and prompts action. Sensemaking does not rely on accuracy but on plausibility, coherence, reasonableness, creation, invention, and

instrumentality. What is believed as a consequence of action is what makes sense and guides behavior. Accuracy is not the issue: what matters is a good story to guide action and allow people to make retrospective accounts that are socially acceptable and credible. Sensemaking cannot be accurate for many reasons: people need to filter data to avoid being overwhelmed and extract the relevant; cues are linked to general ideas according to contexts; a present cue is associated with a similar cue in the past, but the past cues are reconstructions with emotions and desires, which are not accurate; sensemaking has to be fast, which does not allow much room for accuracy; and reality changes, is interactive, interpersonal, and interdependent, and thus it is complex to portray reality accurately.

Cognitive schemas are a useful construct to understand more in depth the dynamics of sensemaking. Cognitive schemas that guide behavior are the result of sensemaking. Markus (1977) defines schemas as the dynamic cognitive knowledge regarding concepts, entities, and events used by individuals to encode and represent information. These schemas serve as mental maps of reality that guide individuals' interpretation of past and present actions and events as well as expectations for the future (Weick, 1979). Moreover, schemas also guide the search, acquisition, and processing of information (Neisser, 1976; Weick, 1979). Schemas help reduce the amount of information to be processed in organizations by providing ready-made knowledge about situations and others (Lord & Foti, 1986). For example, an event schema is a cognitive structure that specifies a typical sequence of occurrences in a given situation or process, though it may or may not specify event content (Abelson, 1976).

Each member in an organization has their own schemas that, over time, come to resemble those from others because all members in the organization need to establish a common meaning in order to achieve social order (Harris, 1994). These similar schemas become organizational schemas over time and are developed by sharing experiential space and time, communicating, interacting, and solving problems together (Schein, 1985). Therefore, organizational schemas refer to the shared knowledge regarding organizations as entities

abstracted for their individual members. These organizational schemas are the closest knowledge for individuals of their organization's culture (Harris, 1994).

Schemas are formed through experiences and face-to-face communication with other members of the organization, which gives sensemaking its social character (Daft & Lengel, 1986; Weick, 1995). Given that organizations are terrains with multiple plausible and conflicting interpretations (Daft & MacIntosh, 1981), people in organizations need rich qualitative information in order to construct organizational schemas. For example, stories are one of the ways in which rich organizational information such as values and expectations is transmitted to new members (Brown, 1985). Weick (1995) identifies the following six vocabularies as forms of activity exchanges and communication in organizations:

1. Ideology: Vocabularies of Society. Ideologies refer to the shared values, beliefs, and norms that bind people together and help them make sense of their world (Trice & Bayer, 1993).
2. Third-Order Controls: Vocabularies of Organizations. Perrow (1986) suggests that organizations operate with three forms of control: first-order by direct supervision, second-order by programs and routines, and third-order by assumptions and definitions that are taken as given. Third-order controls are deep assumptions that are the foundation of organizational culture (Schein, 1985).
3. Paradigms: Vocabularies of Work. These vocabularies refer to standard operating procedures, shared definitions of the environment, and the agreed-upon system of power. In scientific communities, paradigms reflect research methodologies, curriculum, and topical research issues. In the business community, these paradigms are consensus on marketing strategies, profits, and connections between operations and strategies (Pfeffer, 1981). For the purposes of sensemaking, paradigms are sets of recurrent and quasi-standard illustrations that show how theories of action are applied conceptually, observationally, and instrumentally to representative organizational problems. For example, a collection of these

illustrations or stories held together by a theory of action provides a frame within which cues are noticed and interpreted.

4. Theories of Action: Vocabularies of Coping. Theories are cognitive structures that predict outcomes in given situations. For example, a full schema for a theory of action would be: In situation S, if you want to achieve C, under assumptions $a_1,\ldots,a_n$, do A. Theories of action derive from socialization experiences that reflect the ideology of the organization.
5. Tradition: Vocabularies of Predecessors. Traditions are patterns, beliefs, or images of actions transmitted at least for three generations, although each transmission can take place in a short period of time. Images of actions across generations become symbols that contribute to the fostering of a stronger culture.
6. Stories: Vocabularies of Sequence and Experience. Telling stories about remarkable experiences is one of the ways in which people try to make sense (Robinson, 1981). Stories serve as a means for members to express their knowledge, understanding, and commitment to the organization. Story subject matters reveal the task uncertainty that accompanied certain events and the means through which activities coordinate to handle that uncertainty (Brown, 1985).

So far, this section has presented the general process of organizational sensemaking for individuals according to existing literature. However, in order to grasp the mechanisms by which organizational culture is manifested during sensemaking, it is necessary to follow Wiley's (1988) model regarding the different levels of sensemaking above the individual level of analysis. According to Wiley, there are three levels for sensemaking: intersubjective, generic subjective, and extrasubjective. At the intersubjective level, the self "I" becomes "we" through communication processes between two or more individuals. Thus sensemaking is a process between two or more people of making verbal sense of actions and events at a social level of reality. The generic subjective level of analysis corresponds to organizations. This level is

characterized by an abstract concept of generic self—a step further than "we"—leaving behind individualized selves.

This perspective supports Mead's (1934) argument about the internalized conversations between self, others, and generalized others that individuals enact to define themselves and make behavioral decisions relative to the social world. The dialogue with the generalized others is individuals' abstraction regarding the attitudes of the social group. This mental dialogue with the abstract other offers a useful perspective on the process by which the broader cultural context of the organization manifests itself in the sensemaking effort of its members. The outcomes of these mental dialogues between themselves and the abstract others guide the behavior and experiences of individuals in organizations. From a mental-dialogue perspective, the arguments supplied for each of the parties to the conversation are basically the verbalization of normative and cultural pressures (Harris, 1994).

When uncertainty increases in organizations due to the presence of a new element or event, intersubjectivity becomes the focus of sensemaking although generic subjectivity does not completely disappear. In other words, the level of uncertainty in organizations determines the emphasis on intersubjectivity and generic subjectivity. In times of stability, generic subjectivity takes the form of organizational schemas that reflect organizations' order and are cued by stimuli originated in the task environment (Ashforth, 1988). In other words, schemas are subjective theories derived from experience related to what guides perception, memory, inference, and behavior (Fiske & Taylor, 1984). Finally, according to Wiley (1988), the extrasubjective level of analysis replaces the generic self by meanings without a knowing subject. This level refers to the symbolic reality: concepts like mathematics or capitalism.

Weick (1995) believes that the nature of organizations lies between the intersubjective level and the generic subjective. This hybrid nature of organizations becomes clear in the following definition of organizations as entities developed and maintained only through

continuous communication-activity exchanges and interpretations among its participants (Schall, 1983):

> As interacting participants organize by communicating, they evolve shared understandings around issues of common interest, and so develop a sense of the collective "we" . . . that is, of themselves as distinct social units doing things together in ways appropriate to those shared understandings of the "we." In other words, the communicating processes inherent in organizing create an organizational culture, revealed through its communicating activities . . . and marked by role-goal—and context-bound communication constraints—the rules. (p. 560)

Aspects of the intersubjective level are evident in Schall's definitions around the ideas of activity-exchanges and communication of interacting participants. Similarly, hints of generic subjectivity are clear in her references to shared understandings, issues of common interest, and the collective "we." Smircich and Stubbart (1985) offer a parallel description of organizations that suggests sensemaking as an essential element of organizational life. They describe an organization as "as set of people who share many beliefs, values, and assumptions that encourage them to make mutually-reinforcing interpretations of their own acts and the acts of others" (p. 727).

In sum, culture for any given organization can be seen as a shared network of ideologies delivered to members by sensemaking practices; organizational culture is ultimately manifested in the sensemaking efforts and actions of individuals (Harris, 1994). Sensemaking takes place through mental dialogues between individuals and the abstraction of others in the organization. These mental dialogues reflect the culture of the parties involved:

> …the individual-level manifestations and experiences of organizational culture are revealed in the operation of a patterned system of organization-specific schemas held by organizational members. Specifically, I suggest that individuals' organization-specific schemas are the repository of cultural knowledge and meanings and the source of the consensual sensemaking characteristic of culture. In addition, I suggest that the activation and interaction of these schemas in the social context of the organization creates the cultural experience for individuals (Harris 1994, p. 310).

Sensemaking is evoked especially in those occasions that involve a significant level of uncertainty or surprise (Louis, 1980; Weick, 1995). Newcomers in organizations encounter many of these situations that force them to be actively engaged in sensemaking (Harris, 1994; Louis, 1980). Therefore, by analyzing the mental dialogues that new members enact as they cope with their socialization process it is possible to infer the cultures involved in the dialogues between the newcomer and the generalized other.

If entering graduate students expect to find a culture in line with traditional academic values, they might find cultural surprises if they enter a department with significant involvement in academic capitalism. A close examination of the sensemaking processes of entering graduate students evoked by these cultural surprises provides information about potential cultural tensions in these departments and about the way that students cope with such tensions. However, some students might encounter more surprises than others in terms of cultural expectations depending on their past experiences and on other elements illustrated by Weick (1995) in the seven properties of sensemaking described above.

Nonetheless, and according to sensemaking and socialization theories, it is clear that new members (who hold meanings that are different from those of the existing members of the organization) may contribute to the reshaping of the culture in the new setting because they bring new vocabularies designed to interpret surprises. When these vocabularies are shared with insiders, meaning is reshaped (Tierney & Rhoads, 1993; Weick, 1995). This understanding is essential to address the degree to which academic capitalism might be changing the academic culture through the socialization processes of its new members. In other words, and according to Weick's (1995) perspective, the social character of sensemaking allows new members to contribute to the reshaping of the culture (Van Maanen, 1976) as shared understandings are developed through activity exchanges and communication interaction between new members and insiders. The following section discusses newcomers' sensemaking in detail.

Sensemaking and Socialization Processes

Several authors have offered explanations regarding the circumstances under which people engage in sensemaking. Based on the idea of perceived environmental uncertainty, Duncan (1972) considers environmental determinants such as information overload, complexity, and turbulence as properties of an ongoing flow that increases the probability that people in organizations note what is happening around them—cues. These properties are occasions for sensemaking. For example, when the amount of information in an organization is too large to be processed, people start to filter the information by abstraction, omission, and greater tolerance of error or queuing. Thus, information overload is an occasion for sensemaking because it forces cues out of an ongoing flow.

Complexity also calls for cues as perceived uncertainty affects what people notice. Similarly, turbulence, which is a combination of instability and randomness, forces people to notice what they know best, which gives sensemaking its idiosyncratic properties. However, Smith (1988; 1989) argues that at least two different conditions must take place in order for a problem or gap to occur and become a cue for sensemaking: the gap must be difficult to close and must matter. Thus, a problem is an undesirable situation that matters and someone can solve—albeit with some difficulty. In other words, problems are conceptual constructs of disharmony between reality and ones preferences. Nevertheless, for Weick (1995), problems are not necessary occasions for sensemaking because to label a situation as problematic is to infer that it has a solution. In other words, to call a situation a problem makes it a problem. Finally, Starbuck and Milliken (1988) talk about "incongruous events that violate perceptual frameworks" as basic occasions for sensemaking.

Based on these perspectives, Weick (1995) generalizes occasions for sensemaking into two main categories: ambiguity and uncertainty. On the one hand, ambiguity is an ongoing flow subject to many interpretations; assumptions for rational decision-making are not clear. On the other hand, uncertainty refers to a situation where it is not possible to infer future

consequences based on present actions. According to Weick (1995), in the case of ambiguity people engage in sensemaking because they are confused by too many interpretations, and in the case of uncertainty because they are ignorant of any interpretations. This perspective is in agreement with Louis (1980), who talks about surprises as cues that evoke sensemaking as the result of uncertainty and ambiguity in organizations.

Much of the behavioral activity in organizations occurs with no real conscious awareness due to the existence of cognitive schemas about the self, other people, situations, and events (Ashforth, 1988). That way, individuals in nonsurprising situations operate unconsciously following pre-programmed schemas (Abelson, 1976; Schutz, 1964). In other words, conscious thought is not a very large part of our everyday mode of operating unless a surprise stands out. In this case, "out of the ordinary" events trigger a process of inquiry in which the individual's cognitive integrity is threatened (Festinger, 1957), producing a state of tension that calls for a need to restore equilibrium (Lewin, 1951); as a result, individuals must develop explanations to make sense of unpredicted events or outcomes (Scott & Lyman, 1968). Similarly, using Harris's (1994) perspective on mental dialogues, dialogue is not evoked when previous dialogues about a given stimulus have already taken place, regardless of whether the resolution of the dialogue was agreement or not. If agreement was reached, then that schema will become part of the shared meaning with others in the organization. If disagreement is the outcome, it will trigger future mental dialogues. Sharing results from mental dialogue agreements between I and the Other is what Harris (1994) identifies as direct cultural sharing. Similarly, indirect sharing occurs in situations when unconscious sensemaking occurs.

Novel stimuli trigger a conscious sensemaking process that leads to the learning of schemas (Harris, 1994). Given newcomers' uncertainty about their particular roles, task competence, and social acceptance, they are eager to learn organizational schemas during their socialization processes and on-the-job experience (Ashforth, 1988; Katz, 1980). Therefore, as newcomers cope with surprises, they are more likely to engage in conscious sensemaking than

the older members of the organization (Harris, 1994; Louis 1980; Schutz, 1964). As newcomers gain more experience, they develop more elaborate schemas: sensemaking begins to require less conscious effort (Harris, 1994).

Louis (1980) proposes a model for understanding the process of newcomers' sensemaking as they enter new settings based on the idea that change, contrast, and surprise constitute key sensemaking elements of the entry experience for new members. According to Louis, new members have three types of experiences—change, contrast, and surprise. By change, Louis means recordable evidence of difference between the old and the new settings that requires adjustment by individuals. Change is publicly noted and knowable—new location, new title, new salary, and new job description. Contrast is more personal and occurs when individuals experience an emergence of a perception against a general background. For example, a newcomer may or may not notice how people dress in the new setting depending on whether dress codes differ between the old and the new settings.

A special case of contrast is associated with the process of letting go old roles in which newcomers carry memories from the old role. For example, a new member might interpret aspects of the new role using old-role experiences as anchors on internal comparison scales. Finally, surprise represents a difference between individuals' anticipations and subsequent experiences on the new setting. Louis (1980) identifies five forms of surprises that newcomers face in the encounter: 1) when conscious expectations are not fulfilled; 2) when conscious and unconscious expectations about oneself are unmet; 3) when unconscious job expectations are unmet or when a feature of the job is unanticipated; 4) when difficulties arise in accurately forecasting internal reactions to a particular new experience; and 5) when newcomers' cultural assumptions are challenged.

From a cultural perspective, sensemaking depends on individuals' cultural set of assumptions, that is, internalizations of context-specific meanings (Berger & Luckman, 1966). Therefore, cultural surprises occur when newcomers make cultural assumptions, brought from

previous settings as "operating guidelines" (Louis, 1980, p 238) that fail to work in the new setting. Once newcomers realize that these assumptions do not work in the new setting because the people around them share other assumptions, they go through a cognitive revision of themselves in relation to others and their taken-for-granted assumptions (Van Maanen, 1977). Thus, in learning the culture of an organization during socialization processes, new members develop culture-specific schemes to interpret everyday events and respond with appropriate behaviors (Schutz, 1964; Berger & Luckman, 1966). Given that culture differs between organizations, each setting demands a specific cognitive framework—learned during socialization—for expressing and interpreting meanings in a particular culture through sensemaking processes (Louis, 1980).

Attributing meaning to surprises—sensemaking—depends on past experiences with similar situations and personal characteristics (Louis, 1980). Nonetheless, other factors—such as information and interpretations from others—play an essential role in sensemaking for newcomers (Louis, 1980). Louis also recalls that the experiences of newcomers differ in three important ways from those of the insiders: 1) insiders normally know what to expect, so the level of surprise they encounter is considerably less; 2) in the event of surprises, insiders have sufficient history within the setting to interpret the event more accurately; and 3) insiders have established a social network within the organization to compare perceptions and interpretations. In sum, these differences make newcomers' sensemaking more difficult and less accurate in relation to insiders' sensemaking. However, with time and experience, as a newcomer's socialization process evolves, they come to understand how to interpret actions of others and events in the new setting and what meanings to attach to different situations (Louis, 1980). In other words, newcomers' sensemaking can be considered as a socialization mechanism through which culture is learned in an organization.

According to Louis's perspective (1980), new members in stages of early socialization internalize context-specific dictionaries of meaning used by members of the setting as a result of

sensemaking processes triggered by surprises (Louis, 1980; Berger & Luckman, 1966). Therefore, graduate students, by being in the anticipatory socialization stage of the academic profession, begin to internalize a series of meanings through sensemaking that would allow them to anticipate outcomes and events once they become junior faculty. Given that newcomers contribute to the reshaping of the culture in the entering organization (Van Maanen, 1976), the set of assumptions that junior faculty bring from graduate school to the entering organization might help reshape the academic culture.

The literature reviewed regarding graduate students' socialization provides insights regarding their anticipatory socialization and hence about potential shifts in the academic culture once they become junior faculty. It also provides a framework to address doctoral attrition through socialization perspectives. However, most of the studies of the impact of academic capitalism on the academic profession and doctoral education have been focused primarily on faculty members; little attention has been paid to graduate students and none to their socialization process:

> None have offered a qualitative examination of how faculty members involved in research with industry socialize and train their graduate students… The voices of graduate students have not yet been captured, as is often the case with those who lack social standing power. (Slaughter et al., 2002, p. 283)

Despite the lack of research on graduate students and academic capitalism, as illustrated above, there is evidence that training graduate students on corporate research projects creates socialization and cultural dilemmas (Gumport, 1999; Slaughter et al., 2002).

In summary, one of the main assumptions of this study is that academic capitalism offers a context that can potentially modify the anticipatory socialization to the academic profession of graduate students and hence the culture of the academic profession as well as doctoral retention (Golde, 1998; Gumport, 1999; Tierney & Rhoads). In other words, given the differences between industry and academic cultures, the socialization of graduate students who work with industry representatives might potentially affect the academic culture once these

graduate students become faculty members as well as other factors associated with doctoral retention. Moreover, given the significance of sensemaking in socialization processes (Louis, 1980; Weick, 1995), the sensemaking process of graduate students might provide insights to potential cultural clashes as a result of academic capitalism as students cope with uncertainty and ambiguity in departments heavily involved with academic capitalism (Harris, 1994; Louis, 1980; Weick, 1995).

Summary

The 1980s marked the beginning of a new area after the unprecedented expansion of higher education (combined with generous federal research funds) during the 1960s. As global markets opened and funding for higher education started to decrease, the U.S. government defined new policies to encourage cooperation between industries and universities in order to bridge funding gaps and cope with global competitive markets. At the turn of the 21st century, universities are increasingly engaging in academic capitalism by seeking funds in the private sector through grants, contracts, and commercialization of research.

Academic capitalism has impacted epistemological paradigms about higher education and the public good, the academic profession, and graduate education. In particular, empirical evidence suggests that the academic profession is increasingly being transformed as faculty members engage in academic capitalism in order to obtain research funds and prestige, especially in science and engineering. Some of the most significant changes in the academic profession include: overemphasis on applied research; less time for teaching and advising and more time spent in writing grants, reports, patent applications, and performing other entrepreneurial activities; secrecy of knowledge; the fostering of a hierarchy based on prestige and salary differences between entrepreneurial faculty and faculty who are not engaged in for-profit ventures; and for-profit opportunities. In addition, graduate students, who possess research skills, have become valuable labor for industry representatives and tokens of exchange for faculty members in order to consolidate partnerships with private sponsors. As a result, the

implications for graduate education and graduate students are significant, especially from an organizational culture and socialization perspective.

Academic capitalism is stronger in certain types of universities and disciplines such as major research universities and applied fields. About 80%of the federal funding for R&D has been highly concentrated in about one hundred research universities (Slaughter & Leslie, 1997). These funds attract industry representatives to partner with faculty in disciplines where research has commercial potential.

Organizational culture offers a suitable framework in which to understand the impact of academic capitalism on the academic profession and graduate education. Following organizational culture theories applied to higher education and graduate student and faculty socialization, it is clear that faculty and students engaged in academic capitalism face the tension between two different organizational cultures represented by industry and academia. Some of the areas of biggest discrepancy are around knowledge secrecy, rewards structures, and socialization processes. For example, peer review publishing has traditionally been the source of prestige and intrinsic rewards to academics. The hindering of knowledge for profit is at odds with the scholarly principle of knowledge dissemination. Faculty engaged in academic capitalism justify this discrepancy by saying that profits from the commercialization of research allows them to obtain funds for research and that commercialization is the optimal way to transfer products to society in the global economy.

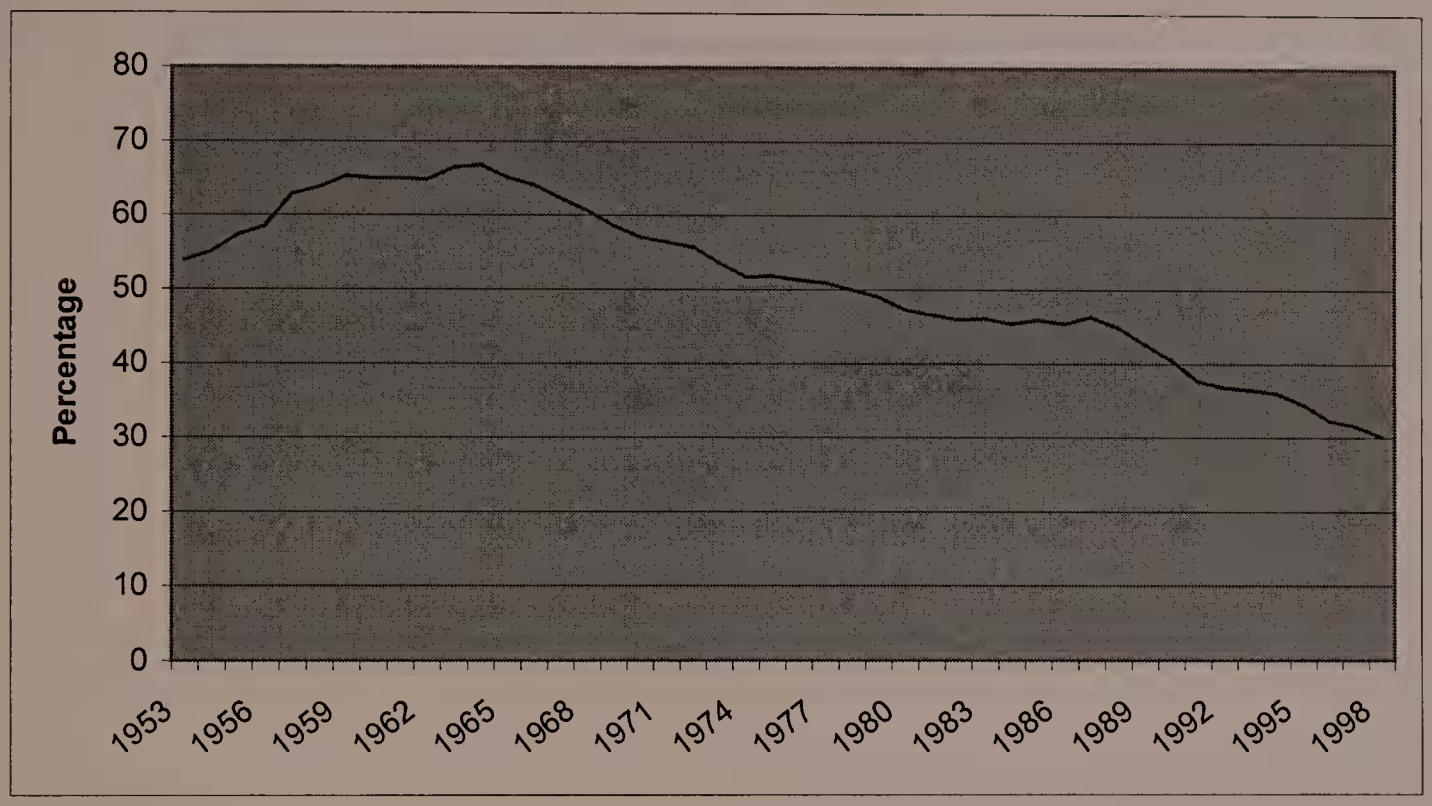
In any organization, culture is transmitted through socialization processes to new members. During socialization, new members internalize values, norms, intellectual traditions and styles, as well as folklore, language, and patterns of relationships. Academics begin their socialization in graduate school and throughout their first years as faculty members. Training graduate students in corporate projects implies socialization processes different from those that are traditional ones in the academic profession. Under this scenario, graduate students are likely to socialize with industry representatives who hold managerial and business-oriented values and

bring a new culture to their entering departments, thus initiating a potential cultural shift in the academic profession as they become established faculty members.

There are potential additional implications for graduate students' retention as they are involved in projects sponsored by the private sector such as the nature of the graduate training and issues regarding intellectual property and secrecy. For example, studies have raised concerns about faculty becoming more project managers than academic advisors. Moreover, some faculty expressed concern about the overemphasis on applied projects in the quality of graduate training. The issue of secrecy around graduate students' research can affect graduation timelines as well as graduate students' publishing records. Finally, there have been some cases of conflict between graduate students and faculty members over ownership of intellectual property with commercial potential, as well as ethical dilemmas among faculty regarding monetary profits stemming from research carried out by students.

This chapter has reviewed the emergence of academic capitalism and its impact on the academic profession, including an account of previously documented effects on graduate students. This chapter also developed a detailed organizational culture framework with emphasis on socialization and sensemaking processes as a lens to view the influence of academic capitalism on the anticipatory socialization to the academic profession and the socialization of doctoral students. The few studies that have documented the impact of academic capitalism on graduate students have been conducted from a faculty perspective, and none have approached the issue from a cultural perspective. Therefore, this study looks at the impact of academic capitalism on graduate students using a framework based on organizational culture, socialization processes, and sensemaking. The significance of this study rests on the fact that the anticipatory socialization to the academic profession takes place in graduate school, and thus the future character of the academic profession depends on the socialization process of graduate students. Also, this study addresses issues of doctoral retention by investigating the impact of academic capitalism on the socialization of graduate students.

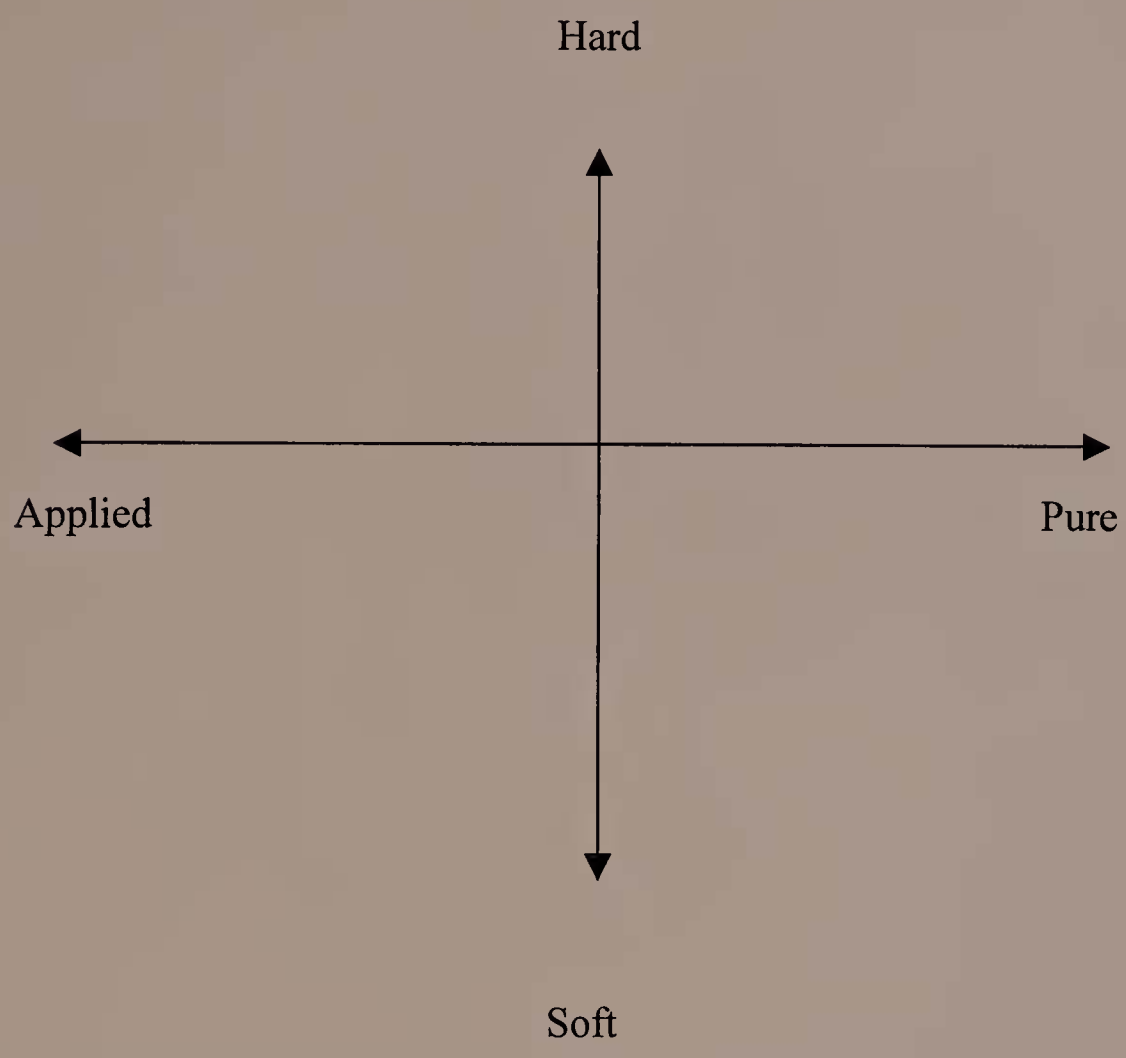
Figure 2.1. Federal R&D Funding from 1953 to 2000



*The data for this graph was obtained from the National Science Foundation databases

www.nsf.gov

Figure 2.2. The Kolb-Biglan Classification of Disciplines (Kolb, 1981)



CHAPTER 3

METHODOLOGY

This chapter presents the conceptual framework drawn from previous studies, as reviewed in Chapter 2, followed by a review of the research questions as logical extensions of the framework. The chapter concludes with an outline of the research methodology of this study.

Conceptual Framework

According to resource-dependency theory, internal behaviors of members in organizations are influenced by external constituencies as providers of resources (Pfeffer & Salanick, 1978). Following this framework, external research sponsors such as the federal government, private foundations, and industries influence faculty members' behaviors as members of higher education institutions, especially in those institutions and fields where external dependency for research funds is more significant, as it is the case in Research I institutions and applied technical fields. In the last two decades, decreasing federal support for research (Altbach, 1999; Geiger, 1999), combined with federal policies to encourage joint ventures between industry representatives and academics, has fostered a fierce competition for research funds mainly in science and engineering (Gladieux & King, 1999; Slaughter & Leslie, 1997; Zusman, 1999). This competitive market for research funds has induced market-like behaviors among faculty members, a phenomenon called academic capitalism (Slaughter & Leslie, 1997).

The academic profession, which is the profession of faculty members, has a set of common values across disciplinary and institutional boundaries: "academic freedom, the community of scholars, scrutiny of accepted wisdom, truth seeking, collegial governance, individual autonomy, and service to society through the production of knowledge, the transmission of culture, and education of the young" (Kuh & Whitt 1986, p. 76). In the same vein, rewards structures in the academic profession are based on prestige and symbolic rewards

such as peer recognition, publishing, and awards. On the other hand, industry representatives hold values according to business and managerial models of product development, efficiency, risk-taking, and monetary rewards. Thus, conflicts and potential cultural shifts in the academic profession are likely to occur as industry representatives work with faculty members. Moreover, according to a number of studies, some of the most significant effects of academic capitalism on the academic profession take place in the academic-culture arena (Brint 2002; Campbell & Slaughter, 1999; Gladieux & King, 1999; Gumport, 1999; 2002; Mendoza & Berger, 2005).

In the past decades, graduate students have been increasingly involved in research assistantships sponsored by the private sector, which have brought concerns regarding the cultural socialization processes of graduate students in departments heavily involved with industry and who work in projects with commercial aims (Campbell & Slaughter, 1999; Gumport, 1999; Slaughter, Campbell, Hollernan, & Morgan, 2002). From an organizational cultural perspective, these studies suggest that academic capitalism might be affecting the academic profession through non-traditional patterns of anticipatory socialization in graduate school as well as the socialization of graduate students in their programs. Therefore, the purpose of this study is to investigate the effects of academic capitalism on the anticipatory socialization to the academic profession and the socialization of doctoral students. Given the relevance of socialization processes to graduate students in light of academic capitalism, the following paragraphs review a theoretical framework for this study based on cultural socialization and sensemaking perspectives.

Culture in organizations is most commonly defined by the set of shared beliefs, values, and assumptions that guide behavior and sensemaking (Ott, 1989). Sensemaking is the ongoing thinking process of individuals purporting to create order and make retrospective rational accounts of the situations in which they find themselves (Weick, 1995). As a result of sensemaking, individuals develop cognitive schemas to predict event sequences and outcomes (Louis, 1980; Weick, 1977). New members learn the culture of their organization as well as

their role in it; this period is known as organizational socialization (Van Maanen, 1976). During socialization, newcomers find themselves in an environment with high levels of uncertainty and ambiguity which forces them to engage in cognitive processes to make sense of their new environment at higher rates than the other members of the organization (Louis, 1980; Weick, 1995). As newcomers gain experience and go through their socialization process, they develop more elaborate in-organizational schemas, and sensemaking for these domains begins to require less conscious effort (Harris, 1994). In sum, in learning the culture of an organization during socialization processes, new members develop culture-specific schemas to interpret everyday events and respond with appropriate behaviors through sensemaking (Berger & Luckman, 1966; Schutz, 1964).

An important aspect of sensemaking is that it is a social phenomenon: shared understandings are developed through activity exchanges and communication interaction between new members and insiders (Louis, 1980; Weick, 1995). This exchange between newcomers and veterans in organizations also affects the sensemaking process of the senior faculty. Therefore, junior faculty as new members might contribute to the reshaping of the academic culture (Van Maanen, 1976). Also, according to Tinto (1993) and other empirical studies (Golde, 1998; Girves & Wemmerus, 1988; Lovitts, 2001), socialization experiences are key factors of doctoral persistence.

Socialization processes and sensemaking in organizations offer a suitable theoretical framework in which to address the mechanisms by which faculty members acquire the academic culture embedded in their respective departments (Becher, 1989; Tierney & Rhoads, 1993). This socialization process starts in graduate school—anticipatory stage—and continues through the pre-tenure years—institutional stage. During the years in graduate school, future faculty members anticipate the roles and behaviors expected from them as future faculty and begin to acquire the values, norms, attitudes, and beliefs of their discipline. In Tinto's theory (1993), graduate education consists of three fundamental stages: 1) transition, where students

gain membership in the academic and social communities; 2) attaining candidacy or development of competencies; and 3) completing the research project, where the anticipatory socialization to the academic profession takes place.

In summary, given that graduate school represents a critical period of culturalization for incoming faculty members and that new members in organizations contribute to the reshaping of the culture of the organization in question (Tierney & Rhoads, 1993; Vann Maanen, 1976), graduate students who become faculty members can be considered as potential shapers of the academic culture, especially if they acquire business-oriented values during their anticipatory socialization in graduate school. If a cultural change is taking place towards a business-like culture in departments heavily involved with academic capitalism, it might have significant implications for the future direction of basic research, as well as the system of rewards and recognition in these departments. Moreover, inequalities in terms of material and symbolic rewards might widen between the fields involved in academic capitalism and the ones that are not. Finally, this framework suggests that academic capitalism might have a significant impact on doctoral retention due to the significance of socialization experiences in doctoral attrition.

Research Questions

Most of the studies on the impact of academic capitalism on the academic profession have documented a range of effects on faculty members involved in partnerships with the private sector and on graduate assistants involved in projects from those partnerships (Brint; 2002; Gladieux & King, 1999; Gumport, 1999; 2002; Slaughter & Campbell, 1999; Slaughter et al., 2002). But there have not been studies focusing on the impact of academic capitalism on graduate students' socialization. Moreover, all we know from these studies about the impact of academic capitalism on graduate students has been documented from the perspective of faculty members, leaving the voices of graduate students silenced. Therefore, the purpose of this study is to focus on graduate students' perspectives. Guided by the conceptual framework and

previous studies on the influence of academic capitalism on graduate students, the principal research question is:

- How do high levels of industrial sponsorship within an academic department influence the socialization of doctoral students from students' perspective?

This study uses the following secondary research questions as a gateway to the primary research question:

- What are graduate students' expectations regarding their departments' values, norms, and expectations of entering students?
- What types of surprises do entering graduate students encounter as they become members of their departments? Which of these surprises are related to academic capitalism? What factors influence the types of surprises that graduate students encounter?
- What are the cues that graduate students pick up in their sensemaking process that reflect academic-capitalism elements of the departmental culture?
- How do socialization experiences in environments heavily involved with academic capitalism influence graduate students' career aspirations and expectations?
- How do socio-demographic characteristics such as gender, age, race, ethnicity, and foreign status influence graduate students' socialization in light of academic capitalism?

Research Design

Qualitative research offers a powerful set of methodological tools for exploring little known phenomena that are context-specific and in which the setting depends on the participants' perspective (Marshall & Rossman, 1994). Therefore, a qualitative approach meets the needs of this study, given that little is known about the influence of academic capitalism on the socialization of graduate students in disciplinary and professional contexts where academic

capitalism is significant. Moreover, the research questions of this study focus on graduate students' socialization processes, which implies an emphasis on the perspective of participants.

Case studies are one of the qualitative research strategies usually employed to understand a larger phenomenon through close examination of a specific case based on a strong theoretical framework and on in-depth investigations of a single example of the phenomenon such as an event, an organization, a group, or an individual (Rossman & Rallis, 2003). If the research question is about explaining a contemporary and context-specific phenomenon or a process and its causes, Yin (1994) recommends a descriptive case study as the main research strategy. Therefore, according to Yin, a descriptive case study offers a suitable research strategy for this work, given that it aims to describe a contemporary phenomenon that has not been studied from a cultural socialization perspective, is grounded on a strong theoretical framework, and depends on academic contexts.

Case studies can be holistic if the case is studied as a whole or embedded when special attention is given to subunits (Yin, 1994). This study uses an embedded-case-study approach where the site is at the academic departmental level and the subunits and primary sources of data are graduate students.

The Site and Participants

According to Marshall and Rossman (1994), the ideal site should have the following characteristics: accessible, with a high probability of finding the phenomenon of interest, where the researcher is likely to be able to build trusting relations with the participants, and reasonably assured data where quality and credibility of the study. In order to guarantee that the department chosen for this study holds high levels of academic capitalism, the criteria used to choose the site are grounded in the theoretical assumption that academic capitalism is significant in Research I Universities and in applied fields in science and engineering aligned with the market, since it is in these places and departments where the most federal funding is invested. These disciplines not only benefit from federal funding but also from industry

representatives attracted by such federal funding and research opportunities with commercial potential.

The department chosen is a high-ranked science and engineering department in a large Research I University. This department hosts a center founded by the NSF to promote partnership with industry. Today, this center is highly successful with more than 30 industrial partners. Clearly, this department satisfies the conditions of an ideal site according to Marshall and Rossman (1994), given its significant involvement with industry and other entrepreneurial activities. Moreover, the department belongs to the researcher's academic institution, which facilitates entry and proximity and has a sufficient number of doctoral students from which to draw the participants. Finally, being a graduate student herself, the researcher was able to build trusting relations with participating doctoral students.

In order to gain access to the site, the researcher met with the head of the department and openly explained the nature of the study, its purpose and procedures, and why the department is a good choice for the case study. Finally, after clarifying a few questions, she solicited permission to conduct the study. The head of the department consulted with the faculty members in a subsequent faculty meeting and permission to conduct the study was granted.

In order to appreciate socialization differences, the sample consisted of two sets of graduate students: one set consisted of ten graduate students who were in the adaptation stage—first two years—and the other of ten students in the last stage where adaptation is achieved and where the anticipatory socialization to the academic profession takes place—doctoral candidates (Tinto, 1993).

A short screening survey with all doctoral students in the department was conducted aimed at identify first-year and advanced students as well as their career aspirations and level of involvement with industry-sponsored projects. The survey included a brief description of the study and the amount of time and level of involvement required, and was administrated during

class time and via e-mail. A series of follow up techniques were used such as phone calls and visits to the offices. Based on the results of the screening survey, doctoral students who qualified for the study and were willing to participate were interviewed once. Each interview was between 50 and 90 minutes long. A gift certificate to a local restaurant was offered to those who eventually took part in the study.

Data Collection and Analysis

According to the conceptual framework and purpose of this study, the research questions focus on the participants' perspective. Therefore, given that what matters is the subjective view of the participants, the main source of evidence consisted of in-depth interviews designed to obtain rich information regarding their socialization process. In-depth interviews are one of the main sources of evidence used in case studies (Yin, 1994), in which the researcher explores a few areas from the participants' perspective. In fact, a fundamental assumption in qualitative research is that the researcher must uncover the participants' viewpoint and not the researcher's views (Marshall & Rossman, 1994).

The type of in-depth interviews used in this study was ethnographic interviews (Spradley, 1979). Ethnography is a body of knowledge aimed at understanding human cultures from the perspective of those who have learned them. Ethnographic interviews are based on cognitive anthropology and are designed to elicit the cognitive structures guiding participants' worldviews and behavior through ethnographic questions aimed at gathering cultural data (Marshall & Rossman, 1994). The value of the ethnographic interviews lies in their focus on culture through the participants' perspective. This approach consists of a constant comparative analysis that generates a typology of cultural classification schemas resulting from sensemaking (Weick, 1995); it also highlights the nuances of the culture. This study used Spradley's method of ethnographic interviewing and analysis (1979) to obtain participants' mental scripts of cultural domains relevant to academic capitalism.

Spradley's Method

Spradley's method starts by assuming that the participants' cultural knowledge is divided into categories; ethnographic analysis is the search for these parts and their relationships as conceptualized by the participants. More specifically, this method is based on the search for cultural symbols and the relationships among them based on the assumption that using symbols creates all cultural meaning. The symbols used in ethnographic interviewing are the folk terms that informants use. There are four kinds of ethnographic analysis: domain, taxonomic, componential, and thematic. All these analyses lead to the discovery of cultural meaning, and therefore it is necessary to discuss briefly the nature of meaning based on a relational theory of meaning (Frake, 1964).

Culture is a system of symbols. A symbol is any object or event that refers to something. All symbols involve three things: the symbol itself, one or more referents, and a relationship between the symbol and the referent. A referent is the thing a symbol refers to or represents. Through the relationship the referent becomes encoded in the symbol. Once the encoding takes place we think automatically of the referent instead of the symbol. Many symbols include other symbols and they form a category. Thus, a category is an array of distinct symbols that we treat as if they were equivalent. Cover terms are generic names given to a category of cultural knowledge, while included terms are all the names given to the symbols of a given category.

Any symbolic category that includes other categories is a domain. Therefore, all members of a domain share at least one feature of meaning. All domains have two or more included terms for each category within the domain. When two folk categories are linked together, the link is a semantic relationship. In a domain, the semantic relationship links each cover term to all the included terms in its set. Domains are the first and most important unit of analysis in ethnography. The task of the ethnographer is to identify the coding rules of category

of symbols. This can be accomplished by discovering the relationships among cultural symbols.

- **Domain Analysis**

Every culture has many domains but very few semantic relationships. By discovering these relationships, it is possible to uncover most of a culture's principles for organizing symbols and domains. There are mainly two types of relationships, the ones expressed by the informants according to their own folk and the ones that are universal and are used in any culture (Table 3.1).

Domain analysis consists of discovering these domains from ethnographic interviews based on descriptive and structural questions. Descriptive questions are meant to elicit a large sample of utterances in the informants' native language by encouraging them to talk about a particular cultural scene. Structural questions help the ethnographer to elicit cover terms and test hypotheses from domain analysis. Table 3.2 illustrates an example of a domain.

- **Taxonomic Analysis**

The meaning of a symbol is revealed by discovering how it differs from other symbols that share some common features and differences at the same time. For example, the sentence "a boy is riding a bike" implies that is not a girl, not a woman, not a man, and not someone else. However, boy, girl, woman, man, and someone else share similarities: for example, they are all people. All these terms form a contrast set. Each domain of a culture consists of folk terms in contrast, and each subset of terms within a domain consists of a contrast set. Contrast questions elicit the different categories within a domain and thus uncover contrast sets.

A folk taxonomy is a set of categories from a contrast set organized on the basis of a single semantic relationship. A taxonomy shows the relationships of all the terms in a domain according to levels of association. A taxonomic analysis uncovers the relationship of all the terms in a domain from data gathered in interviews with descriptive, structural, and contrast questions. Table 3.3 shows and example of a taxonomy.

- **Componential Analysis**

Componential analysis discovers the attributes associated with each cultural symbol. These attributes are usually related to terms through semantic relationships. A paradigm takes all the terms of a contrast set and tells the attribute by dimensions of contrast. These paradigms represent one small part of the cognitive maps known to informants, which enable them to anticipate future situations, plan for them, and make decisions of various sorts. Table 3.4 features an example.

- **Thematic Analysis**

Cultural themes are elements in the cognitive maps that make up a culture. They consist of a number of symbols linked into meaningful relationships. It is a common assumption about the nature of experience. Themes are assertions that apply to numerous situations and so recur in more than one domain. Cultural themes sometimes appear as folk sayings, mottos, proverbs, or recurrent expressions. However, most cultural themes are tacit. Themes also serve as a general semantic relationship among domains. For the purpose of ethnographic research, cultural themes are any cognitive principle, tacit or explicit, recurrent in a number of domains and serving as a relationship among subsystems of cultural meaning. According to Spradley (1979), a thematic analysis is conducted by assuming that every cover term is a contrast set of an overarching domain and conducting a componential analysis of such an overarching domain.

Specific Methodology

This study used Spradley's method (1979) as the main strategy for data gathering and analysis in order to discover cultural domains of knowledge per group of participants. More specifically, this study focused on the cultural domains that contained information in line with previous studies regarding academic capitalism. This study focuses on partnerships with industry and commercialization of knowledge because these are the main manifestations of academic capitalism in science and engineering. Spradley's method involves at least seven

interviews in order to complete a componential analysis of a cultural domain. However, Spradley suggests that in order to accommodate possible participants' time constraints in an ethnographic study, it is possible to use multiple informants instead of one to complete a componential analysis. This requires careful selection of the participants in order to ensure that they share the same cultural scene. On the other hand, in order to ensure validity, it is important to have several sources of evidence. Therefore, in order to achieve a componential level of analysis with each group of students, ten interviews were conducted with ten students from each group (first stage students and advanced students) for a total of 20 interviews.

The following frameworks were used as analytical tools throughout the thematic analysis conducted: sensemaking's properties (Weick, 1995), framework of surprises for newcomers (Louis, 1980), and frameworks of doctoral retention (Girves & Wemmerus, 1988; Golde, 1998; Tinto, 1993). The last methodological strategy consisted of the analysis of basic documents—departmental statistics, orientation guidelines, dissertation topics, and other documentation describing the history and general structure of the department—that provided useful information about the context and experiences of graduate students.

Designed Features for Ensuring the Trustworthiness of the Study

Based on the traditional canons of positivistic research—internal validity, external validity, reliability, and objectivity—Lincoln and Guba (1985) developed a framework that reflects the assumptions of qualitative research based on four alternative constructs: credibility, transferability, dependability, and confirmability. Based on this framework, this section discusses the role played by these four constructs in this study.

1. *Credibility: How credible are the findings in the study?*

   Credibility refers to the ability of the study to demonstrate that it was conducted in such a way as to ensure that the participants were accurately identified and described. The most common method used to ensure credibility is the use of multiple sources of evidence (Yin,

1994). This study had 10 students per group as sources of data to produce domains of shared organizational culture knowledge.

2. *Transferability: How applicable are the findings to another setting or group of people?*

   This construct refers to the degree of usefulness of the findings to others in similar contexts and similar research questions. Transferability is the most problematic construct for qualitative research (Marshall & Rossman, 1994). However, if the researcher carefully attaches the sample and methodology to theoretical grounds, then those who want to apply the results should also assume the same theoretical grounds. Yin (1994) assumes that case studies rely on analytical generalizations rather than on statistical generalizations. Therefore, the findings of a case study can be generalized to a broader theory rather than to a population. Transferability can be achieved by using what Yin calls replication logic, which assumes that similar contexts chosen under the same criteria should produce similar data. In this case, throughout the data gathering and analysis, the researcher maintained a chain of evidence within the theoretical framework such that any external observer should be able to come to the same conclusions by following such a chain. Also, this study is grounded on a strong theoretical framework and followed a very specific methodology that implied thorough documentation of the data gathering and analysis.

3. *Dependability: How can we be reasonably sure that the findings would be replicated if the study were conducted with the same participants in the same context?*

   This construct refers to the researcher's ability to account for changing conditions during the study and effect changes in the design as understanding is achieved. This construct is in opposition to the concept of reliability in the positivism paradigm, in which an unchanging universe is assumed. The social world is always being constructed, and the concept of replication is problematic. In order to achieve trustworthy dependability that adapts to changing environments with results that could be replicated under the same circumstances, it is essential to document all the procedures and data very carefully. Therefore this study

created a database, including, in chronological order, recorded and transcribed interviews, post-interview analyses and pre-interview protocols, plus all analytic memos and personal reflections done throughout the study and final analysis.

4. *Confirmability: How can we be sure that the findings are reflective of the subjects and the inquiry itself rather than a creation of the researcher's subjectivity?*

   Confirmability refers to the objectivity of the study. In other words, this construct asks whether the same findings could be confirmed by another person using the same data. Ethnographic interviewing is a methodology to obtain a realistic account of the culture under study based on the participants' perspectives. In most interviews, there are questions formulated by the interviewer and answers from the participants. Nonetheless, both the researcher and participant come from different cultural backgrounds; therefore, in order to assure trustworthiness, ethnographic interviewing assumes that both questions and answers should come from the participants. This methodological assumption is based on the notion that every cultural statement answers to a question as a result of sensemaking. Therefore, the task of the researcher is to uncover those questions being answered by cultural statements (Spradley, 1979). Thus, the task of the ethnographer, in order to preserve the participants' perspectives, is to discover questions that people are answering in their every act. In other words, the ethnographer needs to know which questions are taken for granted because they are what "everybody knows" without thinking (i.e., culture). This study followed suggestions by Spradley to discover these questions by paying special attention to the questions people ask or by asking questions such as: What is an interesting question about…? Also, the researcher asked descriptive questions that can elicit other cultural relevant questions and created hypothetical situations and asked for questions related to such situations. In addition, other strategies to reinforce the confirmability of this study included data auditing with the dissertation committee members. Moreover, as the study progressed, the analysis included checking and rechecking of the data and a purposeful

examination of possible alternative explanations. Finally, the researchers' subjectivity was constantly evaluated and documented, especially during analysis, by preserving the participants' own language.

The following section presents the different steps followed in this study according to Spradley's method and the theoretical framework. Given that Spradley's method allows the use of several informants carefully selected in order to guarantee that all of them share the same cultural context, the following steps (except for the first) were applied to each group of participants (first-year students and advanced students).

1. Screening survey to all graduate students in the department and selection of participants.
2. First interview with general descriptive questions about the participants' experience in their department.
3. Preliminary domain analysis and tentative cover-term search with special focus on participants' domain of expectations.
4. Second interview using primary descriptive questions that focus on the preliminary domains identified.
5. Thorough domain analysis from all the data gathered that resulted in a list of hypothesized domains discovered and potential other ones.
6. Third interview with primary descriptive questions introducing some structural questions to complete the domain analysis.
7. Fourth interview to verify domains with mainly structural questions with cover and included terms.
8. Preliminary taxonomic analysis of the domains that are closer to the participants' knowledge relevant to the purpose of the study.
9. Fifth interview with both descriptive and structural questions to confirm taxonomies.
10. Sixth and seventh interviews with descriptive, structural and contrast questions.
11. Componential analysis.

12. Eight, ninth and tenth interviews to gather necessary data to complete the componential and analysis and further investigate domains of interest.

Spradley's method offers a detailed guideline of the type of questions to include in the interviews in order to complete the componential analysis. The first interview on the sequence was mainly exploratory, and included questions such as:

- When and how did you start working for your advisor?
- Have you had meetings with industry representatives? If so, can you describe them? Did you find any surprises? Explain.
- Is your dissertation research related to your assistantship?
- Is your research basic or applied? What is expected from your research?
- Are you satisfied with your research? Is it what you expected?
- Have you had intellectual property issues such as secrecy of knowledge, delays in publications, or issues with authorship?
- Have your expectations and views about your department, research, or advisor changed over time? Explain.
- What are your career aspirations? Have they changed? Explain.
- What are your views and thoughts about your department?
- What challenges have you faced?
- Is there anything about your personal characteristics that you think has influenced your experiences in the department?
- I have not been in a research lab like yours, so I do not have much of an idea of what it looks like. Could you take me through it and tell me what it is like? What I would see?
- Could you describe to me what a normal day in the lab is like for you?
- Can you describe the main activities you carry out as a graduate student in your department?

- Can you tell me all the things that happen in a meeting with your advisor? What type of things do you discuss?
- What are the things that you are supposed to do as a graduate student?
- Can you describe your first year in the department? Do you have any stories or surprises to share?

Once preliminary domains were identified from the first interview, descriptive questions for the second interview were focused around those domains. Some examples include:

- Can you tell me how you usually do _____ (*what the participant said she is supposed to do as a graduate student)*?
- Can you show me some of the _____ (*what the participant said she is supposed to do as a graduate student)*?
- Can you give me an example of _____ *(a possible cover term)*?
- You have probably had some interesting experiences in _____. Could you tell me some of them?
- How would you talk about _____?
- How would you refer to _____?

The third interview included structural questions (in order to complete the domain analysis) in addition to more descriptive questions, while the fourth interview had substantial structural questions that led to preliminary taxonomies. The fifth interview included both structural and descriptive questions in order to verify taxonomies. Some examples of structural questions used in these interviews include:

- Are all these different kinds of _____?
- What other kinds of _____ are there?
- Would you say that _____ is *semantic relation* of _____?

The sixth and seventh interviews used descriptive, structural, and contrast questions in order to uncover paradigms. Some example of contrast questions include:

- Do you see any difference between *term 1* and *term 2*? Can you explain?
- Do you agree that some of the differences between these terms include _____?
- Which one of these _____ requires _____?
- Which two of these are alike and which one is different form the others?

The last interviews used all types of questions to further analyze domains and refine componential analysis. Also, in order to attempt to elicit sensemaking processes once at least one paradigm had been fully identified, questions like the following were asked:

- How did you learn that ____ is different than ___?
- Why do you know that _____ is a kind of _____?
- What kind of experiences or surprises led you to know that _____?

Table 3.1. Universal Semantic Relationships (Spradley, 1979)

Strict inclusion	X is a kind of Y
Spatial	X is a place in Y, X is part of Y
Cause-effect	X is a result of Y
Rationale	X is a reason for doing Y
Location for action	X is a place for doing Y
Function	X is used for Y
Means-end	X is a way to do Y
Sequence	X is a step (stage) in Y
Attribution	X is an attribute (characteristic) of Y

Table 3.2. Domain Example

Included terms	*semantic relationship*	*cover term*
To better humanity		
To attract industry		
To discover	is a reason for doing	research
To obtain prestige		
To be cool		

Table 3.3. Taxonomy Example

<table>
<tr><td rowspan="6">Reasons for doing research

Semantic relationship:

reasons for</td><td colspan="3">To be cool</td></tr>
<tr><td rowspan="3">To attract industry</td><td colspan="2">Funds</td></tr>
<tr><td colspan="2">Networking</td></tr>
<tr><td colspan="2">Prestige</td></tr>
<tr><td rowspan="4">To discover</td><td rowspan="3">Applications</td><td>Products with market value</td></tr>
<tr><td>Money</td></tr>
<tr><td>Improve life</td></tr>
<tr><td colspan="2">Contribution to knowledge</td></tr>
<tr><td>To obtain prestige</td><td colspan="2">Funds</td></tr>
</table>

Table 3.4. Paradigm Example

Contrast Set	*Dimensions of Contrast*			
	Non-Profit	Graduate students' desires	Expected by the Department	Happens often
To discover	Yes	Yes	Yes	No
To attract Industry	No	No	Yes	Yes
To be cool	Yes	Yes	No	No
To obtain prestige	Yes	Yes	Yes	Yes

CHAPTER 4

RESULTS

This chapter begins by introducing a series of methodological remarks that emerged as the study progressed and continues with a brief overview of the research structure of the department in order to facilitate the understanding of participants' viewpoints. Then, a detailed description follows of the students' cultural knowledge with cues related to the department's involvement with industry uncovered in this study and how they relate to previous empirical research. Then, a model developed to illustrate the wider context in which the results of this study are located is presented. Finally, this chapter addresses the primary and secondary research questions that guided this study.

Preliminary Remarks

The design of this study was intended to elicit the differences in organizational culture knowledge between students in early stages of socialization and students beyond candidacy as a strategy to understand socialization processes. For purposes of this study, the first group is called the "beginning group" and the second the "advanced group." As the interviews and preliminary analysis of the data progressed, it became evident that students' socialization occurs mainly through interactions and experiences within their research group. Therefore, the perceptions and opinion of students regarding industry-sponsored research differ not by level of seniority in the department but by their degree of exposure to industrial research. Similarly, early in the study, it also became evident that the experiences and views of students depend on other variables such as whether the student wants to pursue an academic career or not and the main disciplinary orientation (physics, chemistry or engineering) of the students' research group. Given that one of the focus of this study is on the anticipatory socialization to the academic profession of future faculty, it became clear that it was necessary to interview students who want to pursue an academic career as well as students who do not, because in many cases students' aspirations change and there is no certainty about their future career paths.

As the study progressed, participants were selected in order to obtain an even representation of students across these variables including immigration status and gender. Although representation across these variables was achieved, it was not possible to find the ideal mix of students. Students who have had direct experience with industrial sponsors were underrepresented and U.S. citizens were overrepresented both slightly in the beginning group. However, non-U.S. citizens were overrepresented slightly in the advanced group. There were two main reasons why it was not possible to achieve the ideal sampling: 1) some desirable students were unavailable or unwilling to participate and 2) there were not enough students from the beginning group with exposure to industrial research because, by the time of the interview, these students had joined their research group too recently and had not had enough exposure to industry. Appendix B describes the final sample.

By following Spradley's method, over 40 domains of cultural knowledge per group of participants were obtained, from which 21 domains contain information relevant to the department's involvement with industry. Out of these 21 domains, six taxonomies and three paradigms were obtained. Appendix C contains a list of the 21 domains selected, Appendix D shows examples of taxonomies, and Appendix E of paradigms. Following Spradley's method (1979), in the last three interviews per group, clue cards were used in order to uncover the dimensions of contrast, necessary for componential analysis, of three domains chosen due to their relevance to the purpose of the study. The three domains chosen are ways to obtain prestige by faculty members, characteristics of industry-sponsored research, and characteristics of good research.

Common themes and differences in the domains, taxonomies, and paradigms were identified across four subgroups: 1) students from the beginning group with industrial exposure, 2) students from the beginning group without industrial exposure, 3) students from the advanced group with industrial exposure, and 4) students from the advanced group without industrial exposure.

General Overview of the Site

The department has become one of the largest academic centers in their field in the world and has been consistently ranked as one of the top programs by U.S. News and World Report and the National Research Council. The department is located at the north edge of the University campus in a futuristic building with more than 100,000 square feet of laboratories and has over $20 million in instrumentation. According to the department's website, its primary mission is to educate the next generation of scientists in the field, and in doing so, the department offers significant contributions to the industry as a natural outgrowth of the department's interwoven educational and research efforts.

The department only offers graduate studies. Presently, the department hosts an average of 90 doctoral-degree candidates and awards 15 to 20 doctoral degrees each year. About 70% of students are U.S. citizens and about 75% are males. Most students enter the program immediately upon receipt of their undergraduate degree; however, approximately a third of the entering students have worked in industry at least for a summer prior to joining the department. About 75% of entering students graduate and about 85% of students go into industry after graduation. The faculty body has close to 20 members, from which only one is a female.

Although the department formally supports only one doctoral program, it offers courses at all levels and short courses on cutting-edge science and engineering topics at professional meetings across the country. The department also offers research opportunities to undergraduates, and many graduate students are involved in K-12 educational activities in local schools. In fact, in recent years, many of the department's outreach programs, especially those in education, have been initiated, designed, and undertaken by members of the official student organization attached to the department.

In the 1970s, the NSF sponsored the establishment of a center in the department to promote interdisciplinary collaborations. Today, this NSF supported center integrates the

efforts of more than twenty faculty members from six departments of the University (biochemistry, chemical engineering, chemistry, plant biology, physics, and polymer science and engineering) and has research collaborations and outreach programs with over 12 other academic institutions. In the early 1980s, another center was established to enhance industrial interactions as part of the Industry/University Cooperative Research Centers (I/UCRCs) program sponsored by the National Science Foundation (NSF). The I/UCRCs are created to foster partnerships between universities and industry around industrially relevant fundamental research, education of scientists with an industrially oriented perspective, and transfer of university-developed research and technology to U.S. industry to improve its competitive position in the global economy. An I/UCRC often begins with a small grant to seed partnered approaches to emerging research areas for five years to a university professor, who is expected to form a team to run a successful Center based on mainly industrial funding. When the initial five-year grant expires, NSF funding may be extended at a reduced annual level for an additional five years. At this point, the Center is expected to be self-sufficient and supported mainly by industrial funds. Currently, there are around 50 I/UCRCs in the nation, with over 700 partners that provide 10 to 15 times the support from the NSF investment (information retrieved from www.nsf.gov/eng/iucrs).

The I/UCRC center in this department is one of the few centers of this kind that has survived beyond the NSF support. Today, this center has more than 30 industrial partners and four basic programs of interactions with industry with specific guidelines and regulations. One program consists of specific research areas of common interest to industry where industrial partners invest for the general advancement of such areas; the second program consists of one-on-one industrially sponsored research where partners sponsor programs tailored to the sponsors' unique R&D needs; the third program consists of unrestrictive research grants to promote the advancement of science in professors' areas of interest; and the fourth program is

meant for short-term exploration of concepts in order to determine their feasibility for longer-term research projects.

Student's Cultural Knowledge and Emergent Themes around Industry Sponsorship

The cultural domains presented in this section are the result of students' sensemaking throughout their socialization and reflect important cues about the department's culture related to academic capitalism. This section starts with four general remarks: 1) Given that the research enterprise in the department is channeled through either of the two centers described in the overview of the site (where one center involves government funding and the other industrial funding), the experiences and views of the students are directly associated with the type or source of their funding and the degree of involvement of their research group with either type of research.

2) A general theme found was that the views of students from the beginning group with industrial exposure are scarce in many areas due to low representation of students with industrial exposure in the sampling and to students' lack of knowledge; the latter in turn was due to students' inexperience and their being in the middle of their sensemaking process, which meant that they had not formed a script that would allow them to explain the situations they were going through at the time of the interview.

3) Differences across gender were not found. One explanation might be that this study was not specifically designed to address these types of variations. However, given the descriptive nature of most of the questions, if students were going through significant socialization processes regarding gender, it most likely would have been present in the students' narratives. The lack of reference to gender issues, especially by women, may indicate that these female students have been socialized to male environments years before coming to graduate school, at least in their undergraduate experiences. Therefore, at the point of the interview, sensemaking related to gender was inexistent because their gender related schemas in their cultural knowledge are probably deep in their unconsciousness.

4) Differences between U.S. citizens and non-U.S. citizens were scarce. A few international students mentioned having communication barriers, especially with industry representatives. Students from foreign countries were usually more impressed by the facilities and the wealth of the department. One student mentioned that the way science is conducted back in this country of origin was different due to the high costs of laboratory supplies. For example, instead of having 100 samples available to run experiments, as it is the case in this department, in his undergraduate institution there were only 10 samples to use. Therefore, he had to carefully design experiments to avoid unnecessary steps, while here, he has the luxury to relay more on trial and error.

Participants' cultural domains of knowledge with cues related to industrial sponsorship described below include: students' beliefs about 1) general characteristics of the department, 2) faculty, 3) things valued in the department, 4) research, 5) types of funding, 6) partnerships with industry, and 7) career paths. Given that higher degrees of consensus among students were found in main key issues, the differences among groups or individuals are noted as needed.

Students' Beliefs about the General Characteristics of the Department

All participants proudly mentioned that the department is considered one of the best departments in field in the country. Unanimously, students described the department as an outstanding place in terms of the quality of its researchers, including graduate students, and its science. Most of the students consider the department to be very wealthy and with plenty of resources and facilities available, and believe that this affluence allows it to fully support all its students and maintain state-of-the-art instrumentation. Also, students perceive the climate as very positive, collaborative, friendly, supportive and hard-working. According to Lord and Foti, (1986), the students' of the department may be reinforced by the students' preconceived knowledge about the department's high prestige in the nation.

Students believe that the department has a good balance between producing science, educating students, and working with industry. A couple of students mentioned that the balance

is achieved by the nature of the department's mission: by educating students well, it produces good science that translates into useful applications to industry. In other words, unlike findings suggested in previous studies, students do not believe that academic capitalism consumes significant amounts of faculty members' time that could have been spent on basic research or the education of students (Campbell & Slaughter, 1999; Lee & Rhoads, 2003; Slaughter & Leslie, 1997). This also suggests that the influence of academic capitalism on faculty members' teaching time might differ by type of discipline and that in applied fields such loss of time might not be as significant as in other fields giving the greater compatibility between industry and applied fields. The following quotes reflect students' views on this issue:

> The relationship with industry is very beneficial for both sides: it provides cheap labor for companies and gives students … great experiences such as learning how future jobs would be like. And there is a pretty good balance: faculty want to make sure they are giving students the best education possible as well as giving industry some new research.

Also:

> You are in academia pushing materials and you have industry pulling, asking for materials, but I think there is a healthy balance. There's some good science going on.

Students' Beliefs about Faculty Members

One student from the advanced group with industrial exposure mentioned that the most successful faculty members in the department have worked in industry before becoming academics. In the following interviews, students were asked about this statement, and the result was that students believe those faculty who have been in industry before have a better sense of what are industrial needs and problems, see applications more easily, have a useful, down-to-earth perspective, are more able to bring grants because they have more connections with industry, and are more likely to think about the commercialization of research. Some students believe that these faculty members are more interesting, as well as better teachers and advisors, because they are able to talk to students about the industry world more accurately than the

faculty members' peers. In addition, some students mentioned that these faculty members are better managers and better at interacting with people. These are some of the students' quotes about the advantages of these faculty members:

> Despite of the publications or prestige or whatever, the highest quality of a faculty member is to have worked in industry because they have more defined goals, know more about the specific things that are important.

> They have more experience at looking at the realistic end of research, the financial visibility and all that stuff. It is nice to have an advisor who knows what it is like in industry as well as in academia. They are good resources, very good resources.

> Faculty that have worked some years in industry before coming to academia give better teaching because can make more connections to applications and real world situations.

> [Faculty who have worked in industry]…are much better managers of their students than advisors that haven't been in industry… [They have] much better people skills. They understand how to read students better. They provide much better support for their students.

In sum, students believe that those faculty members who have been in industry before following an academic career are very successful and valuable complements to faculty members who followed traditional academic paths. This represents a new theme discovered of the effects of academic capitalism on the academic profession that opens the opportunity to new inquiries and practices. It also reflects a successful integration of Mertonian and entrepreneurial paradigms into the academic profession (Slaughter et al., 2004).

Students' Beliefs about Things Valued in the Department

The system of values and rewards in the department perceived by students are those that are traditionally associated with the academic profession. Unanimously, students believe that conducting excellent research is what is valued and rewarded the most in the department. Therefore, all that is necessary to achieve good research is also very valued. For example,

students mentioned that interdisciplinary collaborations, including collaborations with industry, appear to be very valuable because they enhance the production of good science, especially given the multidisciplinary nature of the field. This result is consistent with previous empirical findings that indicate that faculty members continue to be driven by the academic culture (for example, continuing to conduct research for non-commercial reasons) despite new opportunities to engage in entrepreneurial endeavors brought by academic capitalism (Hum, 2000; Mendoza & Berger, 2005; Powell & Owen-Smith, 2002; Slaughter et al., 2004).

- **Publishing versus Patenting**

Students believe that publishing is highly valued because it is the measure of quality and seal of recognition of the science being conducted and what brings prestige and builds prestige for both faculty members and students. Similarly, students believe that funding for research is also very valuable to the extent that it is indispensable. Most of the students consider that patents are not valued in the department or are valued significantly less than publications. Moreover, a couple of students mentioned that making money from the commercialization of research was not valued in the department. In fact, many students were not knowledgeable about patenting activity in the department, which also suggests the undervalue of patenting in the department. Some of the students' quotes about patenting include:

> I'm sure the department has some patents, I just don't even know about them. They talk a lot more about publications and conferences.

> Patents are not a big issue. They are not really here to try to make money per se. If they had the choice to publish or to patent, I think they would rather publish.

> If there is a lot of this kind of commercialization of research going on, I haven't seen it.

> [Patents]… that's not what drives most of the professors.

Nevertheless, the majority of students recognize some of the benefits of patenting, such as monetary rewards and recognition for being part in the development of a leading technology. One student from the beginning group mentioned that, if a useful application to society comes out of research, academics have the obligation to transfer it to society through patenting.

Students explain that the low value of patents in the department is due to the fact that faculty members prefer to publish because a good publication record guarantees grants as well as recognition in the future, whereas the returns of a patent come in a longer period of time or might not even be profitable. This quote reflects this point of view:

> In the long run, if you've a lot of literature publications your name is going to be better and you're going to get a lot of grants for it because your name is out there, but I am not sure of what a patent gets you, whether it gives you as much.

This perspective agrees with the reasons given by researchers to explain the undervaluing of patents in the academic profession, which relates to the fact that patenting is at odds with the traditional values and rewards systems of the academic profession, that the chances of making significant monetary profits from a patent are very unlikely, and that patenting blocks timely publication, which affects junior faculty in particular (Mendoza & Berger, 2005; Slaughter et al., 2004). In fact, according to Slaughter et al. (2004), junior faculty are advised by their senior peers to avoid industrial monies because that type of funding might not be forthcoming and they should first build a base of federal funding and reputation through publications before adventuring to the riskier world of the private sector. Moreover, professors have expressed their skepticism about universities' attempts to maximize income through the commercialization of research because very few patents actually bring significant monetary returns (Slaughter et al., 2004). In addition, as has been indicated by faculty members before (Slaughter et al., 2004), another reason for the low value of patents is that research in academia is still far from being patentable because industry tends to keep in house research that might

lead to patents in order to avoid shares over ownership and royalties with universities. Students in this study expressed similar views in their quotes:

> For the most part the research that has been sponsored is before really being cutting-edge… [It is about] more generalized problems that an entire industry would face so there isn't a lot of interest in patenting because the research is still too far away of real applications.

> The majority of resources that come into an academic institutions aren't industrial applications because industry wants to keep a lot of stuff close to them to patent it, to make all the money off it. But giving general funding to academia is a good way for them to get exposure in academics and in to get their name out there to facilitate the recruitment of talented graduates.

A previously undocumented trend uncovered by this study is that some students believe that patenting is good for students who want to go into industry because hiring companies might be interested in such knowledge. Also, some students mentioned that patenting through the university is a good opportunity because inventors do not have to cover the legal fees involved.

Very few students mentioned that patents lead to delays in graduation due to secrecy of knowledge. These students clarified, as faculty members have mentioned before (Slaughter et al., 2004), that in most cases confidential information is removed from theses or publications without compromising the integrity of the research being presented. In many cases, faculty members are able to publish works from collaboration with industry (Slaughter et al., 2004), as students from this study also indicated. Therefore, according to the students in this study and to previous research, secrecy of knowledge has not been an issue due to the mastery of faculty members in manipulating research to serve various interests. In great part this is possible because, after all, faculty members are the experts and their sponsors or employers do not know enough to control their work entirely (Slaughter et al., 2004). The following quote reflects students' viewpoints on this issue:

> Academics take the broader scientific aspects and publish them although they give more specific results to industry.

However, the hindering of research information to protect for-profit interests of sponsors has been a source of concern among scholars in higher education, and even among some faculty members, because secrecy is at odds with the public demands and traditional academic norms of higher education regarding the free dissemination of knowledge (Gumport, 1999).

- **Students, Teaching, and Advising**

Students from the advanced group believe that students are very valued in the department. The fact that the value of students was not mentioned by students from the beginning group can be explained as a socialization pattern in which students from the advanced group have gained a better understanding of the role they play within the department. However, students from all groups concur that, in general, advising is valued by faculty members, although few students from the beginning group disagree with this viewpoint. This incongruence also shows a socialization pattern in which students from the beginning group have not had as long a relationship with their advisors as the older students and thus, their perceptions about advising are still forming. Teaching was perceived as both valued and not valued by students from all groups, although more advanced students than beginning students said that it was valued. These mixed results again reflect socialization differences, but, above all, relate to the differences in teaching quality across faculty members. In any case, students in general believe that advising is more valued than teaching in the department.

The high value placed on advising in the department perceived by students from the advanced group has important implications to doctoral retention in the department. Advanced students are in the last stage of their socialization process, which is mainly characterized by the relationship with their advisors (Tinto, 1993). Therefore, students' positive views of advising in the department indicate positive relationships with their advisors, which is the strongest predictor of doctoral retention (Girves & Wemmerus, 1988; Golde, 1998). These positive views about advising also complicate previous worries about the time spent by faculty members in

academic capitalism and away from their labs and students (Gumport, 2002; Kerr, 2002; Milem, Berger & Dey, 2000; Slaughter & Leslie, 1997). It is possible that in applied fields like this one, academic capitalism does not interfere with advising as much as in other fields given the proximity of the discipline to industry. However, it is important to note that these views are not necessarily accurate given that are solely based on students' perceptions.

- **Ways to Obtain Prestige by Faculty Members**

This theme stems from a domain of knowledge studied through componential analysis including clue cards. Each clue card used in the last interviews contained the following ways to obtain prestige in the department: doing good research, having a good publication record, getting awards, having a large research group, having good students, being wanted by students, having students going into good positions, having collaborations with industry, having collaborations with academics, having worked in industry, having patents and having spin-off companies, being wealthy, and being a constructive member of the department. Students were asked to rank the cards according to level of importance. To facilitate the analysis of the rankings given by the students, their classifications were collapsed into four levels: very important, important, somewhat important, and not very important. It is important to note that more than one attribute in the clue cards can be on the same level.

Doing good research, having a good publication record, and getting awards were ranked by students as faculty members' top ways to obtain prestige. The majority of the students ranked doing good research as a very important or important way to obtain prestige by faculty members. A lower proportion but still a majority of students believed that having a good publication record and getting awards are very important or important to obtain prestige. About half of the students believe that having good students, having students going into good positions, having collaborations with industry, and being wealthy are very important or important ways to obtain prestige.

The following attributes were considered as very important or important by fewer than half of the students: being a constructive member of the department and having collaborations with academics was considered very important or important. At the same level, less than 15% of the students ranked as important or very important having worked in industry, being wanted by students, and having a large research group. Finally, none of the students considered having patents and spin-off companies as very important or important to obtain prestige by faculty members, which is consistent with the undervaluing of patents in the cultural knowledge of students described above. These results reflect that, although the traditional values of the academic profession such as doing good research and publications are still the primary sources of prestige in the minds of these students, about half of them consider values brought by academic capitalism as important or very important sources of prestige as well (being wealthy and having collaborations with industry). This point reinforces a common theme in this study: the integration of academic and entrepreneurial values in the cultural knowledge of the participants.

Students' Beliefs about Research

The majority of the students believe that the department is very research oriented, although they have mixed views regarding the type of research being conducted in the department. The advanced group characterizes the department's research as fundamental science but also considers the department as being a leader in the development of new technologies. The beginning group tends to have even more mixed views: some of these students believe that the department works for potential application and others believe that many groups are interested in coming up with applied results. This inconsistency demonstrates that each student expresses his or her views according to his or her particular socialization in a given research group. Also, these mixed views show that students have a variety of experiences due to the rich diversity of types of research and sponsorship existing in the department.

As expected, senior students who have been involved with industrial research, have the most developed and rich perspective regarding the different research programs in the department; this, however, is still limited, which indicates a lack of awareness among students of the administrative research structure of the department. Therefore, students with industrial exposure tend to think that their direct experience with industry-sponsored research, which is related to one of the four programs of the industry-sponsored center, is in fact the most general common type of industrial research in the department. For example, some students believe that industry-sponsored research is very focused one specific industry problem or aims to improve materials already in the market rather than on groundbreaking research or cutting-edge technologies. Other students believe that industry-sponsored research is not product-driven but related to a specific area of research that interests industry in general and is open-ended, long-term research, and published in scholarly journals.

The differences across groups can be explained by the property of sensemaking in which people create their own environments to explain their actions based on plausibility and coherence rather than on objective realities. In this case, the truth of the matter is that both forms of industry-sponsored research coexist in the department thanks to the four programs of the industry-sponsored center; however, students believe that the reality is what they directly experience. This coexistence of different types of research reflects once more the integration of opposite paradigms in which both industry and academia come together successfully.

According to previous studies, as faculty members get closer to industrial money they also get closer to research commercialization. Nevertheless, these faculty members still agree that the best research is basic and long-term and industry is usually not interested in investing in these long-term and fundamental enterprises but in a collection of small, applied projects (Slaughter et al., 2004). However, although professors still hold basic research in high regard, the boundary between basic and applied research is not as clear as it was in the past. In particular, faculty from professional schools like medicine and engineering believe that basic

science is important, but that the purpose of their field is to obtain useful applications (Slaughter et al., 2004).

Interestingly, according to this study, and in opposition to previous empirical research, students do not consider applied research to be better than basic research or vice versa. However, the advanced group tends to have more traditional views based on the idea that basic science is the realm of academia and applications the realm of industry. This trend may be explained by the fact that sensemaking is retrospective and, thus, reconstructs past experiences according to the most recent outcomes. Therefore, advanced students perceive that an outcome of the department's research is publishing rather than patenting, which marks a clear distinction between research in industry and in academia. On the contrary, the beginning group does not have the history to make sense in this regard and focuses on cues instead. For them, the clue that triggers their sensemaking is a heavy presence of industry, which forces them to believe that the differences in research between academia and industry are not significant.

The groups that have not been exposed to industrial research believe that industrial research is specific, well-defined, short-term and under time pressure to deliver specific results to sponsors, which is similar to concerns raised related to the quality of education through industrial projects (Gumport, 1999; Slaughter et al., 2002; 2004). However, there are significant differences in this regard between the beginning and the advanced group (both with industrial exposure): the advanced group considers industry-sponsored research short-term but does not consider it under time pressure, whereas the beginning group perceives industry-sponsored research under time pressure but not short-term. These opposite perceptions can be explained by the fact that the beginning group has spent in the department for a shorter time and has not yet formed an accurate perception of what short-term or long-term means and feels greater time pressure as it adjusts to the academic demands of the program. Similarly, only students without industrial exposure believe that industrial research is under significant time

constraints, indicating that this perception changes once students experience industrial research. Clearly, exposure to industrial funding does affect the viewpoints of students about research.

Despite the variation in students' perceptions about industrial research according to their socialization status, these results suggest that industry-sponsored projects are not necessarily short-term and overly applied, as it has been suggested previously (Gumport, 1999).

- **Characteristics of Good Research**

In order to investigate in more depth students' beliefs about the characteristics of good research, the same methodology based on clue cards and employed with the domain of knowledge "ways to obtain prestige" (as described above) was used. In this case, the characteristics of good research in the clue cards uncovered throughout the first interviews include: it advances knowledge, is executed thoroughly, has good publications, develops broad scientific ability and a well-rounded scientist, has good results, is a well-defined and specific problem, has collaborations with academics, has collaborations with industry, has applications to government agencies, and has applications to industry.

In a scale of very important, important, somewhat important and not very important, students unanimously believe that the most important characteristics of good research are that it advances knowledge and is executed thoroughly. Three-quarters of the students believe that having good publications is also a very important characteristic of good research. The following attributes were considered very important as well (though by fewer students): it develops broad scientific ability and a well-rounded scientist, has good results, has collaborations with academics, is a well-defined and specific problem, and has collaborations with industry. The following two attributes were considered important: has applications to government agencies and has applications to industry. Although collaborations with industry and applications to industry are considered important, these results indicate that students place a greater value on Mertonian values in science.

- **Origin of Research Projects and Degree of Freedom in Research**

Again, students have a variety of perspectives about the origin of research projects according to their direct experiences. Some advanced students believe that faculty members obtain their ideas from their own scientific interests and from the science itself. An intermediate position given by several students was that faculty members bridge their own scientific interests and long-term expertise with funding opportunities and use leftover money to pursue their personal interests. Another important source of research ideas mentioned by most students was collaborations with other academics or with potential sponsors, including industrial sponsors. In terms of differences across groups, students without industrial exposure believe that the origin of research projects depends on the level of seniority of faculty members: younger faculty tend to do more fruitful projects in terms of publications and established faculty tend to follow their own interests more. The majority of students with industrial exposure believe that, on a day-to-day basis, research is guided by the science itself, but that the broader topics and choice of projects are generally influenced by industry or funding opportunities. All these mixed perceptions portray a complex departmental research structure where the origin of research projects is a combination of all these perspectives. Also, these results indicate that students without industrial exposure have not had the cues in their sensemaking process to see the extent of the influence of industry in research. Some students' quotes reflecting these viewpoints include:

> The two main factors [for the origin of research projects] I believe are the research interest of the professors in the department and the direction that the funding agencies like to go. Maybe established professors that have a little bit more of pull in the community are able to do a little bit more with the research as far as from their own personal interest. But some of the newer guys might need to guide, actually go where the money is, unfortunately.

The previous quote indicates that this student, as he expressed his frustration—"unfortunately"—, has a Mertonian view of scientific research (1957) related to the fact that the choice of research projects by junior faculty might be guided by sources of funding.

> There's a lot of big push for bio, nano, everything you know, and all these guys need to fund their graduate students and in order to do that they'll try to integrate whatever they can from their background into some type of biology application.

> Younger faculty are guided by exactly where the money is coming from, but once they get established I think the companies and the funding will give them more freedom as to go off into a slightly new, different direction.

Interestingly, one student from the beginning group without industrial exposure who was in another graduate polymer program before coming to the department mentioned that he had not seen industry sponsors as the origin of research projects in the department as much as in his previous institution. He explained this difference by saying that the department has significant amounts of both industrial and government funding that granted it with a greater level of autonomy and freedom than his previous institution.

The two most popular views of students regarding the degree of freedom of faculty members in research are contradictory: most students believe that faculty in the department have either substantial freedom in general or are limited by sponsors' demands. Other students have intermediate positions, as the following quotes illustrate:

> My advisor does what he wants to do in some aspects and another big part of his money comes from direct sponsored research. At the end it comes down to money, so you do have to sort of choose around the projects but you can tailor things to get funding.

> The department has more free type of research. Less in the engineering groups that are more related to industry but some students and faculty prefer research closer to industry because it has more defined goals.

Few students mentioned that faculty members' academic freedom depends on their seniority and prestige:

> Once you become established and your name is out there and people know you've done very good research, if you have some ideas that are right off the wall they would be more up to sponsor that.
> It is much easier to be extremely creative when you are well established because you have all these past successes that if you have failures, people are not going to bother versus if you are brand new in the field.

Finally, most students believe that government research gives a fair high freedom, especially in relation to industrial research, although the majority of students believe that the constraints of industrial research are not an issue in the department:

By looking at students' views by groups, it appears that most students with industrial exposure tend to perceive that faculty can pursue virtually any research interest in their field. This perception may be explained by the fact that faculty members who conduct research more directly related to industrial applications might not feel constrained because they freely decided to conduct research close to industrial applications and usually there is more funding for this type of research than for basic research. In fact, the most popular reason given by students—especially by students with industrial exposure—for faculty members' research freedom was that faculty have the capacity to find funding to pursue any scientific interest whereas students without industrial exposure believe that faculty are more constrained by funding opportunities. This result reflects that students with industrial exposure tend to have a more positive view about funding opportunities that allow faculty to have significant freedom at research.

The perspectives given by students about faculty members' freedom in choosing research projects represent a remarkable finding that has not been previously documented. The greater availability of industrial funding compared to federal grants gives the perception to students that there is more freedom in industrial research because of the greater number of funding opportunities. This represents a new concept developing in the minds of these students,

which is based on the notion that industrial money is easy to get and provides more opportunities. Slaughter et al. (2004) have shown that faculty in their study reported the growth of value placed on industrial grants due to their accessibility in relation to federal funding. The perception of students in this study goes a step further, in which that greater accessibility is translated into more freedom in choosing research projects.

Students' Beliefs about Types of Funding

Most students agree that, although it has significant numbers of collaborations with industry, the department has a good balance between industry and government research. Moreover, even students who believe that there is more industrial-sponsored than government-sponsored research projects, which are mainly students from the beginning group, agree with this perception. These students believe that there is more industrial funding because it is new for them and it is thus more noticeable—a cue for sensemaking. In other words, as they progress in their socialization, students notice industrial funding less.

Older students without industrial funding mentioned that they do not see any apparent difference between government- and industrial-sponsored research except in cases where industrial funding has been abruptly cut by the company. Also, one student from this group mentioned that students involved with industrial funding tend to publish more and get results faster. The fact that these differences were not mentioned by groups with industrial exposure indicate that the cues that lead students to believe these differences are more apparent for students without industrial exposure, and that there are indeed differences between government- and industry-funded research, which are the cues that these students are noticing.

Students from all groups agree that is important to have both types of funding because they complement each other and it is beneficial not to depend entirely on only one source of funding. As one student said:

> Is important to have both government and industry sponsors so industry is not going to have much of a say knowing that you have the backing of government and vice

> versa. I think that it is important that it's coming from lots of different areas just so that you get that balance and make sure that everyone it is kind of like in check.

Interestingly, one student from the older group mentioned that there should be more industrial investment because industry should have the responsibility to contribute to the development of technology for the future of the nation.

Most of the students believe that government funding is as beneficial as industrial funding and see no negative effects of government funding. Only a couple of students mentioned that the negative side they could see about government funding is that sometimes it is targeted to undesirable research—such as weapons—and many times what the government would do with their sponsored research is unclear. On the other hand, students from the advanced group believe that industrial funding is uncertain, since it depends on the market, the economy, and the finances of the sponsor. In fact, some students talked about incidents where projects have been terminated due to cuts in industrial funding. However, they still believe that these incidents are rare and they have positive views about industrial funding. Also, students believe that government funding is longer-term, more reliable, and more interested in basic science and publications. Finally, as recent studies on the decreasing value of federal funding have shown, students perceive that federal and industrial funds are equally valued because what counts are monetary resources to conduct research, regardless of source (Slaughter & Leslie, 1997; Slaughter et al., 2004).

Students' Beliefs about Partnerships with Industry

As faculty has indicated in previous empirical studies (Slaughter & Leslie, 1997; Slaughter et al., 2002; 2004), all students unanimously agree that one of the greatest benefits of partnerships with industry is the funding to conduct research and support graduate students. Also, students unanimously mentioned that other benefits are job opportunities and networking as well as having the opportunity to visit companies, interact with industry representatives, and learn about industry before committing to a company. In fact, one student mentioned that about

75-80% of people who go into industry out of the department go to companies affiliated to the department's industry-sponsored center.

In a similar tone, all students consider that industry-sponsored research is a good experience for their education. Some students said that interacting with industry representatives is interesting and an opportunity to learn about industrial problems, obtain projects for their dissertations, and get feedback and practice presenting and communicating with industry representatives. Students mentioned that industry representatives' insights in the direction of research are very useful and important because they provide a down-to-earth perspective in terms of what is applicable and doable on an industrial scale.

Also, students consider that it is important to stay current and knowledgeable about industrial research, needs, and problems and have their perspective about the department's research because most funding, including government funding, is tailored towards industrial needs. Moreover, some students appreciate the specificity and well-defined nature of industrial research. Other benefits of industry-sponsored research, mentioned by the beginning group, include students as cheap labor for companies and opportunities for students to work in companies for short time periods. Slaughter et al. (2002) have indicated the notion of graduate students' cheap labor for industry sponsors as a sign of potential students' exploitation. However, the students in this study see their cheap labor as a fair benefit to industry in return to the benefits that students receive from these exchanges. In fact, the results of this study did not suggest at all instances of exploitation. Again, it is important to highlight that these are the perspectives of students, who do not have an overall picture of what these exchanges mean for faculty and industry.

The department hosts two conferences a year in which research groups present their research to industry representatives and, at the same time, industry representatives give talks about their companies and job opportunities. During those conferences, industry representatives both stay current about the research being conducted in the department and also actively recruit

students. Students who have participated in these conferences are very satisfied with this experience. From a more pragmatic perspective, students believe that it is a benefit to be able to present their research to industry representatives in the department without having to travel and cover the respective expenses:

> Interactions between students and industry are very positive. Students got to show off their work in their own environment, industry representatives keep portfolios of students and, as they come every year, they got to see students' progress and some recruit them.

Students, particularly those from the beginning group, have very positive views about industrial funding. This tendency can be explained by the fact that students from the beginning group are more engaged in sensemaking, which is grounded in identity construction that tends to preserve a positive image of their organization. Also, students from the beginning group have not been in the department long enough to experience or witness the impact of industrial funding more comprehensively. Also, the department's high prestige and faculty members' high reputation might induce in students a general preconception that everything in the department is good. As students socialize and have a chance to learn about the department more thoroughly, they discover that there might be weak points in the department. This explains why advanced students tend to have less positive views about the department compared to the beginning group. Some of the positive remarks from the students in the beginning group about industrial funding include:

> The relationship with industry is very beneficial for both sides.

> I actually like having all the applied things around because while you are doing some sort of fundamental research here, you are keeping in touch with applied as well.

> Somehow industry is obviously very happy with what is happening because they are giving all the money, so it seems to work and it works for everybody.

They complement each other. It's like a symbiosis.

In summary, students' positive views on industrial sponsorship are one of the most significant contributions of this study. Previous empirical studies have not identified this perspective because they have been focused on faculty members' perspectives. This result complicates previous negative assertions (e.g., Gumport, 1999; Slaughter et al., 2002) about partnerships with industry, which in some cases might bring significant benefits to the education of graduate students.

Most of the negative effects of industrial funding mentioned above were speculative rather than accounts of actual incidents or experiences. In fact, most students mentioned that they could not think of any negative effects of industrial funding. However, the few negative remarks about industrial funding were about the uncertainty about this type of funding, which might not be as forthcoming compared to government funding. Other students mentioned that industrial funding might restrict research and the creativity of academics and graduate students, but then they clarified that they have not seen that happening in the department. Two students mentioned that a very specific industrial project might take students' time away from their academic obligations and focus. However, in the following interviews students were asked about this and none of them reported any specific incident. Similarly, two students with industrial exposure mentioned that industrial projects might sometimes be too narrow and lack a nice overlap with the literature, but no additional supporting evidence was found in the follow-up interviews.

Two students from the beginning group without industrial exposure were the only ones who brought the issue of faculty's spending too much time with industry rather than teaching or advising. However, the views of these two students were contradictory: one considered that faculty members were spending too much time with industry sponsors and meeting their demands, while the other student said that he did not see that happening. These opposite views might reflect isolated instances and differences in students' personal preferences regarding

advising styles—given that some students desire or require more attention from their advisors than others—rather than a systemic issue, as has been suggested in previous studies (e.g. Lee & Rhoads, 2003; Slaughter et al., 2002).

Other isolated, potentially negative effects mentioned by students were all made by the beginning group. However, these students clarified that, although they have not witnessed these incidents in the department, they might happen. One of these students, who has no experience industrial funding, thought that maybe there could be more emphasis on other areas—such as history or philosophy of science—if there were less influence of industry in the field. Another student, who has not had exposure to industrial funding either, mentioned that whether or not there are negative effects of industrial funding depends on the different values and beliefs that each person might have around capitalism models. Finally, only one student from the beginning group that has had exposure to industrial funding mentioned that industrial funding might bring intellectual property issues with it.

- **Intellectual Property Issues**

Previous studies with faculty members have shown that intellectual property issues are one of the greatest areas where tension and conflict can emerge from faculty members' involvement with industry-sponsored research (e.g. Campbell & Slaughter, 1999; Mendoza & Berger, 2005; Slaughter & Leslie, 1997). However, it is remarkable that the majority of students in this study have not noticed any such issues in the department. Some students mentioned that those types of issues did not exist because there were contracts and agreements beforehand in order to prevent them. The fact that students are not aware of intellectual property issues doesn't necessarily mean that there aren't any of such issues. At least is safer to say that the majority of students are not being affected.

Some students with industrial exposure mentioned that the only intellectual property issue they had seen was graduate students' inability to present and publish some results; in some cases, this had led to delays in the completion of dissertations. However, a student narrated a

case where a professor gave a postdoc the option of disclosing patentable information during a job interview and take the risk of not getting the patent. The rationale given by the student for the professor's attitude is that, although patents might be beneficial in the long run, it is even more beneficial for a professor to have a contact—such as a graduate student or a postdoc—in a good industry position, given the possibility of future collaborations.

- **Impact on the Training of Students**

Students believe that industry-sponsored research does not affect the quality of the training of graduate students because, regardless of the project in question, they are still learning how to do research in the discipline and have to understand the basic science anyway:

> There are obviously some projects that are very specific to one thing, but you come to graduate school to learn how to do research. Regardless of the type of project, you should gain knowledge in terms of understanding how to do research and how to use the techniques and even in a very narrow project you can learn a lot about how to do research.

Also, students stressed the role of the advisor in guaranteeing that industry-sponsored projects involving students turn out to be a learning experience and not just work for a company:

> I think so far there has been a really good incorporation of industry-sponsored research into academic projects and working towards the students' goals rather than for industry. Advisors take precautions to make sure that the students are not being used by the company and more that the students get their benefit out of it even though, the company is paying.

Therefore, according to students, advisors make sure that students go through the rigors of academic work even in industrial projects that might be very applied and product-driven. Similarly, Slaughter et al. (2004) have shown that faculty try to engage students with challenging problems related to industrial sponsorship meaningful to their dissertation. In fact, students believe that advisors successfully achieve meeting sponsors' demands and commitments without compromising the training and creativity of graduate students. Most of the students mentioned that industrially funded projects are integrated into students' research

and lead to dissertations, even in cases when a student participates in a collection of small projects, because all these projects generally fall into a theme and can be overlapped and integrated with the literature into one single coherent dissertation:

> My advisor does a good job of trying to incorporate usually multiple projects and he tries to have them all tied together into dissertations.

> Projects with industry have an overlap with each other and with the literature. They are published in journals. Even students who have been sponsored basically by industry, their training has had sufficient basic research and in basic science. Whether research is funded by industry or pure academic research, the process is still the same, the scientific position is still the same.

However, faculty members tend to consider long-term projects to be better than collections of short-term projects (Slaughter et al., 2004); therefore, students' views about short-term projects as equally good, some long-term projects represent a change in the conceptualization of research. These results indicate that students' views are changing in relation to the views of faculty members as students socialize in an environment with industrial funding.

The student who transferred from another department mentioned that, in his previous institution, students have to work for industry in projects aside from their dissertation because that department is not wealthy enough and depends more heavily on industry, leading to more specific and product-oriented research. In that institution, industrial projects tend to be too applied and narrow to be considered part of a dissertation. Some of the quotes given by this student reflecting the situation in his previous institution include:

> Here there is an intimate contact with industry, and yet people don't have to put down their work and do those things. In both cases they're working with industry, but something about this model is working.

> There are students who are very committed by necessity to a TA or to working in the stock room more than 20 hrs a

> week in clerical things to keep the department running. On top of that, there are projects with companies, which are good experience and contacts, except that a lot of times you can't publish what you are doing in that and so you end up working a lot so that these partnerships with business that have money allow the research groups to continue. That is a situation that I don't see here. It's a different type of life… [Here] they have enough money that people don't suffer in traditional ways. It's actually the affluence that makes it a good place to do science.

The comments of this student reveal that the effect of academic capitalism may be highly context-specific. For example, this study reveals that the department in this study occupies a very privileged position, which attracts significant amounts of funding from both government and industry that in turn allows faculty to have enough academic freedom to pursue scientific research and preserve the core academic values and the integrity of assistants as students despite the close partnership with industry. However, this might not be the case in other institutions in less-privileged positions.

Students' Beliefs about Career Paths

Students do not perceive in the department that following an industrial career is more prestigious than following an academic career or vice versa. In fact, students believe that it is better to go into industry for some years before following an academic career. In their minds, the dichotomy between industry and academia does not exist; instead, they see these two worlds as complementing each other. In fact, the most popular reasons given by students of all groups for going into are to academia preserve the core of academic values where industrial experience is seen as a tool to achieve traditional academic goals. This belief complicates previous assertions about the types of values that might be transmitted to students who work in industry-sponsored projects away from academic values (Gumport, 1999).

Participants could be divided in three groups related to their career aspirations: those who want to follow an academic career, those who want to follow an industrial career, and those who aren't sure what path to follow. Some of the students who want to follow academic careers

are considering to first experience industry a few years, which once again indicates the high value of industry for these students and its proximity to the field.

Contrary to what has been suggested in previous studies about students' concerns regarding the demands of the academic profession, very few students mentioned that the high demands of the academic profession was a factor in their choice of career paths (Girves & Wemmerus, 1988; Golde & Fiske, 1997; Fagen & Wells, 2000). This result might be explained by the high selectivity and expectations of the department, which fosters a hard-working environment and attracts high achieving students used to work under pressure to meet high standards. The following sections overview the reasons given by students to follow an academic or a industrial career.

- **Reasons for Going into Academia**

The most popular reason given by students of all groups for going into academia were academic freedom and autonomy. Other reasons for following academic paths include not being constrained by quarter-to-quarter assessments or the finances of a company, the ability to do science for the sake of science, inquire into broader aspects of science, be involved with long-term projects, disseminate knowledge freely, interact with other academics, and go to conferences. Other students want to go into academia in order to teach and interact with students. Finally, other reasons given by students were having a theoretical background and being attracted by the challenges of the academic profession and its prestige and privileges.

- **Reasons for Going into Industry**

Two of the most popular reasons given by students for going into industry were better pay and more options. Another common reason mentioned by advanced students was their preference for working on specific and short-term projects aimed at direct applications, as is usually the case in industry. The fact that this reason was given by students from the advanced group can be explained by their having more research experience and a better knowledge of the different types of research. A few students from the beginning group want to go into industry

because they feel they do not have good enough communication and social skills to be good teachers and interact with students. The fact that the advanced group did not mention this reason might indicate that students gain confidence in these aspects as they advance toward their degrees. Other reasons given by a few students for going into industry were feeling overwhelmed by the demands of an academic career and their aspiration to have other experiences in different environments. Finally, individual reasons given for going into industry include the desire to work on applications that could affect people's lives and the wish to have even more multidisciplinary collaborations than an academic setting can offer.

Overview of Students' Beliefs

In order to illustrate the wider context in which the results of this study are located, the following model was developed for the factors influencing the department's culture and the relation of such factors with the department's products (Appendix F). This model is based on the characterization of the department's culture obtained in this study through the cues picked up by students in combination with the theoretical framework. The next paragraph briefly describes such a model.

The department's culture is influenced primarily by an overarching academic culture. Secondly, it is influenced by a specific disciplinary and the institutional culture of the department's university. The results of this study indicate that the department's culture is also influenced by its high ranking. This high ranking translates into the department's high prestige, which attracts significant amounts of federal and industrial funding as well as outstanding faculty members and students. In addition, the academic, disciplinary and institutional cultures are also influenced by the department's culture because the department's members are all part of these cultures at the same time. Finally, as it is clear from the descriptions above, partnerships with industry also contribute to the department's culture. The abundance of symbolic (prestige), material (funding), and human (outstanding faculty and students) capital foster the culture enacted by its members. The actions of faculty members and students guided

by such a culture produce well-respected research in the field, partnerships with industry, and new scientists that follow academic or industrial careers or a combination of the two. Those who pursue an academic career might contribute to the overarching academic and disciplinary cultures as they bring their cultural knowledge to their entering departments. On the other hand, those who follow industrial careers are likely to continue their relationships with their advisors through partnerships as new industry representatives.

Addressing the Research Questions

Primary Research Question

- *How do high levels of academic capitalism within an academic department influence the socialization of doctoral students?*

According to the results of this study in this specific department, industrial sponsorship, as a form of academic capitalism, influences positively the socialization of doctoral students in this department in a variety of ways. In summary, on the one hand, students believe that industrial funding and their interactions with industry representatives are very beneficial for their education and department. On the other hand, the values that these students are acquiring throughout their anticipatory socialization to the academic profession maintain the core structure of Mertonian values (Merton, 1957). These students see partnerships with industry as a vehicle to achieve the traditional outcomes of the academic profession, which might represent a shift in the academic culture as some of these students pursue academic careers. Slight differences were found between students that have been more exposed to industry than others, but those differences do not represent a significant detour from the academic culture being acquired in their socialization. Therefore, academic capitalism in this specific department, positively influence the anticipatory socialization to the academic profession by promoting a culture that preserves the traditional academic values and recognize the advantages of industrial partnerships at the same time. If this integration of perspectives are occurring broadly across academic contexts, it could favor the future of the academic profession by promoting a culture

that partners with industry without compromising the academic profession as public funding to higher education decreases and scholars are pushed to find alternatives sources of revenues.

The influence of industrial funding on the socialization of students in this specific department offers positive opportunities that are known as strong predictors of doctoral retention such as positive student-advisor relationships and guaranteed funding throughout the program as well as students' direct involvement with the research enterprise of the department (e.g. Girves & Wemmerus, 1988; Golde, 1998, Tinto, 1993). In this department, students normally conduct the research sponsored by industry, which provides them with a central role in the development of research with potential industrial applications. In addition, projects with industry usually foster students' involvement with the department because these projects are generally conducted by a team of researchers including other students, faculty and industry representatives. In addition, the positive views of students regarding advising suggest that student-advisor relationships are positively affecting the socialization of students.

Secondary Research Questions

- *What are graduate students' expectations regarding their departments' values, norms, and expectations of entering students?*

Most of the students in this study expect full financial support throughout the program and access to good and well-maintained instrumentation as well as to find a competitive job upon graduation and to advance efficiently towards completion of the degree. In addition, students from both groups mentioned that the department expects from students to become independent researchers, dedicated to hard work that would lead to outstanding research, competency in the field, and publications.

Interestingly, only students from the beginning group mentioned aspects related to their education. This group said that they expect an appropriate learning and research environment under the supervision of good advisors, publications, and an adequate infrastructure related to extracurricular activities. The fact that students from the advanced group did not mention these

educational aspects could be explained by assuming that students in the beginning group are more actively engaged in sensemaking related to their education than advanced students who are mainly concentrated in their dissertations, graduation, and future professional lives. Also, this can be explained through doctoral socialization theories, in which students in the early stages are concern about gaining membership in the community and developing the competencies necessary to meet the academic demands of the program whereas in the last stage of socialization, the relationship with advisors through research is the critical factor in their socialization. Therefore, students from the beginning group are more likely to pay attention to cues associated to their education. In any case, the expectations of both types of students reflect values of the academic world such as outstanding research, free dissemination of knowledge through publications and adequate education. At the same time, students value pragmatic aspects such as adequate funding and job opportunities.

Empirical studies have shown that discipline expectations unmet are a cause of doctoral attrition (Girves & Wemmerus, 1988; Golde 1998; Lovitts, 2001). All students in this study said that their expectations about the department and the program have been met and are very satisfied with their experiences in the department. Certainly, the department's involvement with industrial partners contributes to students' satisfaction as it has been narrated in the previous section. This satisfaction can be also attributed partially by students' interests in working in industry before enrolling to the program and the high prestige of the program. Nevertheless, these results agree with the retention rate of the department. Normally, the students who leave the program (about 25% of each class) are those who fail the qualifier examinations. Therefore, them main reason to quit the program is mainly academically; although there might be a correlation between academic performance and involvement and motivation to stay in the program in the early stages of socialization that requires further analysis.

- *What types of surprises do entering graduate students encounter as they become members of their departments? Which of these surprises are related to academic capitalism? What factors influence the types of surprises that graduate students encounter?*

None of the students could remember a significant surprise that they encountered when they entered the program. In part, this could be explained by the fact that once sensemaking due to a surprise is concluded, the cultural script acquired through that process becomes part of the basic assumptions and beliefs in the deepest level of individuals' organizational culture, which is usually difficult to observe (Schein, 1985; Weick, 1995). In other words, by the time of the interview, students had forgotten most of the surprises. However, if a surprise evokes significant emotional reaction, it will most likely be remembered (Louis, 1980). This indicates that there weren't significant mismatches between students' assumptions and the department that would've provoked strong reactions.

In fact, most of the students mentioned that they had a good idea of what to expect because all of them visit the campus during the department's interviewing process of prospect students. Students mentioned that during the interview, faculty described thoroughly the department, expectations and the program to students. Also, students clarified that they knew what to expect form their undergraduate institutions. This result emphasizes the academic nature of this department in relation to other academic departments.

These results indicate that the department adequately informs students about the requirements and expectations of the program starting during the interview process. Therefore, the number of surprises or expectations not met encountered by students is minimized, helping students to adapt to the department. Given that lack of clarity regarding doctoral programs is a predictor of attrition (Bolce & Boyle, 1998; Golde, 1998), these orientation practices are fostering students' retention and satisfaction in the department.

Students unanimously mentioned that they encountered significant academic challenges when they entered the program. In fact, the high academic demands of the department were a

surprise for some students. In particular, all students remember the first year as very difficult academically. Also, several students expressed the challenges they faced when they started to work in the lab due to their inexperience with specific instrumentations and techniques. Again, these challenges expressed by students are not related to effects of academic capitalism but to the demands of the academic and research nature of the discipline. Only one student from the beginning group said that one of the greatest challenges faced was to present to industry representatives and learn how to communicate with them. It is important to note that the remarks of this student can be partially explained by the fact that this student is a non-U.S. citizen facing language and cultural barriers.

- *What are the cues that graduate students pick up in their sensemaking process that reflect academic-capitalism elements of the departmental culture?*

Given that sensemaking is a process that becomes unconscious once the individual has adopted a behavioral script in response to a cue (Weick, 1995), students in this study normally had difficulties recalling a cue or a specific sensemaking process. Therefore, it was not possible to obtain reliable information about cues or the sensemaking process of participants as they were going throughout their socialization. In other words, this study obtained information about their cultural domains of knowledge at a given point in time rather than the process by which such cultural knowledge was acquired. Throughout this study, it became clear that in order to access the process of socialization using sensemaking perspectives, it is necessary to conduct a longitudinal study designed to interview a single participant periodically over several months to access their thinking process while is taking place and before is forgotten by the student.

- *How do socialization experiences in environments heavily involved with academic capitalism influence graduate students' career aspirations and expectations?*

The results of this study did not found significant influence of industrial funding on the career aspirations of students. Students either have clear sense of whether they want to go into academia or industry or are undecided; but normally, their career aspirations do not change

throughout their program and are independent of their level of interactions with industrial sponsors. A possible explanation could be that fact that many students believe that obtaining experience in industry before coming into academia is very valuable; therefore, some students mentioned that they were planning to work in industry for a few years and then aspire to academic jobs. In other words, in the minds of these students, industry and academia are not incompatible worlds.

However, having interactions with industrial representatives and the industrial enterprise help students prepare for their future professional careers, either academic or industrial. Also, these connections show students that the program is adequate to meet the demands of industrial jobs. This perception is reinforced by the fact that many students in this department end up working in the companies that sponsored their research as doctoral students. Students' concerns regarding life style and the job market have been shown to be another predictor of attrition (Golde, 1998). Therefore, seeing that there are real job opportunities upon graduation encourage these students to stay in the program. The adequacy of graduate programs for the challenges of professional careers is one of the main concerns of today's graduate education (i.e. Astin, 2002; Gaff & Pruitt-Logan, 1999; Golde & Dore, 2001; Haworth, 1996; LaPidus, 1998). However, the department's connections with industry provide a training environment for graduate students relevant to the careers' present challenges and needs in the field, including an academic career, because in this field, it is closely related to industry. The proximity of this field to industry is evident by the fact that several faculty members in the department have worked in industry for several years before becoming academics.

- *How do socio-demographic characteristics such as gender, age, race, ethnicity, and foreign status influence graduate students' socialization in light of academic capitalism?*

This study did not find significant differences in students' socialization or cultural knowledge due to age, race, ethnicity or gender. However, this study was not specifically

designed to address variations across these variables; therefore, variations might exist. Also, female students have been socialized to male environments years before the interview, which shades any sensemaking process related to gender.

The influence of socio-demographic characteristics on students' socialization found include: 1) A few older students have worked in industry before enrolling into the program. These students have a broader and more realistic view of industry and understand more how to deal with industry representatives. 2) Based on the descriptions of foreign students, they tend to face more communication struggles and anxiety when they interact with industry representatives. Also, students coming from developing countries tended to highlight more the wealth of the department.

Overview of Results

Previous studies have indicated a host of benefits of industrial funding related to graduate education and retention, such as funding and networking opportunities for students, as well as areas of concern such as secrecy of knowledge leading to delays on graduations and publications, overemphasis on applied research that might affect the quality of graduate education, potential intellectual and labor exploitation, and cultural socialization processes at odds with the traditional values of the academic profession and the role of higher education in society (e.g. Campbell & Slaughter, 1999; Gumport, 1999; Slaughter et al., 2002; 2004). However, the results of this study magnify some of the benefits uncovered in previous studies, mitigate some of the concerns raised, and integrate what have been previously presented as opposite perspectives. Nonetheless, it is important to acknowledge that the results of this study are based solely on the views of graduate students, leaving behind other aspects that might affect the socialization of graduate students. Moreover, students' views might be limited to their specific frame of reference. In other words, the views of students are directly related to their close environment, which might not reflect other environments within the department. Also, the concerns and negative effects raised in previous works might indicate that they might

vary according to type of disciplines, in which in applied fields like the one in this case, the effects of academic capitalism might be attenuated by the natural proximity of the discipline to industry.

The graduate students in this study have a very positive view of the cumulative effects of industrial sponsorship on students. They are very grateful for the education they are receiving in the department and the opportunities that they have due to industrial sponsorship. The results of this work portray a department that uses industrial sponsorship to foster a learning environment for students by providing them not only with full financial support throughout their doctoral studies and outstanding facilities—including state-of-the-art laboratories and expensive instrumentation—but, more importantly, with valuable opportunities to interact with the industrial world, be involved in projects that might have a real impact on society, and find jobs upon graduation. In addition, this study suggests that students have positive relationships with advisors. All these factors are known in the literature to be predictors of retention.

Contrary to what has been previously said by other scholars, this study did not find incidence of intellectual property issues, delays on graduation or exploitation of students' labor. Also, these students believe that their research is mainly related to fundamental science, regardless of who sponsors it. Moreover, students mentioned that they have been able to publish and present their research freely without feeling constrained by sponsors' demands. Students in this study are satisfied with the amount of freedom they have in research and believe that their advisors also have such freedom.

This study found a case study where partnerships between industry and academia become a win-win situation. By supporting research in the department, industry gains access to talented students who are trained in their specific areas of interest. Industry also gets insights related to the fundamental science behind their products and firsthand information about new discoveries that might lead to innovative products in the future. Through these partnerships,

industry also has access to sporadic consultation with experts in the field and state-of-the-art instrumentation. On the other hand, partnerships with industry provide students with a powerful educational experience as well as with valuable job and networking opportunities. In addition, the department obtains funds to sustain research and students and opportunities to enhance doctoral retention.

These cumulative effects indicate that, if appropriate contracts with industry meant to protect the academic core values are in place, industrial partnerships offer numerous benefits to academic institutions. Therefore, the results of this study have meaningful implications for policy and practice at various levels, as well as to our conceptualization of academic capitalism. The following chapter develops these implications, overviews the limitations of this study, and provides insights for future research.

CHAPTER 5

DISCUSSION

Synthesis of the Study

Emerging research indicates that academic capitalism has proliferated in the last two decades, particularly in science and engineering (Gumport, 2002; Mendoza & Berger, 2005; Slaughter & Leslie, 1997). In addition, empirical studies have documented a range of effects that academic capitalism has exerted on graduate students, including delays on publications, conflicts over intellectual property issues, and intellectual exploitation (Gumport, 1999; Slaughter, Campbell, Hollernan & Morgan, 2002; Slaughter et al., 2004). Moreover, from an organizational culture perspective, scholars have suggested that academic capitalism might be affecting the academic profession and doctoral education through non-traditional patterns of socialization in graduate school as cultural clashes between industry representatives and faculty members are likely to occur as a result of fundamental differences between business and academic values (Gumport, 1999; Mendoza & Berger, 2005). However, the knowledge generated from these studies has been derived primarily from the perspective of faculty members, ignoring the voices of graduate students. This study investigated the impact from students' point of view of academic capitalism on the socialization of graduate students in environments heavily involved with academic capitalism.

Theoretical Framework

Given the relevance of socialization processes for the purpose of this study, the theoretical framework used is based on frameworks of socialization to the academic profession and in graduate education with emphasis on sensemaking perspectives. This section briefly overviews the key points of such a theoretical framework.

On the one hand, faculty members learn the academic culture, depending on their discipline and specific department, through a socialization process that consists of two stages: anticipatory and organizational (Tierney & Rhoads, 1993). Anticipatory socialization occurs

during graduate school, where individuals learn attitudes, actions and values about the faculty group in their discipline and the profession at large. On the other hand, this anticipatory stage corresponds with the last socialization stage of Tinto's theory of doctoral persistence (1993), which places socialization as an essential process to retain doctoral students.

Sensemaking refers to the ongoing cognitive process to rationalize the situations in which members of organizations find themselves (Weick, 1995). During socialization, newcomers find themselves in an environment with high levels of uncertainty and ambiguity that forces them to engage in sensemaking at higher rates than do the older members of the organization (Louis, 1980; Weick, 1995). New members may contribute to the reshaping of the culture in the new setting because they bring new vocabularies that are shared with insiders. The sharing of these new vocabularies might provoke sensemaking processes in older members, who in that case would redefine meaning and reshape the organizational culture (Weick, 1995).

Therefore, graduate students in the anticipatory socialization stage of the academic profession and doctoral socialization begin to internalize a series of meanings through sensemaking that allow them to anticipate outcomes and events to succeed in graduate school and as junior faculty. Given that newcomers contribute to the reshaping of the culture in the organization they enter, the set of assumptions that junior faculty bring from graduate school might reshape the academic culture of the entering department when they are successfully socialized and become part of the faculty. If junior faculty bring cultural knowledge with business-oriented values to their entering department, they could foster a cultural change in departments heavily involved with academic capitalism through socialization processes towards a businesslike culture, which might have significant implications for graduate education, the future direction of basic research, and for the system of rewards and recognition in these departments.

Research Methodology

Giving the existing gap of knowledge regarding the impact of academic capitalism on the socialization of doctoral students in science and engineering, the research strategy chosen was a descriptive case study (Yin, 1994) of a department with high levels of academic capitalism at a Research I university; graduate students were the primary sources of data. Ethnographic interviews were used in order to obtain rich information about participants' cultural domains of organizational knowledge in light of industrial sponsorship, a form of academic capitalism (Marshall & Rossman, 1994; Spradley, 1979).

By following Spradley's method of ethnographic analysis (1979), several domains and a few taxonomies and paradigms of the cultural domains containing relevant information about industrial sponsorship were obtained per group of participants. One group consisted of 10 doctoral students in the early stages of socialization (adaptation stage) and the other of 10 doctoral candidates students beyond candidacy (anticipatory socialization stage). Once these domains, taxonomies and paradigms were completed, common themes across the groups of participants were identified in order to assess the degree to which the cultural knowledge differs in these paradigms. Then, a thematic analysis was conducted following Weick's (1995) seven properties of sensemaking, Louis' framework of surprises for newcomers, and theories of doctoral persistence (Girves & Wemmerus, 1988; Golde, 1998; Tinto, 1993).

Results

Students are very satisfied with the climate, experiences, and opportunities that the department offers and believe that such a positive environment is due to the wealth accumulated from both industry and government funding which allows it to attract excellent students and faculty members and maintain outstanding facilities. The research structure of the department fosters the coexistence of both government and industrial funding, leading to a rich variety of types of research, from basic to applied, as well as interdisciplinary collaborations involving academia, government and industry. Due to this rich research environment, the separation

between applied and basic research is shrinking more rapidly in the minds of these students than in the minds of the present generation of faculty members (Slaughter et. al, 2004).

Findings from this study suggest that academic capitalism has implications for the anticipatory socialization to the academic profession. The cultural knowledge acquired by these students includes the belief that industrial funding is very beneficial to the department. In fact, a remarkable finding of this study is that the majority of students could not see any negative effects of industrial funding. Students in general are very satisfied with the opportunities that industrial funding offers to their training, such as the opportunity to stay current about industrial applications, networking for future jobs, projects and ideas for dissertations, useful feedback, exposure to different communication styles, and visits to companies. Moreover, students highly regard faculty members who have worked in industry before becoming faculty members and consider them as valuable resources and a complement to faculty members coming from traditional academic paths.

However, despite the high value that students place on industrial partnerships, the traditional values of the academic profession are being preserved throughout their socialization. Moreover, students believe that, by providing resources, valuable experiences to students and research insights, these partnerships play an essential role in the achievement of the main goals that traditionally have guided the academic profession. For example, students in this study believe that good research published in prestigious journals and the training of students are very valued in the department. Therefore, according to these students, patenting and students labor to consolidate partnerships with industry are not guiding faculty members' behaviors. Instead, students believe that faculty members' commitment to the advancement of knowledge and the training of future scientists is not being jeopardized by academic capitalism.

The differences found in this study between students who have been directly exposed to industrial funding and students who have been sponsored mainly through federal grants indicate that, as they participate in research sponsored by industry, students acquire views in favor of

industry-academia partnerships. The most salient differences between students exposed to industry funding and students sponsored by the government include:

1) Students without industrial exposure tend to have more traditional views based on the idea that basic science is the realm of academia and the applications of science belongs to the realm of industry. Additionally, these students believe that industrial research is very specific, well defined, short-term, under time pressure to deliver specific results to sponsors, not in the core of students' dissertation, and without a coherent overlap with the literature. However, once students are exposed to industrial research, they realize that applied research requires a fair amount of basic research and that there are many types of industrial research, including projects that are long-term and less specific. Also, as they engage in industrial-funded research, students find that there is no more pressure to deliver results to industrial sponsors than to present at academic conferences or submit papers to journals. On the other hand, these students believe that industrial projects usually fall into a theme that can be integrated into a dissertation and the literature in the field.

2) Students who have been supported mainly by federal funding believe that funding opportunities are competitive and difficult to obtain, whereas students who have been sponsored mainly by industry believe that funding is plentifully available and easy to obtain. Also, students relate faculty's ability to obtain funding with freedom in research. Therefore, those students who have been sponsored by industry believe that faculty have sufficient freedom to pursue the full range of their scientific interests due the broad sources of funding available; on the other hand, students who have been supported through federal grants believe that faculty are constrained to some degree due to funding availability.

The results of this study indicate that exposure to industry-sponsored funding has effects on the retention of graduate students, at least in this department. This study suggests that students have good relationships with their advisors in the department, which has been identified as the strongest predictor of doctoral retention (Girves & Wemmerus, 1988; Golde,

1998; Tinto, 1993). Also, one of the greatest factors of doctoral retention identified in the literature is funding through assistantships, in part because they promote students' involvement through relationships with faculty and students. In this department, funding from industrial sponsors also promotes relationships with industry representatives and enhances students' involvement with the department. Moreover, the department can afford to guarantee full funding to students thanks to the collaborations it has with both industry and government. The networking opportunities that industrial funding offers to students is another key predictor of doctoral retention in the program because students feel confident about their future careers (Golde, 1998). Also, working in research relevant to industry makes students feel that their work is meaningful to society. Similarly, by having the opportunity to work with industry, students in this study feel that they are being trained adequately to meet the demands of industry or academia, given that academia in this field is closely related to industry. This department provides a model related to relevance of graduate training for the challenges of today's society (Astin, 2002; Gaff & Pruitt-Logan, 1999).

Implications

The results of this study have significant implications for our conceptualization of academic capitalism, policy, practice, and research. Through the discussion of these implications, this study aims to guide future research and discuss best practices related to industry-academia associations.

Implications for the Conceptualization of Academic Capitalism

Contrary to most of the discourse found in the literature about the impact of academic capitalism on higher education (e.g. Gumport, 1999; 2002), the results of this study demonstrate that the organizational culture of this department maintains the traditional values and norms associated with the academic profession and graduate education despite its heavy engagement with industrial partners. This study presents a case in which academic capitalism is fostering a change in the academic culture through socialization processes in the anticipatory socialization

stage to the academic profession in disciplines with research relevant to products competitive in the global market. In particular, the students interviewed in this study are acquiring a culture that embraces a utilitarian perspective, in which Mertonian values (Merton, 1957) are preserved while engaging in partnerships with industry (Kezar, 2004; Slaughter & Rhoads, 2004).

The organizational culture acquired by these students in such an environment has significant implications for the supply of future faculty members to the academic profession. The students of this study, as potential new members of the future generation of faculty members in the field, consider industrial funding as a source of benefits and opportunities to enhance the quality of research and the training of graduate students. In other words, these potential future academics see partnerships with industry as an asset to achieve the traditional outcomes of the academic profession. For example, they believe that faculty members first have to engage with the traditional activities of the academic profession in order to secure their establishment as faculty members according to the traditional roles, norms, and values of the academic profession before participating in more risky venues such as patenting and founding spin-off companies. In addition, this study shows that these potential future academics have a high regard for the education of students and believe that it is the responsibility of faculty members to guarantee the integrity of students' education above corporate interests.

By providing strong empirical evidence of a case in which partnerships with industry bring significant benefits to the education of doctoral students while simultaneously preserving the core academic values transmitted to students, these results have significant implications for the way in which scholars have conceptualized academic capitalism (e.g., Gumport, 1999; 2002; Kezar, 2004; Slaughter & Rhoades, 2004). These views of the students in this study presents a case that complicates previous negative assertions made in other studies about the impact—potential exploitation by corporate sponsors, issues of knowledge secrecy, overemphasis on applied research, the transmission of business-oriented values, and faculty members as administrators and project managers—of academic capitalism on the education of doctoral

students and the academic culture (e.g., Campbell & Slaughter, 1999; Slaughter et al., 1997; 2002; 2004). Also this study questions whether the effects of academic capitalism on fields close to industry might be more positive than in other fields.

This study also contributes to the discussion about the public good of higher education in the new economy by reinforcing a utilitarian perspective as defined by Kezar (2004). This perspective offers a lens to understand the new charter between higher education and society based on the premise that individuals aim to maximize their own benefits by collaborating to meet societal needs. The department studied represents a case in which industry, government, and academia collaborate to produce knowledge, transfer technology to society, and educate the future generations of scientists while preserving the individual interests and goals of each party. In this process, as suggested by Slaughter and Rhoades (2004), the academic culture of this department integrates both its traditional Mertonian values (Merton, 1957) with the entrepreneurial values brought by the new opportunities of academic capitalism.

Alpert (1985) developed a matrix model to portray the organizational practices and structure of universities. This model is also useful to visualize the array of subcultures influencing discipline-based departments in universities (Figure 5.1). The matrix model places all universities of a given nation in rows (U1, U2,...) and the departments within each university in columns (D1, D2,...). Therefore, analogous departments across universities are placed one above the other such that, for example, d12 represents a department in university 1 (U1) and in discipline 2 (D2). Given that universities do not have the same departments, the matrix has holes in places where a given university does not have a given department. Figure 5.1 also represents external influences at a departmental level from external constituencies such as accrediting and professional associations as well as from private, industrial and government sponsors. Similarly, Figure 5.1 includes external influence at a university level by external communities such as alumni associations, educational councils, state governments, and private donors.

However, the new economy and utilitarian models complicate this matrix of universities' structures and practices. Now, industry sponsors collaborate with higher education, which adds an extra dimension (I1….I2) to Alpert's two by two matrix. By adding an extra dimension, now we have a cube representing departments and universities in one plane and industrial partners in another orthogonal plane. In this model, the department's culture is influenced by the culture of all the departments in that discipline, its institution and its industrial partners.

Implications for Policy

This case study has significant policy implications at the federal level. Its findings provide valuable insights into the distribution of federal research funding and the shaping of policies aimed to stimulate collaborations between industry and academia by presenting additional evidence related to the impact of these policies and funding distribution on the traditional norms and values of the academic profession and institutions. This study provides empirical evidence in support of federal programs such as the Industry/University Cooperative Research Centers (I/UCRCs) sponsored by the National Science Foundation (NSF) during the past two and a half decades.

The department in this case study hosts one of the first I/UCRC center founded in the 1980s and has successfully been funded solely by industry for more than a decade. Therefore, the findings from this study indicate that federal initiatives such as the I/UCRCs have the potential to foster productive and long-lasting collaborations between industry and academia that enhance the education of the future generation of scientists, provides funds for basic research to academic institutions, and transfers scientific knowledge, technology, and skillful workforce to industry. However, these findings also suggest the following theme that requires further investigation across different types of academic contexts: in the absence of federal grants, academic institutions might depend too much on industry as a source of research funds, thus potentially jeopardizing fundamental academic values and the quality of education.

Therefore, this study reinforces the need to maintain levels of funding in the form of block grants to individual academics by the federal government in order to maintain the balance between research supported by industry according to their own corporate interests and the academic freedom necessary to conduct basic research that leads mainly to broaden the knowledge base in the field beyond direct applications.

According to the students interviewed in this study, the positive effects of industrial partnerships found in this department are in great part due to the large amount of federal grants that their faculty members bring in, which allow the department to maintain a comfortable stream of revenue. This wealth accumulated over the years makes the department less dependent on industry and able to maintain traditional academic values. Therefore, the results of this study have another significant policy implication related to potential negative effects that can result from uneven distributions of federal funding across academic institutions. This study suggests that, if federal grants are concentrated in a few institutions, those departments with less federal funding might be compromising their core values in order to service industrial sponsors in exchange for funds. More specifically, the federal government should increase the level of federal research funding in order to guarantee equal opportunity across different types of institutions and the preservation of the core academic values in all types of academic institutions.

Finally, this study informs policy-makers about ways to improve doctoral education in science and engineering according to national needs. It also offers insights to federal programs aimed to increase doctoral retention in science and engineering.

Implications for Practice

This study provides substantial empirical evidence related to the range of benefits to graduate students that projects sponsored by industry could offer in certain academic settings. These results have important implications for the education and retention of graduate students in science and engineering by offering a model in which students report high levels of satisfaction

in their education due to the opportunities that the department offers to students to interact with industry representatives, visit companies, learn about the research enterprise in industry, and have job options after graduation. Also, students report great satisfaction related to funding and relationships with advisors.

As academic capitalism gains more momentum in higher education, fueled by federal polices and funding practices, a growing number of departments are partnering with industry to bridge funding gaps. The department studied in this dissertation has successfully nurtured partnerships with industry for almost three decades since the inception of the NSF-founded center in the 1980s. This department has developed an elaborate and mature industry-academia partnership program bringing significant benefits to the core mission of the department, which is to conduct fundamental research while educating students at the same time. Therefore, the experience of this department with industry offers valuable lessons to departments in earlier stages of engaging with industrial partnerships. More specifically, the four different programs of the department's center for the development of industrial partnerships provide specific guidelines for the development and implementation of practices in other departments or institutions in the process of building such relationships without having to sell out the core values of academic institutions.

This study also informs faculty members about ways to cope with the increasing trend of widening federal funding gaps by forming partnerships with industry without endangering the integrity of core academic values. Campus leaders and academics might look at partnerships with industry as an instant payoff; however, in order to preserve academic integrity, faculty members and campus leaders should patiently and carefully craft relationships with industrial sponsors that would bring significant returns to academics and departments beyond monetary returns. In particular, if funding from industry is channeled through contracts that allow sufficient basic science and long-term results, students will benefit in many ways: they will have valuable opportunities to learn about the industrial world—its research, culture,

and even physical facilities; they will carry out research related to real industrial applications that might have an impact on society; and they will have access to networking opportunities for jobs after graduation.

Finally, a significant implication to students of partnerships with industry that do not compromise the Mertonian values of academic institutions is a socialization process that promotes retention and traditional academic values despite industrial collaborations. Therefore, if industry-academia partnerships are formed under clear contracts protecting the education of students, basic science, and free dissemination of knowledge, the traditional values of the academic profession are not compromised as these students become faculty members.

This study also reveals important implications for faculty members. Through these partnerships, faculty in this department receive funds to maintain research and support students. In addition, these faculty members have the opportunity to learn and stay current about industry's challenges and work on projects that might have a real impact on society. Also, interactions with industry scientists usually result in seminal ideas for future research projects. But, most importantly, this study reveals ways in which faculty members can continue operating under the traditional values and norms of the academic profession by seeking alternative sources of revenue in the private sector as federal support for research continues to decline.

At the university level, this study presents a case that can be used as a model by university administrators to promote healthy collaborations with industry among departments involved in research relevant to industry. The success of this department in partnering with industry is due to a mature program of industrial funding with specific guidelines that protects the department's mission of conducting basic science and educating students as they establish relationships with industry. University administrators could adapt those specific guidelines to the design and implementation of programs aimed at promoting industrial partnerships among universities' academic constituencies based on practices that do not compromise core academic values.

Implications for Research

The cumulative knowledge generated throughout further empirical studies like this one will contribute to the shaping of policies, practices, and programs at the federal, institutional, and departmental levels aimed at fostering healthy collaborations with industry while preserving the integrity and public good of academic institutions. This section outlines several future empirical studies that stem from this dissertation.

First of all, this dissertation has provided new empirical evidence on our understanding of the implications of academic capitalism. However, given the in-depth nature of qualitative studies like this one, more empirical evidence is needed built on the findings of this study that could strength its limitations. In particular, given that this study was based on an ethnographic approach, few domains of knowledge from the list uncovered throughout the first interviews were studied in depth due to time limitations. Therefore, future research could continue investigating those domains that were not pursued in detail, including students' beliefs about characteristics of successful faculty members, characteristics of industry representatives, types of challenges faced by students, and types of students' expectations of the department.

The results of this study are solely based on students' perspectives; therefore, in order to acquire a comprehensive view of the department's organizational culture in light of academic capitalism, an immediate future study would include the voices of faculty members. This follow-up study with faculty members could be based on semi-structured interviews based on the key themes uncovered here related to the impact of academic capitalism on the department. This study would significantly contribute to the understanding of the implications for the core mission and values of the department's involvement with industry.

Future studies could further investigate the effects of industrial sponsorship on doctoral retention. In particular, studies could focus on student-advisor relationships in light of industrial sponsorships given that these relationships are the strongest predictor of doctoral attrition.

Also, studies of this nature could be designed to determine to what extent industry sponsorship facilities teaching and advising as well as collegiality.

The I/UCRC center to promote industrial sponsorship of this department became self-sufficient in the 1990s and today has the support of more than 30 companies. Future research could investigate the reasons for the significant success of this particular center in relation to its peers through a historical analysis of relevant documentation and in-depth qualitative studies with faculty in those departments that have had one of these centers at any point in time. This study could provide valuable lessons to other departments and federal initiatives regarding ways to foster long-lasting partnerships with industry leading to fruitful collaboration while preserving the academic values and mission of departments in science and engineering.

The results of this study suggest the need for future research in order to assess the extent to which and the ways in which academic capitalism is influencing the core values and mission of the academic profession and graduate education in different types of institutions, disciplines, and departments. Previous studies have not differentiated the differences of the impact of academic capitalism across departments with different levels of prestige; however, this study suggests that prestige plays an important role in the department's ability to maintain its status. The unique characteristics of the site studied in this dissertation are in great part due to the fact that this department is ranked as one of the top departments in the field in the nation, which attracts significant amounts of both federal and industrial funding, as well as outstanding faculty members, researchers and students. More specifically, the comprehensive understanding of the implications of industrial partnerships in this department achieved through the findings of this dissertation and the follow-up study with faculty members could serve as the basis for other comparative case studies of departments in science and engineering in other institutions with different rankings, levels of funding, and prestige. These comparative studies would represent an important contribution to the understanding of the extent of the implications

of academic capitalism for the academic profession and graduate education in science and engineering in various academic contexts.

Once a solid empirical knowledge base related to academic capitalism has been achieved through a series of cases studies in different academic contexts in science and engineering, a large-scale quantitative study could be conducted across disciplines in science and engineering and types of institutions in order to acquire a broader view of common patterns of the implications of academic capitalism in science and engineering. Finally, studies like this one could be extended to other disciplines in the social sciences and humanities. Given the lack of empirical knowledge about the impact of academic capitalisms in these disciplines, in-depth qualitative studies are needed to fill in gaps of knowledge followed by large-scale quantitative studies once key themes have been identified through the emergent qualitative studies.

Limitations

An important source of bias in this study relates to students' self-selection in enrolling in this specific department. Therefore, the students' cultural knowledge uncovered in this dissertation might be influenced by students' reasons to enroll in the program according to previous expectations and preconceptions before enrolling in the program. Further similar studies in different academic contexts would help to illuminate this bias.

Although academic capitalism is present across disciplines and institutions and provides a certain degree of uniformity, the department studied here exhibits a series of circumstances that might not be found in similar academic contexts. Therefore, transferability is a significant limitation of this study. In particular, the combination of two factors makes the academic context of this department unique. On the one hand, it is one of the few departments top-ranked nationwide in the discipline. In addition, it hosts one of the few I/UCRC centers that has partnered with industry very successfully. Therefore, careful contextual analysis must be conducted in order to be able to generalize the findings to other academic environments.

However, the findings of this dissertation can be safely generalized in our conceptualization of academic capitalism (Yin, 1994).

The high prestige of the department might represent a source of bias of students' perceptions by shading potential negative effects of industrial sponsorship. Students are aware that faculty members in the department are considered among the top scientists in the field; they are also aware that they are among the best students in the field. Therefore, there might be an inherent assumption that the department's success means that almost everything in the department is good, including industrial sponsorships.

As it is true in any case study, this dissertation provides focus and depth related to the cultural knowledge of doctoral students but neglects other aspects of the department's organizational culture that might be of relevance for the purposes of the study. This study provides in-depth evidence about students' share in the organizational culture of the department but ignores faculty members' perspectives. In addition, the cultural knowledge obtained in this study might not necessarily reflect the students' cultural knowledge overall, given that each student socializes mainly with his or her specific research group and its particular subculture. In other words, this study does not highlight aspects related to industrial funding unperceived by students that might be affecting their experiences. For example, unlike their advisors, students don't deal with contracts and agreements with industry representatives directly and are not responsible to deliver results.

Another limitation of this study is related to sampling and methodology. International students were slightly overrepresented and students in the early socialization stage with industrial exposure were slightly underrepresented. A couple of students were too new in the department, and their perceptions about industrial sponsorship were based more on rationalizations rather than actual socialization experiences. In terms of methodological biases, as suggested in Spradley's method (1979), few domains of knowledge were chosen and studied in depth throughout the last interviews. The choice of these domains was based on the degree

of relevance to academic capitalism; however, other meaningful domains might have been left aside as these choices were being made.

Subjectivity is always a concern in qualitative studies where the individual characteristics of the researcher inevitably affect the environment under study and shape the character of the interviews and the interviewees' responses. Given that students in general did not have a chance to reflect about the issues being asked beforehand and that a few of them lacked of socialization experiences related to industrial sponsorship, their perspectives and answers might have been affected by infiltrating information through the questioning or prompting by the researcher, based on the knowledge she acquired from previous interviews. Finally, subjectivity is also manifested by the personal interpretations of the researcher based on past experiences and inherent characteristics. In particular, the researcher had previous knowledge regarding academic capitalism, and an insider perspective as a former graduate student in physics that might have influenced the analysis and the questioning in the interviews.

Conclusions

A number of scholars have stated that the public good of higher education is being compromised as universities aim towards more economic and private goals, undermining the public trust in academic institutions and manifesting itself in less public support (e.g. Gumport, 2002; Kezar, 2004). In particular, empirical studies have documented negative effects that academic capitalism might be exerting on graduate students (e.g. Campbell & Slaughter, 1999; Slaughter & Leslie, 1997; Slaughter, et al., 2002). Also, based on the theoretical framework developed for this study, academic capitalism might be influencing the socialization of doctoral students (Golde; 1998; Tinto, 1993) and the anticipatory socialization to the academic profession due to fundamental differences between business and academic values (Gumport, 1999; Tierney & Rhoads, 1993). These effects could have significant implications to doctoral retention and the nature of the academic profession.

Given previous studies, a remarkable finding of this study is that the majority of students in this specific context could not see any negative effects of industrial funding and are very satisfied with the opportunities that it offers to enrich their training. These students see partnerships with industry as an asset to achieve the traditional outcomes of the academic profession leaving behind the dichotomy of business versus academic values presented in previous studies. The cultural knowledge of these students, acquire throughout their socialization process, reflects the essence of the traditional culture associated with the academic profession and positive beliefs about industrial partnerships. Therefore, the cultural knowledge that these students might bring to their entering departments reflects an integration of traditional academic values with new perspectives brought by academic capitalism. This integration preserves the integrity of Mertonian values (Merton, 1957) and values partnerships with industry as an effective mechanism to accomplish the goals of the academic profession. This study also shows that industrial partnerships enhance students' retention in this department by providing opportunities for student involvement as well as funding and training relevant to the nature and challenges of future career options.

This study has significant implications for research, policy and, practice by offering rich descriptions of a case in which partnerships with industry bring significant benefits to the department and the education of graduate students while preserving the core values of the academic profession that are transmitted to students as they go through the anticipatory socialization to the academic profession. This study also contributes to the discussion about the public good of higher education by showing a case that reinforces a utilitarian perspective in which industry, the government, and academia associate in productive collaborations to produce knowledge, transfer technology to society, and educate the future generations of scientists. However, the departments' positive environment is due to the wealth accumulated from both industry and government funding which allows it to attract excellent students and faculty members and maintain outstanding facilities. Therefore, more studies are needed in

departments with different levels of funding and prestige in order to determine the extent of the implications of academic capitalism across different academic contexts.

According to previous studies and assumptions, the empirical evidence in this dissertation complicates our understanding of the impact of academic capitalism on graduate students' socialization. Although this evidence relates to a specific academic context, it opens up the study of academic capitalism to a whole new set of questions and challenges existing assumptions related to the complexities of academic capitalism across different types of fields and institutions.

Figure 5.1. Matrix Model of Organizational Practices and Structure of Universities (Alpert, 1985)

Federal and State Sponsors

▼

Industrial Sponsors

▼

Private Sponsors

▼

		D1	D2	D3		
	U1	d11	d12	d12		
State Gov. → Private →	U2	d21	d22	d23 ←	Alumni ←	Ed.
Donors	U3	d31	d32	d33	Assoc.	Councils
	U4	d31	d32	d33		

APPENDICES

APPENDIX A

SAMPLE

Variables		Planned	Interviewed
Beginning Group			
Career Aspirations	Academic career	5	5
	Not an academic career	5	4
	Uncertain	--	1
Industry Exposure	Exposure to industry-sponsored research	5	3
	No exposure to industry-sponsored research	5	7
Disciplinary Background	From a physics research group	3	3
	From a engineering research group	3	3
	From a chemistry research group	4	4
Foreign Status	U.S. citizens	7	8
	Non-U.S. citizens	3	2
Gender	Female	3	3
	Male	7	7
Advanced Group			
Career Aspirations	Academic career	5	4
	Not an academic career	5	3
	Uncertain	--	3
Industry Exposure	Exposure to industry-sponsored research	5	5
	No exposure to industry-sponsored research	5	5
Disciplinary Background	From a physics research group	3	3
	From a engineering research group	3	4
	From a chemistry research group	4	3
Foreign Status	U.S. citizens	7	5
	Non-U.S. citizens	3	5
Gender	Female	3	3
	Male	7	7

APPENDIX B

LIST OF DOMAINS OF CULTURAL KNOWLEDGE UNCOVERED RELEVANT TO ACADEMIC CAPITALISM

1. Characteristics of research in academia
2. Characteristics of good research
3. Types of origins of research projects
4. Reasons for staying in academia
5. Characteristics of faculty members
6. Characteristics of successful faculty members
7. Characteristics of the department
8. Types of things valued in the department
9. Types of things less valued in the department
10. Types of challenges faced by students
11. Characteristics of industry representatives
12. Characteristics of industry-sponsored research
13. Characteristics of government-sponsored research
14. Types of benefits from partnerships with industry
15. Types of negative effects from partnerships with industry
16. Types of benefits from government sponsorship
17. Types of negative effects from government sponsorship
18. Characteristics of patenting
19. Types of expectations of the department by students
20. Types of expectations of the department by the university
21. Types of expectations of the university by the department

APPENDIX C

EXAMPLES OF TAXONOMIES OBTAINED FROM THE DATA

Type of characteristics of research	Represents an important leap forward in understanding	Produces an incremental change of knowledge base Advances knowledge Leads to a new area Broadens the area and leads to other developments Is the first in a particular area that inspires others Is something that you will be remembered by
	Has good results	Works Has good results to learn about a problem or to understand things or refute theories Has results according to the engineeringcode of ethics Has reproducible results
	Is executed thoroughly	Has good techniques Has gone through every avenue possible Analyzes a problem into different aspects Provides coherent reasoning Has good facilities and access to variety of instruments
	Is well communicated	Is published in prestigious journals Is presented in conferences Has a good number of papers with a good citation basis Gets other people interested
	Has collaborations	Collaborates with many industry labs Has multidisciplinary collaborations
	Produces good things for the world	Has applications to industry Has applications to government agencies Applies to other fields
	Reflects hard work	
	Is original	
	Is a well-defined problem	
	Has good guidance from advisors	

Ways to get Prestige	Getting recognition by the science done	Being good at self promotion Having publications Having quality papers Being invited to talks Giving press briefings Getting Awards
	Doing good research Being well established Getting Expertise Having good collaborations with other academics	
	Having a good scientific group	Having good students Having a good number of students Being wealthy by getting industry or government money Doing good research Getting recognition by the science done
	Having experience with industry	Knowing industry needs and ways Having worked with industry
	Having students going into good positions	
	Being wanted by students	Doing good research Being a good advisor and teacher Motivating students Getting recognition by the science done
	Consulting Having a high income level Owning patents and companies Being in a first ranked department	
	Keeping up with good research and publishing throughout years	Working hard
	Being a constructive member of the department and society	Having good social skills Having good communication skills, including to non academic audiences Caring about the department's well-being Not putting students down or stressing them up Not being arrogant Not being competitive Having a balanced personal life and being content with themselves Being a good person

APPENDIX D

EXAMPLES OF PARADIGMS OBTAINED FROM THE DATA

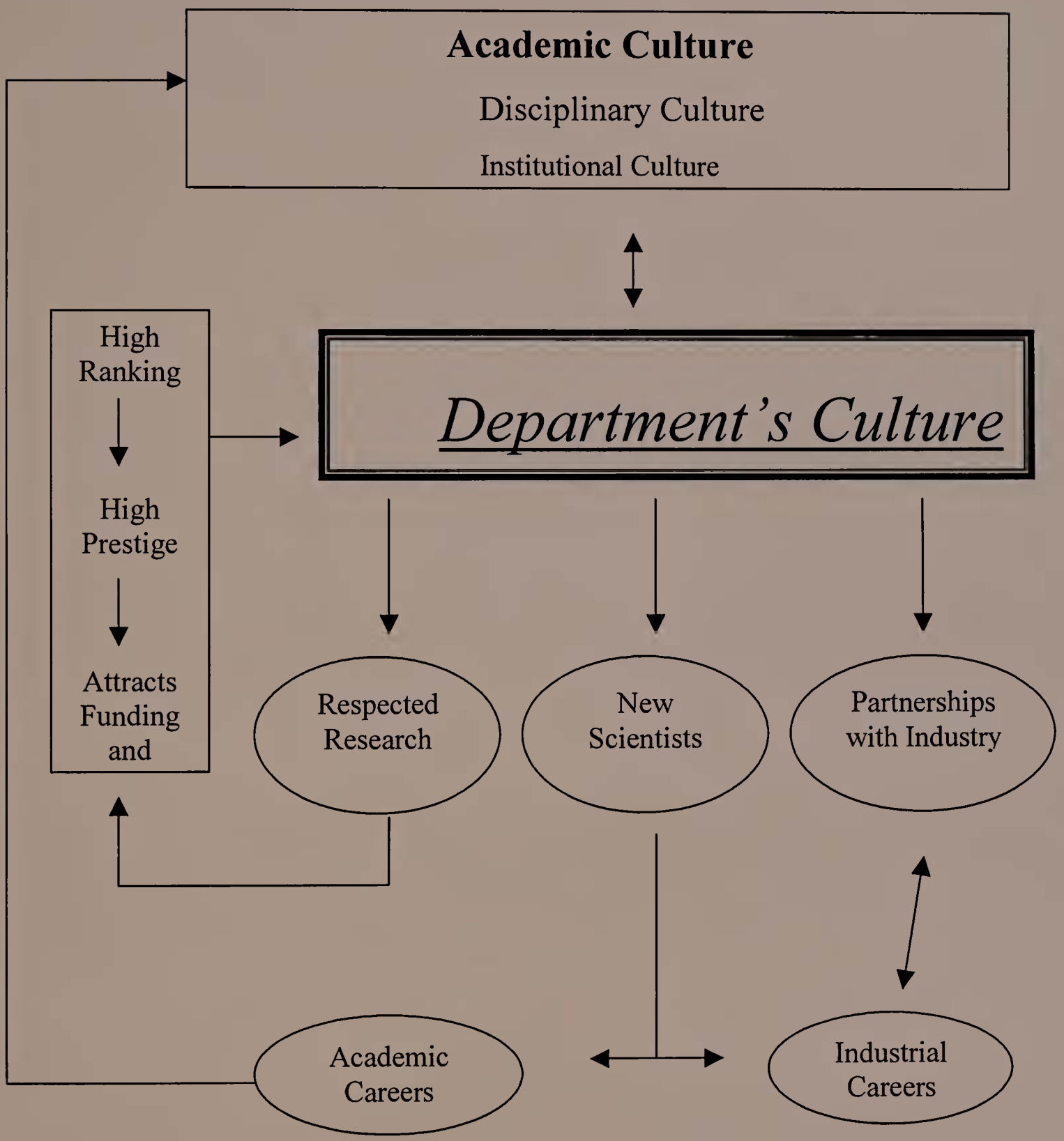
Ways to get prestige	Contrast Levels: Degree of Importance			
	Level 1	Level 2	Level 3	Level 4
Doing good research	Yes			
Having a good publication record		Yes		
Getting awards		Yes		
Having good students		Yes		
Having collaborations with academics			Yes	
Having collaborations with industry			Yes	
Having students going into good positions			Yes	
Being wanted by students			Yes	
Being a constructive member of the department			Yes	
Being wealthy		Yes		
Owning spin-off companies				Yes
Owning patents				Yes
Having worked in industry			Yes	
Having a large research group				Yes

Characteristics of Good Research	Contrast Levels: Degree of Importance			
	Level 1	Level 2	Level 3	Level 4
Develops broad scientific ability and a well-rounded scientist			Yes	
Has good communication		Yes		
Advances knowledge	Yes			
Is executed thoroughly		Yes	Yes	
Has collaborations with industry			Yes	
Has collaborations with academics			Yes	
Has applications to government agencies			Yes	
Has applications to industry				Yes
Is a well-defined and specific problem			Yes	
Has good results			Yes	

Characteristics of Industry-Sponsored Research	Contrast Levels: Negative or Positive Effects		
	Benefit	Negative	Both
Has direct applications	Yes		
Exposes students to specific industrial problems	Yes		
Exposes students to other forms of communication	Yes		
Academics still have freedom at research	Yes		
Constrained to industrial needs		Yes	
Is not interested in the basic science		Yes	
Market- and economy-driven		Yes	
Has an important role in the direction of research		Yes	
Under time pressure			Yes
Short-term projects			Yes

APPENDIX E

FACTORS SHAPING THE DEPARTMENT'S CULTURE AND PRODUCTS



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