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Intellectual Property Ownership, Technology Transfer, And Entrepreneurship Education: University Student And Administrator Perspectives

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INTELLECTUAL PROPERTY OWNERSHIP, TECHNOLOGY TRANSFER, AND
ENTREPRENEURSHIP EDUCATION: UNIVERSITY STUDENT AND
ADMINISTRATOR PERCEPTIONS

by

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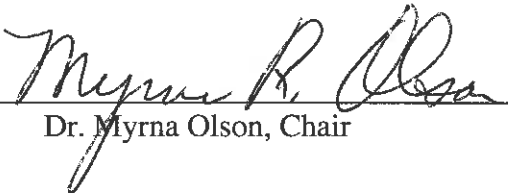

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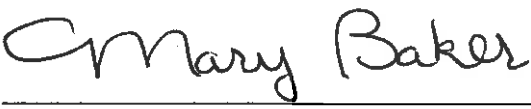
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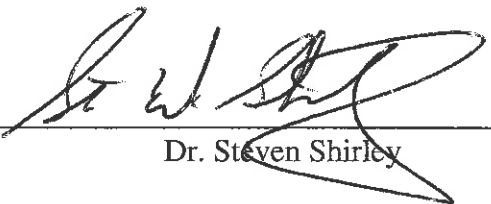
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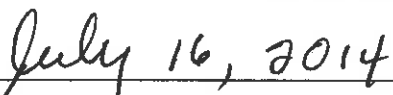
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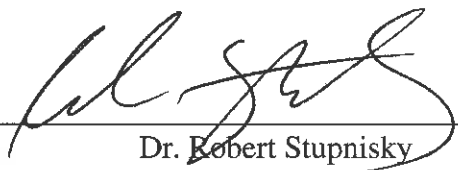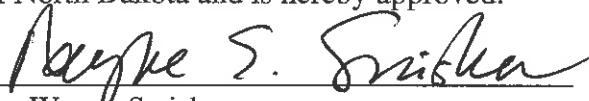
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Craig Alan Silvernagel
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ABSTRACT

This mixed methods study was designed to investigate student knowledge and attitudes concerning university intellectual property (IP) ownership, and the reaction of campus IP experts to the student perspective. Study participants included 226 students from a Midwestern research university and three employees with IP commercialization experience from that same university. A paper questionnaire was completed by students and the survey results were used to construct questions for semi-structured interviews with the campus IP professionals.

The student survey included demographic questions, Likert-type questions, and open-ended questions. The Likert-type questions were organized into three constructs: Student Knowledge, Student Fears, and Student Attitudes. Survey results showed that students had low levels of campus IP policy and IP commercialization knowledge. Students also indicated that they worried about the university potentially owning their ideas or projects with commercial value.

Qualitative data from the recorded, transcribed interviews was coded, categorized, and themed. Thirteen codes were organized into three categories: Communication Inadequacies, Student IP Disconnects, and IP Culture on Campus. Three qualitative data themes were defined, leading to a discovery assertion: Inadequacies in communicating IP policy and processes to students perpetuates

misunderstandings between students and Technology Transfer Office intentions, impeding the development of a more transparent and productive student IP culture on campus.

Final recommendations included more robust and proactive IP policy and IP commercialization communication activities, and an expanded IP-related training program for faculty. Several suggestions concerning new lines of student IP and IP commercialization research inquiry were also presented.

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CHAPTER I

INTRODUCTION

Intellectual Property Background

Intellectual Property (IP) is defined as the "valuable intangible property owned by persons or companies" (Byers, Dorf, & Nelson, 2015, p. 584). For the purposes of this study, student intellectual property is defined as intellectual property created or initiated by students while enrolled at a research university in the United States.

Intangible creations of the mind, or IP, sometimes lead to the development of tangible, commercialized products and processes. These commercial products and processes (or some of their components) may be eligible for protection under United States IP law. Common IP protection tools include trade secrets, patents, trademarks, and copyrights. The potential value of an IP tool, such as a patent, comes from the owner's ability to exclude others from duplicating, or infringing upon, the protected innovation for a specified period of time (Kuratko, 2014). While most Americans are familiar with IP-related items seen in the marketplace, such as a registered trademark symbol (®) on a logo, the realm of IP is not limited to the corporate or consumer environment. Universities (including faculty, staff, administrators, and students) also interface with IP laws, practices, and policies.

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The Bayh-Dole Act was a major catalyst for the development of IP policy and IP commercialization activity on American research university campuses. The Bayh-Dole Act was passed by Congress in December, 1980 (Colaianni & Cook-Deegen, 2009). The purpose of the act was to "promote the efficient commercialization of government-funded research and to create uniformity among the various federal agencies that fund such research" (Bloomberg, 2004, p.1). From the 1940s through the 1970s, universities "resisted the commercialization of academic research or actively discouraged it," and as such, discoveries resulting from federally funded research projects were available to "any interested person anywhere in the world" (Kumar, 2010, p.325). Thursby and Kemp (2002) note that the Bayh-Dole Act "changed the nature of ownership of inventions developed under federally funded programs" (p.109). In essence, the Bayh-Dole Act provided universities the ability to own the IP on innovations resulting from federally-funded research, with a requirement that universities pursue patents to protect those discoveries (Thursby & Kemp, 2002). The resulting patents could then be licensed by the university to external entities, or used to create new companies (Ashworth, 2013). The impact of these Bayh-Dole Act accommodations on university patenting was enormous.

Today, most research universities have formal policies, processes, and offices responsible for protecting and commercializing IP that emerges from federally funded research, or other creative activities (Geiger & Sa, 2008). The process of protecting IP created on campus, and then attempting to commercialize the related innovations, is commonly known as technology transfer. This term has emerged to represent the

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activities surrounding university patenting and the subsequent efforts to license patented discoveries (Sampat, 2006).

While the Bayh-Dole Act primarily addresses the commercialization of discoveries resulting from federally-funded faculty research, university students are also often bound by overarching campus IP policies and IP commercialization processes. Little has been done to study the impact of university IP policies and IP commercialization processes on the student experience. Specifically, it is not known how IP policy and IP commercialization processes affect students' willingness to share and pursue IP creations and projects with commercial potential while in the university setting.

Entrepreneurship Education Programming Overview

As the commercialization of university research discoveries grew after the passage of the Bayh-Dole Act, so did the number of campuses in the United States offering Entrepreneurship Education programs. Katz (2003) lays out a detailed timeline of entrepreneurship education, from a national perspective, that dates back to 1876. In 1967, only two schools offered entrepreneurship courses. By the late 1990s, there was a significant level of activity across the country, where more than 1400 schools had added entrepreneurship courses. Katz (2003) argues that by the late 1990s, entrepreneurship education had become mature as an educational field. Today, there is a proliferation of technology transfer activity and entrepreneurship education programming across the country related to innovation and new venture creation.

Examples of IP commercialization activity on American research university campuses are abundant. A research foundation publication from the University of North

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Dakota (UND), for instance, describes a UND faculty-student team working on a wind tunnel turbine testing project (Pedraza, 2010), an example of how students engage in university research projects with commercial potential. A recent article in the Minneapolis Star-Tribune focuses on the fact that the University of Minnesota (UM) has started to rethink its approach to IP policy concerning student activities (Lerner, 2014). The UM office for technology commercialization stated that student innovations are happening more regularly, and as a result, the policy regarding ownership of student projects originating in the classroom has been changed. The news release also notes that the student IP ownership policy change was initiated because there was a feeling that the current policy approach was acting as a barrier to student entrepreneurial activity. Part of the purpose of this mixed-methods study is to move the discussion concerning optimal student IP policy and IP commercialization process approaches from anecdotal (e.g., the UM decision), to evidence-based.

Through entrepreneurship classes, individual projects and assignments, sponsored research, and specialized programs, university students from a broad range of academic pursuits are now immersed in an environment where the possibility of IP creation is both encouraged and supported. This support and encouragement takes place both inside and outside the classroom. In the classroom, for example, students may enroll in a new product development class and be asked to design and build a prototype for a new product of their own conception. In a venture creation class, students might be asked to write a business plan for a new company of their own design.

Outside the classroom, some campuses provide specially designated student living arrangements and other non-classroom programming related to entrepreneurship.

At Drexel University in Philadelphia, students who have entrepreneurial interests have the option of participating in an Entrepreneurship Living Learning Community ("Creating a Community," 2014). This specialized residency program is for students from any academic area on campus. In the Drexel program, first-year students live on the same floor of an on-campus residence hall and are required to actively participate in a range of entrepreneurship and innovation-related activities throughout the academic year. Another example is the University of Wisconsin's Entrepreneurial Residential Learning Community, where entrepreneurially-minded students gather to participate and work together ("Entrepreneurial Residential Learning Community," 2013). Students in this program are even able to apply for funding support to develop their own nascent venture ideas.

Other recent developments demonstrate a growing recognition of the significant role university students can play in innovation and technology development. For example, on January 31, 2011, President Obama introduced *Startup America Initiative*, a new program designed to foster and support product innovation and commercialization to help create jobs. One of the nation's largest academic entrepreneurship associations, National Collegiate Inventors and Innovators Alliance (NCIIA), is a key partner. NCIIA executive director, Phil Weilerstein, noted that universities are a highly appropriate venue for such a program (National Collegiate Inventors and Innovators Alliance, 2011). Even though the Startup America Initiative is designed to function in the academic arena, with a focus on commercializing student-created projects, student IP issues are not highlighted as a key component of the process. In practice, student projects supported by organizations and programs such as

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NCIIA or Startup America will almost certainly have to navigate IP policy and IP commercialization processes on their respective campuses. It is troubling that the student IP topic (and its many implications) is not presented as a central theme in this highly-touted, student-centered entrepreneurship education and innovation initiative.

A Student Intellectual Property Case

Imagine that as part of completing a class assignment, a university student created an idea for a new mobile device application. The student had good technical skills and worked without the help of a professor, but with the help of a few classmates, and wrote the code needed to make the mobile device application work. Now imagine this same student posted the mobile device application online, where it was subsequently downloaded more than 250,000 times. As a result, this student and the classmates who helped build it were rewarded with a trip to the Apple Corporation, and even received job offers from leading technology companies such as Google. This was the actual experience of Tony Brown, an undergraduate student at the University of Missouri. Then his story took an unexpected turn. Tony described being shocked when he was contacted by the university technology transfer office and served with legal papers that claimed 25% ownership of the mobile device application he created and two-thirds of any profits it might generate. Tony noted that he had a feeling of helplessness in responding to the university, and that he initially felt like giving up (Associated Press, 2011, January 24).

The University of Missouri ultimately backed away from its ownership claims against Tony Brown (Associated Press, 2011, January 24). Even so, the case exposed some of the challenges and potential conflicts surrounding students, intellectual

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property (IP), entrepreneurship education, and university technology transfer and IP commercialization activities.

Need for the Study

The growth of entrepreneurship education and other innovation-related campus programming, and incidents like the Tony Brown case at the University of Missouri, raise two important questions. First, how much do students really know about university IP policy and university IP commercialization processes? Second, do student attitudes about campus IP policies and IP commercialization processes impact their motivation to pursue entrepreneurial projects or intellectual creations with commercial value while in the university environment?

Even though entrepreneurship education, innovation commercialization, and IP activity at United States research universities has expanded significantly since the passage of the Bayh-Dole Act in 1980, little has been done to study issues surrounding student interactions with IP. The growth of student IP activity, the prevalence of IP commercialization activity on American campuses, and initiatives such as *Startup America*, signal a need to recognize students as an important part of the technology transfer and university IP discussion.

The evidence shows that research universities are encouraging student engagement in the areas of innovation, creation and entrepreneurship through a range of educational offerings and specialized programming. Students will benefit most from these programs if they are motivated to bring their best ideas and efforts into the environment. If students believe that their ideas or projects may be confiscated, even partially, by university IP policy or process (e.g., the Tony Brown case), what is the

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impact on their motivation to perform and engage? If students deem campus IP policy to be fundamentally unfair, or if they are uninformed about university IP issues, one of two motivation outcomes seems likely: students will be de-motivated and not bring forward their best efforts and ideas, or students will be motivated to subvert the system. Neither scenario is attractive, and works against the best interests of students and universities. A student who knows little about IP or campus IP policy may believe the university can make an ownership claim on IP emerging from a class assignment, when in fact it may not. On the other hand, a student may unknowingly work on a project in such a way that the university is entitled to make a claim to IP ownership.

This study focused on student knowledge and motivation related to IP in the university setting as previously described. The results provided data-driven evidence that administrators, policy makers, and other stakeholders can use to help foster an environment that is conducive to both student success and IP commercialization success. In other words, these two items need not be mutually exclusive. The background presented strongly indicates that entrepreneurial activities and programming in the university environment will continue to grow, and that the student interface with IP is an important, yet underdeveloped topic of study.

Purpose of the Study

A 2009 study (Silvernagel, Schultz, Moser & Aune), highlights the expanding prevalence of the student role in projects with technology transfer potential at public research university campuses. Silvernagel, et al. (2009) argued it is critical that IP policies both encourage and reward students for bringing forward and working on their best ideas. The authors also found that students worried about sharing their ideas in the

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classroom. This mixed-methods study builds upon the Silvernagel, et al. (2009) findings, and was specifically designed to address the issue of student knowledge and motivation related to IP creation. This mixed-methods study was not intended to outline the various IP policy approaches found across research university campuses.

An additional purpose of this study was to identify information-sharing breakdowns between students and the campus IP commercialization office. Findings in this area will help students and university Technology Transfer Office (TTO) administrators better communicate on the topic. While increased communication and student knowledge of campus IP policy and commercialization practice is beneficial, it is important to remember that students are disadvantaged in terms of power. Patel (1995), argued that "Due to students' non-employee status and their inability to organize a force that can act to negotiate equitable ownership policies, faculty and university administrators need to consider the inequities students face today" (p. 512). In other words, university IP policy makers should take into consideration the disadvantaged position of students when considering campus IP policy and IP commercialization process development and implementation. In light of the student power disadvantage, this study was intentionally designed to articulate the student perspective, and then share that student perspective with campus IP experts for their reaction. It is hoped that campus policy makers who review the student-focused study findings will begin to better understand the student perspective, and see it as an integral part of creating successful IP commercialization policy and process. It is also hoped that students will benefit by seeing how TTO professionals react to various student

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perspectives on campus IP issues. In the end, both groups might be able to learn from one another, and ultimately work together more effectively.

Significance of the Study

What has not been thoroughly addressed in the literature is how IP policy and IP commercialization practice on American research university campuses impact students' motivation to engage in innovation and other creative intellectual activities. By examining student knowledge and attitudes concerning campus IP ownership issues, this mixed-methods study provided both qualitative and quantitative data that campus administrators, technology transfer officers, faculty, and other stakeholders may use to inform, redevelop, or reaffirm policy and process positions.

In part of their chapter on transformative mixed methods design, Mertens, Bledsoe, Sullivan and Wilson (2010) note that a transformative mixed-method study design addresses the "recognition and challenging of power in relationships in the research context and wide society" (p. 142). The approach and overall design of this mixed-methods study emphasized the student perspective, and fits the transformative model as described by Mertens et al. In this mixed-methods study, the student perspective led the conversation with more advantaged groups of administrators and faculty (i.e., administrators are asked to respond to the student position). Consequently, the results of the study have the potential to impact policy discussions and debates in a way that assists all stakeholders, but especially students, to have a voice at the table and the ability to support that voice with evidence.

The theoretical framework, Expectancy Theory, was used to guide the study design (described in Chapter III). This is a management and employee motivation

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theory that has been previously applied to the university environment with regard to employee relationships. For example, Chen, Gupta and Hoshower (2006) use Expectancy Theory to view factors that motivate faculty to pursue research. The concept of expectancies has also been used to study student motivation related to alcohol use (Goldsmith, Tran, Smith & Howe, 2009; Ham, Zamboanga, Olthuis, Casner & Bui, 2010). This study has the potential to add to the literature, as it was framed using a well-known employee motivation theory in a "quasi-employment" environment. The quasi-employment setting exists, because students are not employees; yet, they may be bound by certain rules and policies to which employees are subjected (e.g., IP policy). Finally, this study examined how students may or may not engage fully in IP and/or innovation activity because of the potential downstream impacts (e.g., students believe the university might try to make claim on their money-making idea or related IP). Knowledge about the student perspective and how it affects their behavior has implications for the classroom, technology transfer policy-making, as well as alumni relations.

Research Questions

The growing levels of student activity in the area of entrepreneurship, innovation, and IP creation beg several important questions. These questions have a wide range of implications for research projects, course assignments, and non-classroom activities. For example, campus IP policy dictates how a university will respond to an engineering student who utilizes the campus broadband network and university-owned software programs to design a new product. The research questions

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for this study specifically addressed student IP knowledge and attitudes related to the pursuit of ideas with commercial potential. Research questions included:

1. How much do students believe they know about university IP policy and IP commercialization process?

2. What university resources do students believe paying tuition entitles them to access, without having to relinquish IP ownership?

3. Does intellectual property policy affect student willingness to bring their best new product or company ideas to campus or the classroom?

4. Are there differences in student knowledge and attitudes about university IP policy depending on major field of study, year in school, or entrepreneurial interests?

5. How much do faculty and administrators involved with technology transfer activity know about the student perspective on campus IP issues?

6. Do IP-policy or process misperceptions exist between students and the Technology Transfer Office?

The first four research questions informed the design of a quantitative-focused survey instrument (presented as Appendix A). The resulting questionnaire was completed by voluntary student participants. Research questions five and six were addressed with semi-structured "depth-probing" interviews (Glesne, 2011, p. 134). These interviews were conducted with two TTO professionals and a faculty member with IP commercialization experience. Four guiding interview questions were developed and utilized:

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1. How do you interface with students and/or student intellectual property in your current role?

2. In your experience, how do students find out about the campus intellectual property policy and technology transfer office operations?

3. In your experience, how do students react to campus IP policy and process information?

   a. Do they seem to understand the materials or are they confused by the materials?

   b. Do they express interest in the university's ability to help them protect their IP or do they express frustration/surprise that the university may be involved?

4. What would you say to a student who is concerned about whether or not the university might "own" part of the IP on their product or business idea?

Learning more about student knowledge, attitudes, and expectations concerning intellectual property ownership and the administrative response to these positions is an important first step in helping build a university environment that supports and encourages student innovation. In addition to creating IP policy and commercialization processes that encourage entrepreneurial activity, it is also important that key constituents (i.e., students and TTO faculty/staff/administration) feel equitably rewarded for their contributions. This mixed-methods study brought together these two important groups, and the data and resulting recommendations identified several potential ways in which students and universities might work together more effectively for the benefit of all.

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Delimitations

This mixed-methods study was conducted on a single research university campus in the upper Midwest. Although the generalizability of the findings may be limited related to the single location design, the researcher asserts that many high research activity universities (as defined by the Carnegie Foundation) are similar in structure in terms of IP policy and TTO activities, and as such, findings would likely be similar across this category. In addition, the purpose of this mixed methods study design was not simply to generalize findings; it was also to identify perspectives and points of miscommunication and misunderstanding. These discoveries can be utilized to assist in the formation of policy approaches and provide a platform for additional research in this area. With additional research and development, this study has the potential to improve the student experience in the areas of entrepreneurship and innovation.

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CHAPTER II

LITERATURE REVIEW

Intellectual Property Overview

The idea that an individual or organization might be entitled to own certain rights around a creation of the human mind is not new. The roots of intellectual property (IP) run deep into recorded human history. It is believed, for example, the Venetians were using patent and copyright concepts as early as 1450 and that two IP enforcement events (one related to copyright and one related to patent) took place in 1499 and 1502 (Prager, 1944).

Today, the ownership of IP is seen in abundance, and in varied forms, across the globe. Intellectual property has its own, quite extensive, subsection on the World Trade Organization (WTO) website. In fact, it is required that WTO member nations provide one another at least a minimal measure of IP protection ("Intellectual Property," 2013). Since nations can differ significantly in IP policy approach and levels of enforcement, the WTO is seeking to identify some international common ground and cooperation. The WTO notes that IP is a critical part of international trade, and differing international approaches to IP management can create conflict and economic obstacles.

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Another international group dedicated to the topic of intellectual property is called the World Intellectual Property Organization (WIPO), which is a part of the United Nations. According to its website, WIPO exists to lead the creation of a global IP system that inspires world-wide innovation, benefiting all nations ("Inside WIPO," 2014). In addition to an international footprint, IP practices must also adapt to fast-changing technology, adding to the complexity (Samuelson & Davis, 2000). These examples indicate that IP is a global issue, critically important to trade and economics, highly complicated, and susceptible to rapid change. All of these elements make IP an interesting, yet challenging topic of inquiry.

It is in this broad, multi-dimensional setting, that student IP in the research university setting must be framed for consideration and analysis. It was not the intent of this literature review to capture the entirety of all the IP topics, approaches, and perspectives. Instead, specific literature streams were explored that demonstrate how IP on the American research university campus fits into the larger IP picture. Leading themes in the higher education IP-related literature included copyright, work-for-hire, fair-use, and the significant impacts of the Bayh-Dole Act of 1980. A review of the literature from this perspective exposed a gap concerning campus IP and university students. This gap in the literature pertains to student knowledge of, and attitudes about, campus IP policy and IP commercialization processes.

The literature review revealed how IP policy and technology transfer activities are a common part of the modern American research university campus. The Bayh-Dole Act of 1980, and the resulting explosion of campus IP commercialization activity,

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played a major role in defining the campus IP environment that students and employees must navigate today. Student knowledge and attitudes about campus IP policy and IP commercialization processes, and their impact on student behavior, is not yet well-represented in the literature. This mixed-methods study was designed to address the important topic of student IP and begin to fill this literature gap.

Intellectual Property Forms in the United States

Common forms of IP in the United States include trade secrets, patents, trademarks, and copyright. Trade secrets are protected "information and processes that have commercial value and are not known or easily ascertainable by the general public or others" (Kuratko, 2014, p.286). Trade secrets can include items like customer lists or formulas. A commonly known example of a trade secret is the confidential recipe for Coca-Cola. Patents are typically related to the invention process and are available in three forms: utility, design, and plant (Byers, Dorf & Nelson, 2015). Patents give owners the right to exclude others from competing for a specified period of time (either 14 or 20 years, depending on the type of patent). Byers, Dorf, and Nelson (2015), note that utility patents protect "new, useful, non-obvious, and adequately specified processes, machines, and articles of manufacture" (p. 247). Trademarks are used to protect company names, slogans, logo designs, and other related items, and can be held in perpetuity as long as the proper renewal process is followed and fees are paid. Copyright protects works in the areas of writing and art and includes items such as novels, music, film, computer programs, and more. Copyright belonging to an individual author can be enforced for the life of the author plus seventy years (Kuratko, 2014).

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Usselman and John (2006) outline important milestones and debates surrounding the early evolution of patenting and intellectual property in the United States. The authors note that US patent laws are actually embedded in the Constitution and are "older than the country itself" (p. 100). Thomas Jefferson, while serving as Secretary of State, personally reviewed and approved early patent applications (the authors note that he was quite critical in his reviews). Subsequent reviewers were not as thorough, and tended to simply approve patent submissions, letting the courts sort out any resulting disputes. It was in this environment that IP ownership rights were awarded to some of the most well-known mechanical inventions of their time, such as the cotton gin (Usselman & John, 2006). In 1836, the US Congress created the patent office, where employees were dedicated to the review of patent applications to "determine if it was technically novel and sufficiently distinct from patents the patent office had already designed" (p. 101).

Today, intellectual property in the United States is managed from multiple offices across the country. The United States Patent and Trademark Office (USPTO) is the nation's IP repository with headquarters in Alexandria, VA. The USPTO is responsible for patents and trademarks ("USPTO Organization," 2014). To date, the USPTO has issued more than 8,500,000 patents ("Table of Issue Years," 2014). Trademark activity at the USPTO is also substantial. In the year 2013 alone, 259,681 trademarks were added to the registry ("Second Quarter FY 2014," 2014).

Copyright, another common IP form, is managed by a separate office known as the United States Copyright Office (USCO). On its website, the USCO notes that the first copyright law was approved by Congress in 1790. Early USCO filings were

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recorded in district courts, but in 1870, these recordings were centralized. Since its centralization in 1870, USCO has registered more than 33 million copyright claims ("United States Copyright Office," 2014).

Intellectual Property Philosophy in the United States

The ongoing and highly-publicized patent infringement dispute between Apple and Samsung is an example of the potential economic impacts IP can have on an organization, as well as an entire industry. Apple and Samsung have been litigating for more than three years over alleged patent infringements concerning the technology and software that enable their competing smartphones. Apple was awarded a $900 billion patent infringement settlement in a 2012 court decision, yet the legal battle between these technology giants continues. Samsung has filed appeals, and now both corporations are accusing one another of additional IP infringements. This particular IP infringement case might continue for some time, as the two companies have thousands of smartphone related patents, and the current dispute concerns only a handful of them (Associated Press, 2014, March 30).

In order for a nation to implement, manage and enforce an IP system, and the resulting IP protection tools (and disputes), a founding philosophy must be defined. Macedo (2013) notes that in the United States, the provision allowing for IP ownership, and patent ownership more specifically, is found in the Constitution. The philosophy of IP ownership in the United States is rooted in the idea that innovation and intellectual creations should be encouraged and rewarded. The practice of this ideal includes a defined trade-off between an inventor and the government. In the United States, this trade off historically included "rewarding inventors with a limited monopoly on their

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invention in exchange for public disclosure," but only "first and true" inventors (Macedo, p.1).

The concept that IP ownership should be awarded to the first inventor of the IP is commonly known in the United States as first-to-invent. For example, if two individuals were working independently, and conceived the same invention, the inventor who created the idea first would be entitled to the IP ownership. Under the first-to-invent model, this ownership scenario would be true even if the second inventor brought the invention to market sooner than the first inventor. As a caveat to the first-to-invent philosophy, there is a recognition that some inventions take additional time to mature, after they have been created. This maturing process often leads to changes or modifications to the original invention design or execution. To help with the potential problem of IP maturation, the first-to-invent model includes a one-year extension. This one-year extension provides inventors additional time to protect their creations (Macedo, 2013).

The first-to-invent approach had been steadfastly in place for most of American history, and is an important part of how the nation's IP philosophy was framed, especially as it relates to patents. In 2011, a "significant shift in the patent laws of the United States" occurred (Ashworth, 2013, p.384). The United States abandoned its long-standing first-to-invent IP philosophy and instead changed over to a first-to-file model.

The Leahy-Smith America Invents Act was enacted in September of 2011, and after being signed by President Obama, transformed the United States from a first-to-invent nation to a first-to-file nation. This act, and the major changes it provided for,

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was the first large-scale change to the US patenting system in nearly half a century (Ashworth, 2013). Leading up to the 2011 passage of the Leahy-Smith America Invents Act, the United States was the only nation in the world using a first-to-invent policy. The rest of the world was already using a first-to-file IP policy approach.

A first-to-file system essentially flips the first-to-invent system upside down. In a first-to-file environment, "the inventor who files a patent application first is granted a patent even if another independent inventor of the same invention was the first to conceive and/or create the invention" (Rucker, 2014, p.119). The first-to-file change to the American patenting system has caused some to question how entrepreneurs and smaller companies might be affected as they try to compete with larger, established corporations (Ashworth, 2013). The implementation of the Leahy-Smith America Invents Act and its impacts on IP practice, the national economy, and innovation at large, are still emerging. The United States' transformation from a first-to-invent IP nation to a first-to-file IP nation is sure to be the subject of many new research efforts going forward.

Intellectual Property in Higher Education

Most individuals are likely familiar with at least some of the IP forms previously described. These IP forms, and their related language and symbols (e.g., the phrase 'patent pending'), can often be seen on the packaging or in the promotional materials of the products and services consumers regularly purchase and use. Yet, the realm of IP is not limited to the corporate and consumer environments. Sun and Baez (2009) note emerging IP-related issues in higher education, including ownership rights pertaining to online courses and licensing of university marks (e.g., athletics logos).

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The authors also identify the significance of university IP policy, noting that "Intellectual property policies in higher education certainly affect the academic core. Universities can dictate the terms of intellectual property rights for faculty and students (through employment contracts and policies related to academic programs)" (p. 9). Other important university-related intellectual property topics include the ownership of faculty-created classroom materials (Blanchard, 2010), and the fair use of protected properties, such as text books, as part of educational activity (Quartey, 2007).

Institutions of higher education, as well as the faculty, staff, and administrators who work within those institutions, are surrounded by IP usage and ownership issues. While the overarching IP forms are the same (e.g., copyright, trademarks, and patents), there are specific provisions, applications, and impacts that are unique. For instance, the Bayh-Dole Act of 1980, and its transformative effect on university patenting and technology transfer activity, is a critical component of the higher education IP discussion. Another contemporary IP issue in higher education surrounds the question of who owns the copyright on content created for online course offerings (Meloy, 2013).

Although broad review of IP issues from the literature has been presented, two topics appear regularly in the literature regarding IP in higher education: (1) copyright and the related work-for-hire and fair-use provisions, and (2) patenting or licensing related to research discovery commercialization. While copyright and patenting topics are not the only IP issues relevant to higher education (e.g., Sun & Baez, 2009, note that trademark protection, for example, is sought by many institutions), they are IP

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elements that faculty, staff, and students will encounter on a research university campus.

Copyright, Work-for-Hire, and Fair-Use

Campbell (2010) notes that United States copyright laws were created to "strike a balance between providing all members of society with ready access to information and providing creators with enough incentive to continue to create new works" (p. 322). Faculty members, in particular, can be impacted by a part of the copyright law known as the work-for-hire doctrine (Sun & Baez, 2009).

The Copyright Act of 1909, first addressed the concept of work-for-hire. In the Copyright Act of 1909, it was noted that an employer could be the author of a work. Unfortunately, specific language clarifying the definitions of an employer, and what constituted work-for-hire, were not provided. Later interpretations of the Copyright Act noted that work-for-hire exists when the creation of an authored item is both compelled, and paid for, by an employer. The Copyright Act of 1976 provided more specific work-for-hire definitions of what constitutes an employee, and an employer. Even these definitions were interpreted differently by various courts (Gertz, 2013). In essence, under a work-for-hire arrangement, the employer is the owner of any IP created by employees in the scope of their work. For example, a research scientist working for a chemical products corporation may make a technical discovery. Under the work-for-hire doctrine, the company would own the IP related to this discovery, since it was created as part of the scientist's job. The work-for-hire doctrine leads logically to several important questions for those in higher education, such as "who is the copyright

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owner of faculty research manuscripts?", and "does a faculty member or the university own the copyright on prepared course materials?"

As part of the answer to campus copyright ownership questions, the work-for-hire doctrine provides an important exception for teachers. Sun and Baez (2009) explain that if an agreement is not in place between a faculty member and the employing institution, copyright ownership related to scholarly work is typically retained by the faculty member, not the university. The authors also point out, however, that a work-for-hire argument could be made for university ownership of copyright to faculty scholarly output. In this work-for-hire argument, an institution might claim that since faculty members are hired to conduct research and write about the results, the university (i.e., the employer) should be considered the copyright owner, not the faculty member. Finding concrete answers to IP ownership scenarios under the work-for-hire teacher exemption is difficult. This difficulty is summarized well by Blanchard (2009), who states that "the teacher exemption remains vulnerable and unsettled law" (p.65).

Fair-use is another provision of the United States Copyright law, and it "permits limited uses and reproduction of copyrighted materials without the owners' permission" (Sun & Baez, 2009, p.31). The concept of fair-use was first addressed in the Copyright Act of 1976 (Campbell, 2010). Four factors must be contemplated when determining whether use of copyrighted material without author permission is admissible under the fair-use provision. Two considerations include whether the usage is related to commercial or education purposes, and what proportion of the total work is being used (Sun & Baez, 2009). The remaining two fair-use considerations include

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usage impacts on the marketability of the original copyrighted work, and "the nature of the work" (Duncan, Clement, & Rozum, 2013, p.278).

Trying to understand what is admissible, and what is not admissible, under fair-use can be confusing. Aufderheide (2012) describes how fair-use of copyright should meet a standard of transformation. Using this transformation standard, fairly-used copyrighted content should serve a new purpose. To illustrate this concept, the author used the example of a professor who plays a movie clip (from a copyrighted movie) as part of a classroom lecture. In this case, Aufderhide (2012) explains that using a movie clip as a teaching tool meets the transformation standard, because the clip now serves a new purpose: to aid in educating students about the subject matter at hand. In addition, this new educational purpose is not likely to hurt sales of the movie (its original purpose). Duncan, Clement, & Rozum (2013), caution that many faculty members erroneously believe any use of copyrighted content in an educational setting meets the fair-use standard, and that "this confusion is understandable" (p.277). The authors reiterate that type of use (e.g., education) is only one of the four criteria, and all four considerations are important.

The management of copyright issues is becoming more complex in the higher education environment, and as a result, some institutions have established specific offices to manage all copyright activity on campus, according to Ryan & Ferullo (2011). The authors specifically address the significant impact technology has had on copyright practice in the university environment. For example, can an institution be held liable if a student illegally downloads music using the campus computer system? Several Congressional legislative actions, such as the passage of The Digital

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Millennium Copyright Act of 1998, and the Technology, Education and Copyright Harmonization Act of 2002, have had major impacts on the copyright environment. The implications of these acts in the higher education setting can be multiform, and were a catalyst for the creation of specific copyright policy on many campuses (Ryan & Ferullo, 2011).

As an interesting example of the unique situations that can arise concerning faculty-owned copyright, Gertz (2013) summarized a case concerning note-taking during a faculty lecture. In the case, *Williams vs. Sherrill*, the two parties argued about whether an individual can sell the notes taken during a professor's lecture without violating copyright law. In *Williams vs. Sherrill*, it was decided that since the notes were not given to the attendee in written form by the professor, nor was the lecture recorded, the professor's copyright was not infringed upon.

While issues related to copyright law and its doctrines impact several areas of university life, campus patenting policy and IP commercialization activity also have important ramifications. These connections among universities, private firms, federally funded research, and commercial projects, were fundamentally redefined by the Bayh-Dole Act of 1980.

Intellectual Property Commercialization and the Bayh-Dole Act of 1980

The passage of the Bayh-Dole Act in 1980, provided universities the ability to more readily own intellectual property emanating from federally-funded research. The literature thoroughly addresses the fact that the Bayh-Dole Act has had a significant and enduring impact on American research universities. Post Bayh-Dole campus developments include the expansion of patenting and commercialization activities, the

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creation of technology transfer offices, and the widespread development of intellectual property policy surrounding innovation activity on campus (Colyvas, et. al, 2000; Mowery & Ziedonis, 2002; Agrawal, 2001; Rafferty, 2007; Thursby & Kemp, 2002; Nelson, 1998).

Sampat (2006) writes that "Most economic historians agree that the rise of American technological and economic leadership in the postwar era was based in large part on the strength of the American university system" (p.773). In the 1980s, "a rising chorus of voices demanded that universities contribute to overcoming the prevailing economic stagnation" (Geiger & Sa, 2008, p.12) and work to commercialize research discoveries with economic value. Colaianni and Cook-Deegan (2009) argue that Bayh-Dole created "a clear and uniform mandate" (p.684) for universities to protect innovations and discoveries stemming from federally-funded research and pursue arrangements with the potential to earn spin-off royalty payments. Today, the terms technology transfer and office of technology transfer (or OTT) or intellectual property commercialization are common vernacular on U.S. research university campuses. Most American research universities have not only an OTT, but also an established IP policy related to the commercialization of university-discovered IP and related technologies.

In 1970, fewer than 250 patents were granted to universities in the United States, with that number growing to over 3,000 by 1995 (Dai, Popp, & Bretschnedier, 2005). In that same time frame, the number of campuses establishing technology transfer offices to license university-owned patents grew by "eight-fold" (Thursby & Kemp, 2002, p. 110). More recent IP commercialization results have been framed in terms of university IP licensing and other revenue streams. In 2000 alone, for example,

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it is estimated that more than $1.2 billion in income was earned through university licensing agreements (Sampat, 2006). In 2005, Stanford University sold its stake in Google for $336 million (Malakoff, 2013), and in 2011, Northwestern University earned $192 million dollars through its commercialization efforts (Malakoff, 2013). Kumar (2010) notes that money from licensing royalties can help further the research mission of an institution, especially as public subsidies for higher education started to decline in the 1970s.

Mowery and Zeidonis (2002) argue that in addition to Bayh-Dole, "other factors" (p.415) played a role in this surge of IP commercialization activity. These mitigating factors included the emergence of the biomedical technology field, and a related Supreme Court case that "opened the door to patenting the organisms, molecules, and research techniques emerging from biotechnology" (p.415). Myers and Pruthi (2011) agree that biotechnology plays a key role in supporting entrepreneurship in the academic environment. The authors state that "biotechnology firms have special features that necessitate their reliance on universities more than other types of high-technology firms" (p.351).

Since 1980, American research universities have experienced tremendous change, and some notable successes, in the areas of patenting and IP commercialization. The desirability of these changes is often debated. For example, the patenting of faculty or student research discoveries, and subsequent efforts to commercialize these discoveries, can create a series of conflicts between "openness and secrecy" (Kumar, 2010, p.332). Kumar notes that secrecy related to the patenting of research discoveries can delay the sharing of the new knowledge and obstruct

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publishing rights. From another perspective, Sampat (2010) argues that the policies and procedures enabled through Bayh-Dole simply trade one problematic situation, for another. In his commentary, Sampat states that Bayh-Dole "eliminated restrictions on patenting and technology-transfer licensing in favor of promoting overly restrictive licensing" (p.756). He adds that some university licensing approaches are "now souring the relationship between universities and industry, especially in information technology" (p.756).

Rafferty (2006) studies the question of whether Bayh-Dole may have "succeeded too well" (p.29) in focusing campuses on revenue generating opportunities, effectively shifting the focus of university research from basic to applied. He uses an input model (research and development) as opposed to an output model (number of patents secured) to study the issue, and concludes that Bayh-Dole did not have "a significant influence on incentives" (p.39). Jelinek and Markham (2007) also acknowledge the argument that Bayh-Dole incentivized universities to move away from basic research toward applied research, but note that these claims are not substantiated by data. Adding to the discourse on IP commercialization effects concerning university research mission, Pirnay, Surlemont, and Nlemvo (2003) summarize that "for a long time the sole purpose of academic research was to enhance human knowledge…this classical conception of science…is increasingly challenging by the economic conception" (p.362).

Regardless of the position one takes on whether Bayh-Dole has impacted university research mission (basic versus applied), the benefits of licensing and royalty revenues from industry-university partnerships must be weighed against the drawbacks

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of IP commercialization activity. Some of the potential drawbacks include a limit to the free flow of information, and a faculty focus on patenting and licensing at the expense of teaching (Poyagao-Theotoky, Beath & Siegel, 2002). In addition, universities have experienced several IP commercialization obstacles. For example, securing and managing a portfolio of patents can be quite costly, and the resulting licensing agreements and royalty revenue can take longer to materialize than expected (Boettiger & Bennett, 2006). This time lag between research and revenue exists, in part, because universities are not directly developing products. Instead, university owned IP is licensed to external entities (e.g., for-profit corporations) which can then use the IP to create marketable products (Sine, Shane & Gregorio, 2003).

A wide range of technology transfer results have been experienced by different types of institutions. Lipinsky, Minutolo, & Crothers (2008), note that many campuses have put in place "extremely complex systems" concerning IP commercialization and that these systems are "shortsighted and produce marginal benefits for all but a select few universities" (p.113). Colaianni and Cook-Deegan (2009) also note the tendency for the vast majority of university IP royalty streams to come from a very few, significant discoveries, adding that "only a lucky few institutions will reap the rewards" (p.710).

The reputation of an institution also plays a role in how willing private firms are to license university-owned IP. Sine, Shane, and DiGregorio (2003) found that "general university prestige increases the licensing rate over that predicted by past performance" (p.491). Additional factors that contribute to the outcome of campus IP

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commercialization efforts include the culture of an institution, its geographic location, and even the efforts of local governments (Lipinsky, Minutolo, & Crothers, 2008).

Just because a university owns IP (e.g., patents), does not mean it will earn meaningful royalty revenues. The difference between a university research discovery and a marketable consumer product can be quite large. Jelininek and Markham (2007) argue this gap exists because discoveries made through federally-funded research are often more basic in nature. These foundational discoveries then require several more stages of development before they are ready be transformed into viable, commercial products. The authors conclude that "university patents cover early-stage research that is far from commercial use" (p.258).

Barr, Baker, Markham and Kingon (2009) identify the gap between research findings and the business community as the "Valley of Death" (p.371). In their study, the authors promoted a model where teams of students and subject matter experts work with existing university-owned IP to help move research discoveries more effectively into the marketplace. The Barr, Baker, Markham and Kingon article described a clear example of how students interact with university-owned IP. The model proposed by the authors (teams of students working with current university IP) is focused on a product development process, but does not address the issues of student IP knowledge or attitudes about campus policy and processes. These unaddressed student IP topics are highly relevant to the setting. For the Barr, Baker, Markham and Kingon (2009) model to work, students must be fully engaged in their projects. If students believe that the university may make a claim on the business or product that emerges from their projects, how will this affect their motivation to achieve? In addition, student teams

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may be significantly, and unknowingly, impacted by downstream IP discoveries. What happens if the team makes its own IP discovery that builds upon the existing university-owned IP? Are the students even aware of this possibility or how the university IP policy would address the situation? These are critically important questions to address as part of any discussion concerning the engagement of students in the university IP commercialization process.

Student Intellectual Property

In legal terms, the student interface with IP has been identified as a topic worthy of study. A 1995 *lndiana Law Journal* review of graduate students and university-related IP identified "Student-Generated Intellectual Property" (Patel, p. 502) as an area with enough unique characteristics to warrant its own description and exploration. In his review, Patel (1995) focused on the legal proposition concerning if, or how, a university might make claim to IP emanating from a student creation. Today, nearly twenty years later, the answer to Patel's (1995) salient legal question about whether or not a university can make claim to student IP seems to be a resounding "yes." The inclusion of students in university IP policy is now widespread.

Even though the study of the student interface with intellectual property on campus is still emerging, some research has been conducted in the broad arena of IP and students. Starkey, Corbett, Bondy, and Davidson (2010) examined how much secondary school students and teachers in New Zealand knew about IP items (e.g., patents and trademarks). The authors argued the value of IP in society is growing and so is the value of IP knowledge. As such, it behooves students and teachers to be "familiar with aspects of intellectual property" (p. 336). While the Starkey et al. study

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does help shed light on IP knowledge gaps from a technical standpoint (e.g., do students or teachers know the difference between a patent and a trademark?), it does not address how students might interface with IP in an educational setting, or how this environment impacts student behavior. In another IP-related study, Butakov and Barber (2012), explored the connection between plagiarism detection services used by universities and their potential intrusion on student IP rights.

Silva, Henriques, and Carvalho (2009) advocated a product development process as a way to help encourage engineering students to learn to innovate and create. The authors noted that student learning about IP rights related to innovation might serve to incentivize their efforts. While this study identified both student knowledge and motivation as important parts of encouraging IP creation in the university setting, it did not address how IP policy and IP commercialization process may impact student motivation.

Student creation of IP is not limited to the areas of business, engineering, and other sciences. Students in the liberal arts also create valuable IP, although one study points out how students in a writing program were largely unaware of the topic. Lunsford, Fishman, & Lieu (2013), worked to inculcate students with a deeper understanding of how their writing might bring value to others. Specifically, students learned that others may try to quote, cite, or even steal their material. The authors noted they soon "realized how difficult it was for students to imagine these possibilities" and that one student participant laughed out loud when asked if she "thought about her writing as intellectual property" (p.476).

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Music, and IP related to copyright, was the focus of a study by Thibeault (2012). The author shared a story about how one of his students posted to the internet a poem recording project from a music technology class, and found that soon after it was modified and reposted by someone else. Thibeault (2012), notes that technology is impacting the ease with which works can be shared and modified, adding "It would be little more than a curiosity if this creativity was limited to works found in the professional marketplace, but the same creativity is happening in higher education classrooms" (p.105).

Finally, a highly-publicized and recent set of events with student IP connections is the conflict between student-athletes and Northwestern University. In a potential landmark case, Northwestern University football players earned the opportunity to vote on organizing as a labor group, seeking to be recognized as employees. If passed, the group intends to seek expanded medical coverage, increased scholarships, and other compensation (Levinson, 2014). Although on the surface the context of the Northwestern case concerning athletics seems different than that of student IP on campus, the two topics share some important IP characteristics. Both situations involve students in "quasi-employment" environments (e.g., student athletes being bound by NCAA policy, and students being bound by university IP policy), and both situations include the potential commercialization of student IP (e.g., the use of student athlete names and achievements to create revenue, and the use of student created IP for licensing).

The IP literature, as reviewed, connected the broad, global IP environment to the history, philosophy, and IP tools currently used in the United States. Next, the

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various ways IP tools connect to the higher education environment was addressed, noting copyright and patenting as being most impactful. Specifically, the Bayh-Dole Act of 1980 and its transformative effect on university IP policy and IP commercialization efforts was reviewed. Special note was made concerning how the campus impacts related to the Bayh-Dole Act of 1980 have trickled down to students through campus IP policy and entrepreneurship-related programming.

Literature addressing the potential mismatch between the implied goals of entrepreneurship-related programming (to support and enable students in the area of creativity, innovation and entrepreneurship) and the implementation of IP policy and IP commercialization practice is lacking. This mixed-methods study and its findings begin to fill the literature gap as presented and identify several additional areas worthy of more exploration and research (described in Chapter V).

CHAPTER III

METHODOLOGY

Student Intellectual Property Study Design

This student intellectual property (IP) knowledge and motivation study utilized a mixed-methods model based on an explanatory sequential design (Creswell & Plano-Clark, 2011). Creswell and Plano-Clark describe the explanatory sequential model as one in which quantitative data is collected first and the results of the quantitative data analysis are used to shape the qualitative questions and data collection that follows. The authors also note how the explanatory sequential design is appropriate when a researcher wants to "assess trends and relationships with quantitative data but also be able to explain the mechanism or reasons behind the resultant trends" (p.82). The final step in the explanatory sequential design is to analyze and integrate the results from both the quantitative and the qualitative data sets.

In a typical explanatory sequential design, as described by Creswell and Plano-Clark (2011), the participants in the qualitative component would be selected from those who completed the quantitative instrument. Selecting the qualitative participants from those who completed the survey instrument is appropriate, since part of the intention of the design is to gather deeper insight into the quantitative results (Creswell & Plano-Clark, 2011). This mixed-methods study deviated from that

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procedure, in that it did not draw the qualitative participants from the quantitative set. The participant set for the quantitative portion of this study consisted of students from a Midwestern public research university. Administrators and faculty working in the area of IP commercialization from that same institution comprised the participant set in the qualitative portion of the study. This explanatory-sequential model modification was deemed appropriate because it was expected that several gaps in understanding, communication, and perspectives exist between these two participant sets (students and TTO faculty/administration).

Theoretical Framework

Expectancy, a component of a well-known work motivation theory contributed to by Victor Vroom, provided the theoretical framework for this mixed-methods study. Vroom wrote about Expectancy (and many other motivation elements) in his well-known book titled *Work and Motivation* (1964). In this large work, Vroom addressed several employee motivation-related questions, including how individuals choose their occupations, what leads to employee satisfaction, and what leads to high levels of employee performance. Vroom (1964) introduces the idea of Expectancy as a model to help understand employee decision-making. He first notes that "specific outcomes attained by a person are dependent not only on the choices that he makes but also on events which are beyond his control" (p.17). Vroom then explains how behavior decisions always involve some risk concerning multiple possible outcomes. Applying the Expectancy model to how an individual makes choices, he writes, "it seems clear his behavior is predicted not only by his preferences among these outcomes but also by

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the degree to which he believes these outcomes to be probable" (p.17). In explaining Expectancy, Vroom is arguing that the expected outcome (from several alternatives) has a significant impact on the choices people make. In a recent application of the model, Johnson (2009) explains how Vroom theorized that employees will be motivated to perform if they believe they are expected to perform, have the ability and opportunity to perform, and will be rewarded for their performance. Daft (2012), added that Expectancy Theory concerns "individuals' expectations about their ability to perform tasks and receive desired rewards" (p.462). In other words, if the expected reward for accomplishment is not attractive to the employee, then his or her motivation to achieve is negatively impacted. While Vroom is strongly linked to Expectancy Theory, Daft (2012), notes that "a number of scholars have made contributions in this area" (p.462).

The concept that the desirability of expected outcomes can impact motivation was used to help understand how campus IP policy and IP commercialization processes might impact student behavior. If a student does not understand the campus IP policy, or does not like the potential outcome (e.g., the university may make an ownership claim on the IP created by the student), student motivation to participate in these activities might be diminished. In the case of student IP, the unattractiveness of the outcome in the students' minds could be real, or perceived.

From the university's perspective, student de-motivation is not a desired outcome, as most would argue the university exists to encourage and enable student achievement. If a university wants to encourage students to excel in the area of IP creation, innovation, and entrepreneurship, students should have the ability to perform,

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and the rewards for that performance should be attractive. If these conditions do not exist, the resulting behavior influences might include students not bringing forth their best ideas and efforts to the campus environment, or students trying to circumvent the system. Both of these scenarios are undesirable.

Research Instruments

This mixed-methods study used two research instruments for data collection: a quantitative-focused survey instrument, and a set of qualitative semi-structured interviews (Glesne, 2011). Undergraduate students at a Midwestern research university were asked to voluntarily complete the survey. Research commercialization office employees (from the same campus), and a faculty member with strong connections to IP commercialization (from the same campus), were asked to voluntarily participate in 30-minute interviews. Participant responses in both data sets were anonymous.

The survey instrument included three sections: 1) Demographic questions; 2) Likert-type questions on a six-point scale (i.e., Strongly Agree, Agree, Somewhat Agree, Somewhat Disagree, Disagree, Strongly Disagree), and 3) Open-ended questions. The resulting survey data was analyzed using *SPSS* software. The survey instrument is presented as Appendix A.

Interviews were used to collect data from three individuals with Technology Transfer Office (TTO) experience. Interview participants included two TTO employees (both serving different roles in the office), and a faculty member who has worked with the TTO office to secure patents based on his research. These interviews lasted 20-30 minutes and were recorded and transcribed, using pseudonyms to protect the anonymity of the participants (Glesne, 2011). The semi-structured interview was a good fit for this

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mixed methods study as some structure was needed, yet openness to unexpected or unforeseen areas of discussion proved fruitful, due to the largely unexplored nature of the topic area (Glesne, 2011).

Student Survey Design

The final structure of the quantitative-focused survey instrument was completed through several iterations. Initial feedback from the author's committee members was used to edit the overall design, including the addition of several questions and the deletion of several questions. Additional editing included several iterations on construct design (Bernard, 2000) and the consideration of question wording alternatives. No formal pilot test was conducted to pre-check instrument reliability; yet, the survey was shared with three graduate students and one undergraduate student for comments and feedback. These four students provided several helpful suggestions that were used to improve the survey. For example, three of the four student reviewers commented that question 17 was difficult to understand. Based on this feedback, question 17 was reworded. Other useful input included a suggestion that the ordering of Likert-type categories begin with "Strongly Disagree" on the left and move toward "Strongly Agree" to the right (the survey was initially set up in the opposite arrangement), as this coincides with the ordering of Likert-type questions on the instructor evaluation forms students fill out multiple times each semester. In its final form, the survey contained 34 questions in three categories: a) demographic questions, b) Likert-type questions, and c) open ended questions. Demographic questions asked participants to identify their gender, age, academic major, and year in school. In addition, participants were asked to indicate their level of IP knowledge, whether or not they had previously read the

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campus IP policy, and if they were currently working on an idea with money-making potential. The survey also included 25 Likert-type questions organized into five categories. Twenty-one of the questions were part of four constructs, and the four remaining questions were independent of any construct and intended to collect additional descriptive data.

The four survey constructs (Bernard, 2000) included *Knowledge, Access, Fear,* and *Attitude*. The Knowledge construct was intended to gather data on student knowledge about IP policy and TTO activity on campus and included Likert-type questions 1, 2, 6, 7, 9, and 10. The Access construct was intended to gather data on student opinions about the accessibility and understandability of IP policy documents and TTO processes and included Likert-type questions 3, 4, 5, and 6. The Fear construct was intended to collect data on how worried students were that the university might try to make an IP ownership claim, if they created a potentially high-value idea, and included Likert-type questions 11, 15, 16, 18, and 20. Finally, the Attitude construct was intended to gather data on student attitudes about the fairness of IP policy and what resources students believe they should be able to access without giving up IP ownership. The Attitude construct included Likert-type questions 12, 13, 19, and 20. The final two open-ended questions provided students the opportunity to comment on the campus IP policy and provide any other feedback about the survey or the topic of student-created IP. The student survey is provided as Appendix A.

Data Collection

After completing the IRB approval process, survey data was collected over a relatively short time period of approximately two weeks. Survey data was collected

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from students in a variety of classes, with an intention to capture responses from students in four categories: business, engineering, aerospace, and the liberal arts. The researcher began the survey data collection process by contacting faculty members in engineering, aerospace, business, and art, seeking permission to ask students in their classes to participate in the survey. At least one course from each undergraduate level was included (100, 200, 300 and 400) to help ensure a range of students from freshmen to seniors.

Data was collected in eight classes. The specific classes accessed included electrical engineering, mechanical engineering, entrepreneurship, aerospace, marketing, and business administration. Paper copy surveys were brought to each classroom by the researcher. At the beginning of the class session, the researcher introduced and summarized the study and then asked students for their participation. Students were informed that they must be at least 18 years of age to complete the survey and that their participation was voluntary and anonymous. The researcher then distributed paper copy surveys to students and collected them upon completion. The entire process took approximately ten minutes for each class. A total of 226 surveys were completed, with a nearly 100% participation rate, as fewer than 10 students chose not to participate or did not qualify to participate.

This approach to survey data collection helped ensure the stratified sample that included a minimum of 150 total student participants. Overall, the distribution of student majors was fairly even. Business students comprised the largest proportion of participants (34.7%), followed by aerospace students (23.6%), engineering students (22.7%), and art and other students (19.1%). The student respondents were 70.4% male.

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This larger number of male participants is not unexpected, since classes in engineering and aerospace are primarily populated with male students. The final distribution of student survey participants was 8.8% freshman, 20.8% sophomores, 33.2% juniors, and 36.7% seniors. One graduate student completed the survey and was included with the seniors for data analysis. Even with this larger number of juniors and seniors, there were enough participants in the freshman (n=20) and sophomore (n=47) categories to allow for reliable statistical analysis. The student survey demographic data is presented as Table 1.

Table 1

Student Survey Participant Demographic Information

Characteristics	n	%
Gender		
Male	159	70.4
Female	67	29.6
Year in School		
Freshman	20	8.8
Sophomore	47	20.8
Junior	75	33.2
Senior	83	36.7
Graduate	1	.4
Major Area of Study		
Business	78	34.7
Engineering	51	22.7
Art and Other	43	19.1
Aerospace	53	23.6

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Descriptive statistics from the student survey assisted greatly in framing the questions for the qualitative component of the project. This was a key mixing point of the current study. For example, a high percentage of students who completed the survey indicated disagreement with the statement that universities do a good job of communicating IP policy. Qualitative interview participants were asked to react to this result, and other survey data. In addition to the four guiding interview questions presented in Chapter I, these five additional interview questions were derived from the student survey results:

1. Approximately 22% of student respondents indicated they received clear information on the campus IP policy and only 11% on the IP commercialization process. Approximately 20% indicated that they thought this information was easy to find. Why do you think this is the case? Does this surprise or concern you?

2. In their open-ended responses to the survey, students responded overwhelmingly that they think the university needs to be more proactive in providing them information about the campus IP policy. Many students indicated they had never heard about this topic before. Do you believe this is a fair criticism? Why or why not?

3. Over 80% of student respondents indicated that they believe paying tuition and fees entitles them to access university resources, such as equipment and spaces to work on their own product or company ideas, without relinquishing any IP ownership. Roughly, 57% indicated the same for even specialized high-

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tech equipment and labs. How do you respond to these assertions? Are students being unreasonable?

4. Considering the feedback collected, 62.4% of students agreed they worry about the university owning part of a potential money-making idea that they develop in a class, and 77% agreed they would advise a friend not to work on a money-making idea on campus. Does this surprise you? What would you say to these students to ease their concerns?

5. Overall, students indicated that they worry about sharing and working on their own potentially high value ideas on campus more if they had read the IP policy. What is your reaction to this?

The interviews also included two broad-based questions related to student IP misperceptions and the overall student IP topic:

1. Do you think students have misperceptions about the campus IP ownership policy or procedures on campus? If so, do you have any suggestions on how to address this?

2. Is there anything else you would like to add concerning students and university IP and commercialization?

Survey Data Coding and Editing

To begin the survey data analysis process, several preparations were required. First, the demographic data was coded numerically. Since these demographic data were nominal in nature, the numbers used did not represent a value, but only a category for analysis. In addition to the numeric categories for demographic data, responses to the Likert-type questions were also assigned a numeric value. Since these data were scaled,

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the assigned numbers did represent a value. For all Likert-type questions, the range of numbers from 1-6 was used to represent the six response categories with "1" used to represent "Strongly Disagree" and "6" used to represent "Strongly Agree." Once the numeric codes were assigned for the demographic and Likert-type data, the results of the survey were entered into an Excel spreadsheet. In addition to the numeric values from each survey, any written responses to the two open-ended questions were entered into columns so that corresponding comments and the numeric responses remained connected. In this way, future correlation analysis options would be available, if the open-ended survey response data were to be quantified. While entering the survey data into Excel, the researcher looked for any signs of problematic surveys (e.g., responses in patterns/geographic shapes or the same response to all questions). Only one survey was deemed to be problematic (all the responses on this questionnaire were marked as "Slightly Agree" or "4"), and these were removed from the data set prior to data analysis.

Data Treatment

Several statistical treatments and tests were applied to the student survey data (N=226) using *SPSS*, including descriptive statistics, reliability analysis, factor analysis, ANOVA, t-tests, and construct correlations. Key results from each of these treatments are presented in Chapter IV, along with several related tables.

In addition to descriptive statistics, quantitative data was tested for significant differences between groups (e.g., engineering students compared to business students). Differences between groups were also explored by testing demographic data against constructs (e.g., did engineering students indicate they knew more about IP policy than

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non-engineering students), and by testing demographic data against individual questions (e.g., do business students indicate they are less likely to bring their best ideas to campus than non-business students). Correlations were used to test for construct independence.

Testing for differences between genders was not one of the primary research questions, yet as an exploratory measure, ANOVA analysis was conducted to test gender against all three survey constructs. While no significant differences were found, one measure was nearing statistical significance with female students indicating less overall negative responses than male students to the idea that a university might make claim to student created IP.

The three semi-structured interviews were transcribed and prepared for analysis. The transcribed interviews were imported into a qualitative analysis software application called *HyperResearch*. Using the software, the interview data was analyzed and subsequently organized into codes, categories and themes (Glesne, 2011). A figure depicting the qualitative data codes, categories, and theme results was also created, using an illustration software program named *FreeHand*. A qualitative data code, category, and theme chart is presented in Chapter IV, Figure 2.

Finally, both the quantitative and qualitative data sets were analyzed and integrated. The integration of the two data sets revealed points of agreement and points of conflict, adding to the richness of the findings. In addition, the data integration helped define several issues which warrant additional study.

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Validity and Reliability

Golafshani (2003) and Creswell (2003) note a test-retest option for addressing reliability in quantitative methods and Golafshani (2003) adds that in re-testing an instrument "a high degree of stability indicates a high degree of reliability, which means the results are repeatable" (p.599). Since the quantitative-focused survey instrument was used to collect data on a single campus, a test-retest option was not available. The survey instrument was tested for internal validity of constructs using Cronbach Alpha and factor analysis (Bernard, 2000). Final construct alphas were .88, .83, and .62. A detailed review of the factor analysis is presented in Chapter IV.

Creswell (2003) argues that reliability, in terms of generalizing findings and/or applying them more broadly, plays a "minor role in qualitative inquiry" (p. 195). Creswell & Plano-Clark (2011) argue that in the qualitative portion of a mixed methods study more emphasis is placed on validity. A triangulation strategy (Glesne, 2011) was used to address validity in the qualitative data collection. Triangulation was achieved by selecting interview participants from different parts of the technology transfer process. A graphic depicting this triangulation relationship was created, utilizing *FreeHand*, and is presented in Figure 1.
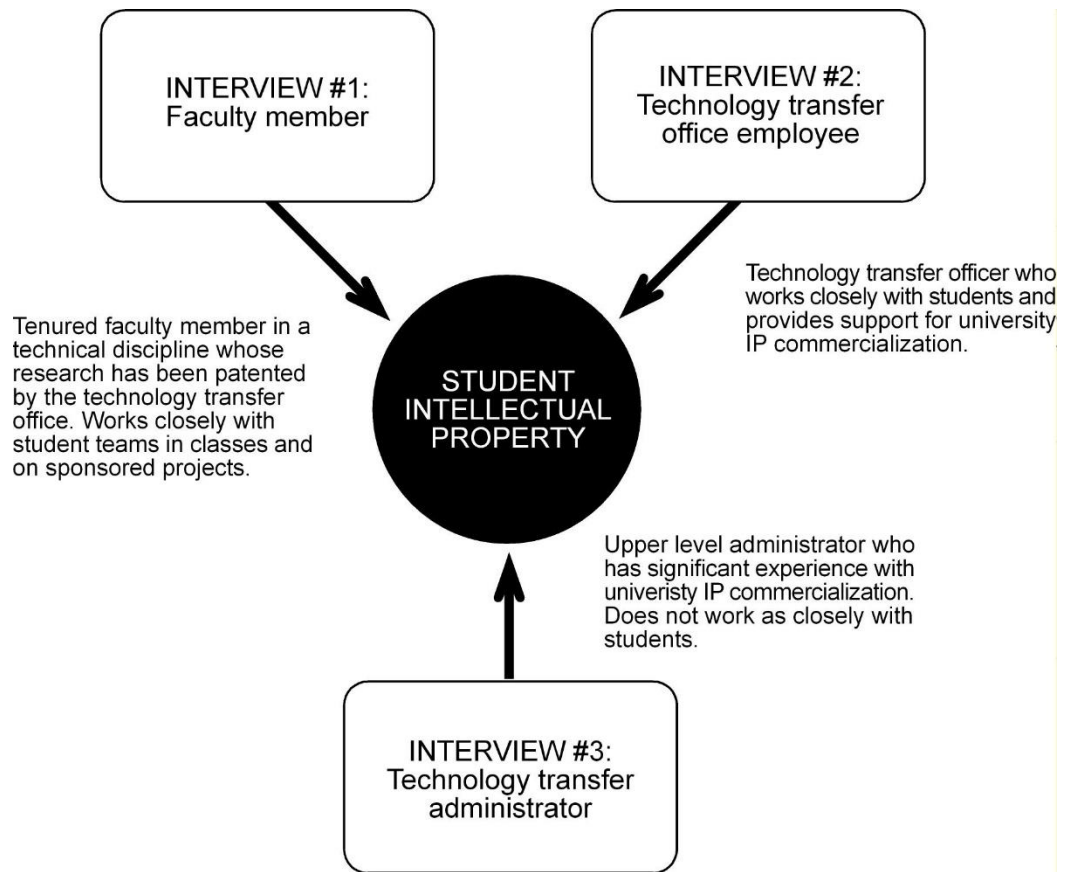
Figure 1. Graphic showing triangulation validity strategy for qualitative interviews.

CHAPTER IV

PRESENTATION OF FINDINGS

Introduction

This mixed-methods study produced a large data set from both the survey and the semi-structured interviews. The survey was designed to capture student knowledge and perspectives concerning campus intellectual property (IP) issues, and the interviews were designed to capture the reaction of campus Technology Transfer Office (TTO) professionals to the student survey results. In this chapter, student survey results are presented first, followed by a qualitative interview analysis. In Chapter III, a key mixing point for the quantitative and qualitative data sets was noted. Additional mixing and interpretation of the two data sets is presented in Chapter V.

Overall, students indicated extremely low levels of knowledge about IP policy and IP commercialization processes on campus, and high levels of uncertainty about what student IP the university may or may not own. Survey results showed that students would like more information about IP topics to be provided to them proactively by the university. The interview participants provided a wide range of reactions to the student survey results. The two interview participants who work most closely with students were not surprised by the survey results, while the interview participant in a more administrative role (who still works with students, but not as

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regularly) was more surprised by the student survey results. The interview participants provided data suggesting students need to learn more about the research process and TTO office intentions regarding student IP ownership, that sometimes student expectations are unreasonable, and that the university needs to do a better job of communicating with students about IP. From the data, it is evident that several misperceptions exist between students and the TTO office. Specific recommendations regarding the study results are presented in Chapter V.

Quantitative Survey Question Results

A majority of students (53.5%) indicated they believe they have low levels of overall IP knowledge. Just 6.2% of students surveyed indicated a belief that they have high levels of IP knowledge. Only 12.8% of students surveyed indicated they had previously read the university IP policy, while 39.2% of student participants indicated they currently had an idea they believe has money-making potential. Additional useful descriptive data were extracted from the 25 Likert-type questions. All question responses were measured on a six-point scale from "Strongly Disagree" to "Strongly Agree" (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Diasagree, 4 = Somewhat Agree, 5 = Agree, 6 = Strongly Agree). Responses to each question are shown in Table 2 and include the percentage of participants who indicated some form of agreement along with respective means and standard deviations.

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Table 2

Student Survey Participant Descriptive Statistics Including Percentage of Some Form of Agreement (strongly agree, agree, slightly agree), Mean, and Standard Deviation

Question Number	Question	% of Agreement	M	SD
q1.	I can describe the difference between patents, trademarks, and copyrights.	70.2	3.9	1.3
q2.	I can describe what the term "technology transfer" means.	27.6	2.6	1.2
q3.	I have been provided clear information about the campus intellectual property policy.	22.3	2.5	1.3
q4.	I have been provided clear information about the campus intellectual property commercialization process.	11.2	2.1	1.0
q5.	My professors have helped me learn about the intellectual property policy on campus.	19.6	2.3	1.2
q6.	My professors have helped me learn about the intellectual property commercialization process on campus.	11.1	2.1	1.0
q7.	Information about the university intellectual property policy is easy to find	21.4	2.7	1.1
q8.	Information about the university intellectual property commercialization process is easy to find.	20.0	2.6	1.0

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Table 2 continued

Question Number	Question	% of Agreement	*M*	*SD*
q9.	I can clearly describe how the university intellectual property policy relates to students.	15.6	2.2	1.1
q10.	If I worked on a team project in class to develop a product or business idea, I would be unsure about who owns the project if it turns out to be profitable.	61.7	3.9	1.3
q11.	I worry about the university owning my ideas.	42.4	3.2	1.5
q12.	Since students pay tuition, the university should not be able to claim any ownership of students product or company ideas, even if students use university equipment and spaces to develop their ideas.	82.7	4.6	1.2
q13.	If a student develops a new product or business idea on campus, it is fair for the university to have partial ownership.	22.2	2.5	1.2
q14.	If a professor creates a new product of business idea on campus, it is fair for the university to have partial ownership.	42.0	3.0	1.3
q15.	If my friend had a product or business idea with money-making potential, I would advise them to keep the idea away from campus so the university can't claim ownership someday.	77.0	4.2	1.2

Table 2 continued

Question Number	Question	% of Agreement	*M*	*SD*
q16.	I worry that if I work on a potential money-making idea as part of a class, the university might own some of it.	62.4	3.7	1.3
q17.	If a professor helps a student significantly improve their product or company idea, that is part of the professor's job and the student should still own the entire idea.	61.1	3.9	1.2
q18	Even if the intellectual property policy states that the university will not claim ownership of an idea created by a student as part of a class, I still worry about sharing my ideas in class.	41.7	3.2	1.2
q19	If a student creates a new product idea, I think the intellectual property commercialization office is a good place for them to go and get help protecting it.	76.9	3.9	0.9
q20	I would not share or work on a potential money-making idea anywhere on campus because I worry that the university might own some of it.	46.4	3.3	1.3
q21	If a student uses a specialized university resource like lab space or high-tech equipment to develop a new product idea outside of a class, I think it is reasonable that the university should be able to claim some ownership.	43.0	3.0	1.2

Question Number	Question	% of Agreement	M	SD
q22	I think students in majors like engineering, technology, or business need to know about and understand campus intellectual property policy.	97.8	5.3	0.8
q23	I think students in majors like music, theatre, and the liberal arts need to know about and understand campus intellectual property policy.	83.3	4.6	1.3
q24	In the future, I can see myself as a business owner.	73.1	4.4	1.5
q25	In the future, I can see myself inventing something that has money-making potential.	64.6	3.9	1.3

While 70.2% (q1) of students agreed they could describe the difference between common forms of IP like patents and trademarks, only 27.6% (q2) agreed that they could describe what the term "technology transfer" means. When asked to identify their level of IP knowledge, 40.7% of student participants selected "low" and 12.8% selected "none." Only 12.8% of the students indicated they had read the university IP policy, yet 39.2% indicated they believed they had a money-making idea.

Another result that speaks to the issue of IP policy communication, education, and information access, is the finding that 22.3% (q3) of students indicated some form of agreement that they had received clear IP policy information. Just 1.3% of student participants strongly agreed that they had received clear IP policy information. Only 11.2% (q4) of student participants indicated some form of agreement that they received

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clear information on the IP commercialization process, and not a single student selected "Strongly Agree" when asked if they had received clear IP commercialization process information. Finally, 21.4% (q7) of students indicated they believe campus IP policy information is easy to find and 15.6% (q9) indicated they know how the IP policy relates to students.

When asked if they worry about the university owning their ideas, 42.4% (q11) of student participants indicated some form of agreement, and 46.4% (q20) indicated they would not share or work on an idea anywhere on campus, because they think the university then might own part of it. In a related question, 82.7% (q12) of students believe that since they pay tuition, the university should not be able to claim any IP ownership, no matter how many university-owned resources students use. Students indicated 61.7% (q10) Students were also asked about their classroom project ownership knowledge, and 61.7% (q10) indicated they would not know who owns a classroom-initiated project, such as a new product or business idea, that turns out to be potentially profitable. Finally, 97.8% (q22) of the survey participants thought that engineering, business and other technical students need to know the campus IP policy, and 83.3% (q23) thought that art, theater, or liberal arts students had a need to know. Responding to questions about their entrepreneurial interests, 73.1% (q24) of students agreed they could see themselves as a future business owner, and 64.6% (q25) indicated they could see themselves inventing something with moneymaking potential. These findings suggest IP issues are highly relevant to all university students, not just those studying business, engineering, or the sciences.

The survey design included four constructs (*Knowledge*, *Fear*, *Access*, and *Attitude*, as described in Chapter III). When analyzing the survey results, an initial factor and reliability analysis was conducted on these four constructs. The results of these tests showed that some adjustment to the construct components would be appropriate. Conceptually, it was determined that the questions in the Access construct (e.g., "I have been provided clear information about the campus intellectual property policy") represented additional dimensionality of the Knowledge construct, not a separate construct of its own. Factor analysis indicated that this construct was statistically appropriate as well. As a result, it was determined that the two factors initially defined as Knowledge and Access were actually a single factor. The Access construct was incorporated into the Knowledge construct to form a single new construct consisting of the first nine Likert-type survey questions, titled Knowledge. The Fear and Attitude constructs were also evaluated. Specifically, factor analysis illustrated that question number fifteen ("If my friend had a product or business idea with money-making potential, I would advise them to keep the idea away from campus so the university can't claim ownership someday.") was a more appropriate fit with the Fear construct than the Attitude construct. After further consideration, this adjustment makes sense conceptually, since the question represents another dimension of fear (e.g., cautioning a friend, for fear of the negative outcome of losing ownership and/or control) and as such is an appropriate addition to the Fear construct. After making these adjustments, a three factor solution was analyzed in *SPSS*. The results showed three factors with eigenvalues greater than 1.00, a scree plot strongly supporting a three factor solution, and varimax rotated factor loadings ranging from .44 to .87 on the

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expected factors. The alpha score for the Knowledge and Fear constructs indicate a high degree of construct reliability while the Attitude construct is approaching the .70 range for reliability. The items of these constructs were summed.

Correlations indicated one statistically significant relationship between the Knowledge and Fear constructs. The .22 positive correlation between the constructs is small, but quite interesting. The relationship indicates the more students knew about the IP policy and IP commercialization process on campus, the more fear they had about how they may be negatively impacted. To further test this relationship between knowledge and fear, a *t*-test of means was conducted on the Fear construct comparing students who indicated they had read the IP policy with students who indicated they had not read the IP policy. This test showed a statistically significant result of $F(2, 223) = .04$, $p = .006$, $d = .55$ where students who read the policy ($M = 4.0$, $SD = 1.02$) indicated higher levels of agreement with questions in the Fear construct than those who did not read the policy ($M = 3.45$, $SD = .99$).

Table 3

Correlation of Subscale Constructs and Measures of Internal Consistency

Subscale	Question Numbers	Knowledge	Fear	Cronbach's Alpha
Knowledge	1 – 9			.88
Fear	11, 15, 16, 18, 20	.22*		.83
Attitude	12, 13, 17, 21	-.11	.10	.62

*p < .05

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In addition to the statistically significant findings presented, it is important to mention tests that did not return statistically significant results. No significant ANOVA results were found when comparing student responses to the Knowledge construct based on year in school. No significant *t*-test results were found when comparing student responses to the Knowledge construct based on entrepreneurial interests. In other words, students showed similarly low levels of knowledge, regardless of their academic experience, or if they had a potential money-making idea.

<div align="center">

Open-ended Survey Question Results

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The survey instrument also provided students the opportunity to respond to two open-ended questions. The first question asked what students would say to a top administrator about the campus IP policy, and the second asked students to identify anything else they wanted to share concerning the topic. A remarkably consistent set of responses were provided by the student participants, with two main ideas clearly identifiable. The first idea is represented by the student participants who wrote: "Why don't we know about this? Should it not be handed to us in every class syllabus just like attendance policies and the like? We should have all of this info within reach at all times"; and "Inform all majors about it since this is my first time hearing about it and I am a junior"; and "Isn't this something I should know about? Shouldn't it be your job to teach me this?"

Repeatedly, students wrote that they had not heard about the IP policy, did not understand the policy, or simply wanted to know how to find IP policy information. These open ended responses are not surprising as they reflect quite vividly the results found in the survey's Knowledge construct.

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The second set of common open-ended question responses related to the concept of a university making a claim on student-created IP. The prevailing student position on this concept is represented by the following quotes: "If I am paying high tuition to attend school here and put forth substantial effort on an idea of creation why would the university own some of it?"; and "As students of the University paying thousands of dollars to fund equipment and staff, any ideas we create are ours and ours alone."

While a minority of students (42.4%, q11) claimed they worried about the university owning their ideas, written responses to open ended questions seem to show a strong distaste from many students to the general concept of a university making claim on student created IP. It is important to point out that these highly-consistent responses emerged from two very broad, open-ended questions, making the commonality even more compelling.

Qualitative Data Coding

After the student surveys were collected and analyzed, three semi-structured interviews were conducted as previously described. The framing questions for the interviews emerged from both the study's research questions and the student survey results, providing a mixing point. Three interviews were completed over the course of two weeks, and the interviewees were each given pseudonyms: Ryan, Amy, and Mick. Ryan is a faculty member in a technical field, Amy is a TTO staff member, and Mick is an IP commercialization administrator. The interviews with Amy and Ryan took place in the researcher's office and each lasted approximately twenty minutes. The interview with Mick took place in his office, and lasted approximately thirty minutes. All three

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interviews were recorded using a digital recorder, and were transcribed using word processing software.

The transcription strategy was to include all of the words and utterances, including "ahhs" and "umms" and other common conversational expressions. The transcribing of the interviews was completed with the use of only a few conventions (Roulston, 2010), specifically the intentional noting of wherever a laugh or a pause occurred. In the final presentation of interview results, some quotes were edited to eliminate utterances not germane to the statement, in order to aid readability.

The transcribed interviews were imported into a qualitative data analysis software application, known as *HyperResearch*, and prepared for coding. Before coding began, the transcripts were read to help familiarize the data. The coding strategy included two iterations. During the first coding iteration, transcripts were coded from top to bottom without any pre-conceived notion of how many codes might be named and identified. A code was applied to as many of the pieces in data sets as possible. Using the *HyperResearch* analysis software, this initial coding iteration resulted in 32 separate codes.

Some of the code names such as *inventor versus owner* came directly from the transcripts and are what Roulston calls "in-vivo" (2010, p.150). Descriptive words and phrases were selected for other codes such as *what tuition does not pay for*, with the intention of picking code names that gave a real sense of the data (Roulston, 2010). As a result of these coding strategies, the final code book is a combination of code names generated from both the transcripts and the researchers' personal descriptions.

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The first coding iteration was reviewed, and it became apparent that several codes were too narrow in scope and should be combined. This combining effort simplified the data without losing any data richness (e.g., *students confused* and *students do not know* were both placed into a single category titled *students do not know IP*). After the second round of coding was complete, the total number of codes had shrunk to 13. The final 13 codes, their definitions, and a sample that is representative of each are included in *Table 4*.

Table 4

Data Code Book with Code Names, Code Definitions and Examples

Code	Definition	Example
IP Apathy	Comments concerning a lack of interest in IP from students and faculty	Amy: "I'll contact faculty members and volunteer… and I've gotten far more refusals from faculty…"
Students Do Not Know Research	Comments concerning the idea that students do not understand research or its role in IP commercialization	Mick: "…I don't know that students really understand what scientific discovery is all about."
Information Hard To Find	Comments concerning the challenges in distributing campus IP information	Amy: "…It's on our website but we have a weird name. I don't even know people know the name of the office to be… perfectly honest…"
Valuing IP	Comments concerning whether or not IP commercialization is part of the campus culture	Mick: "…their culture is a little bit ahead of ours, and you'd expect that…this isn't going to happen with policy…"

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Table 4 continued

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Code	Definition	Example
University Risk	Comments concerning IP commercialization challenges faced by the university	Ryan: "…you know they put a lot of money into it… lawyer's fees, filing fees, and travel to places to talk about the IP…"
University Owns IP	Comments concerning when and/or how the university owns student (and faculty) IP	Amy: "The University will outwardly own something if the student was paid to do the research…"
Student Information Sources	Comments concerning where/how students find campus IP information	Amy: "…maybe our website. We do have our policies and everything on our website…"
Unreasonable Expectations	Comments concerning what students are entitled to access and what tuition does not pay for	Ryan: "…yes, they're paying and yes they should feel entitled to get their money's worth, but really they're paying for the classes…"
Surprised by Results	Comments concerning surprise at the student survey results	Mick: "Yeah, it does surprise me actually… especially today, maybe not 10-15 years ago, but today students know where and how to get information…"
Students Do Not Know IP	Comments concerning lack of student knowledge about campus IP issues	Ryan: "…our goal should be that the students know about it. The fact that they don't know about it puts part of the blame on us as the university…"

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Table 4 continued

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Code	Definition	Example
When Students Make Contact	Comments concerning student-initiated contact with the technology transfer office	Amy (concerning how many students have worked through the TTO to protect IP): "…we only have two situations where that's ever happened…it's quite rare…"
Student Critical	Comments concerning negative student reactions to campus IP policy	Amy: "…I'm trying to explain to them that we're not being greedy…"
Not Surprised by Results	Comments concerning a lack of surprise at the student survey results	Ryan: "I don't think it surprises me that only 22% say they received clear information…"

Qualitative Categories

After completing the coding process, the codes were categorized, with the

ultimate objective of identifying themes and a discovery assertion (Roulston, 2010).

The resulting themes and discovery assertion were then integrated with the quantitative

data results (Creswell & Plano-Clark, 2011), as presented in Chapter V. Three

qualitative data categories emerged from the coding and organizing decisions,

including *IP Culture on Campus, Communication Inadequacies*, and *Student IP*

Disconnects. In Figure 2 a complete data analysis chart is shown, including codes, code

definitions, categories, themes and discovery assertion (Creswell & Plano-Clark, 2011).

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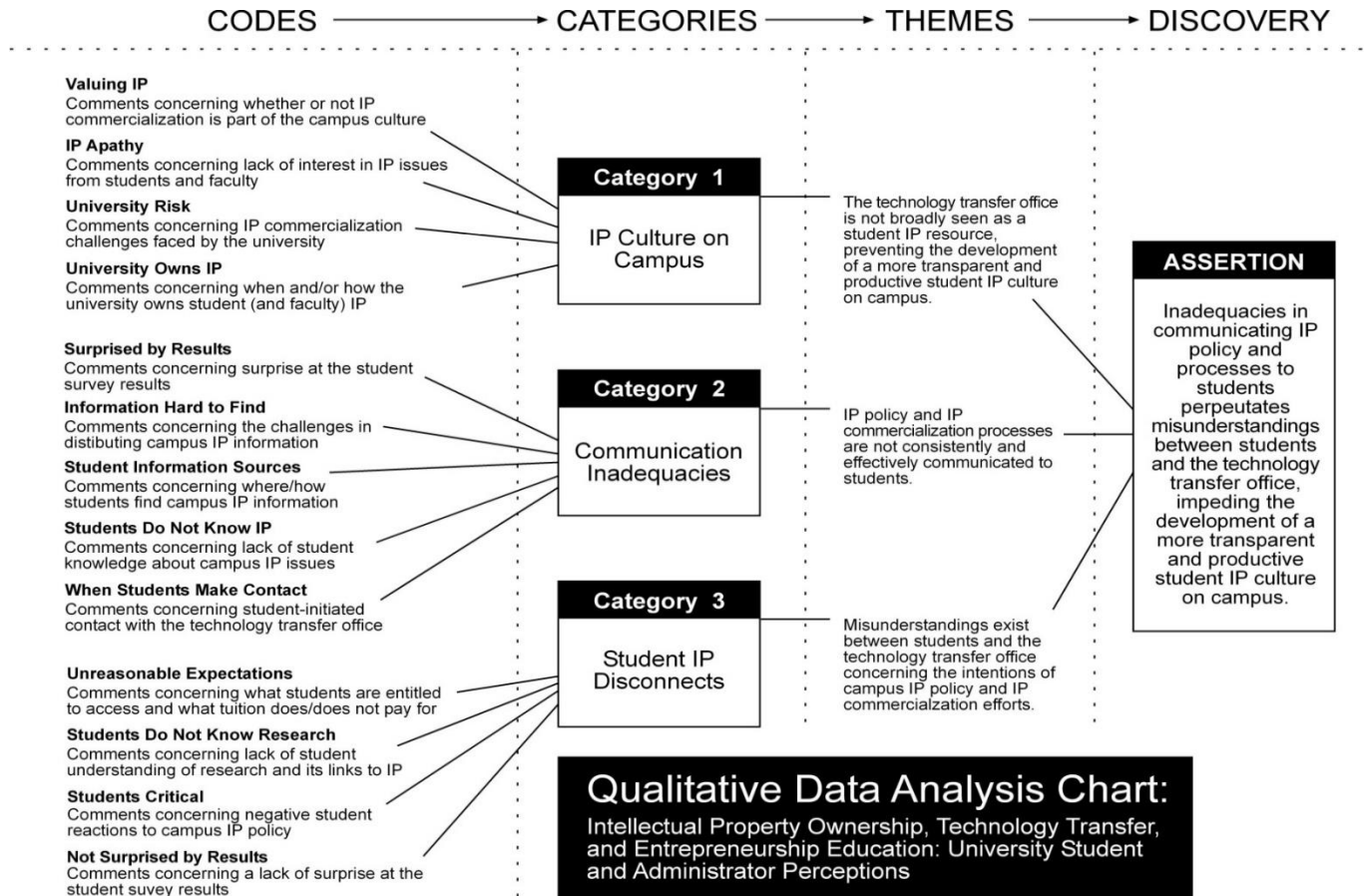
Figure 2. Graphic showing qualitative analysis summary chart.

IP Culture on Campus

The IP Culture category included four codes: *IP Apathy*; *University Risk*; *University Owns IP*; and *Valuing IP*. The IP Apathy code was demonstrated several times, in relationship to both students and faculty. In response to a question pointing out that the vast majority of students indicated they had not received clear information about IP policy or commercialization process, Amy noted "the fact that these numbers are this high among students is not surprising to me. I don't think a lot of students really care." She added, "I think honestly that if you did this with faculty, I think you'd probably have the same number." Ryan, a faculty member, responding to the same question, said "I don't think it surprised me that only 22% say they received clear information…but I wonder of the remaining 78% how many of them actually actively sought out information?"

The code title University Owns IP was assigned in the interview data from both Amy and Ryan. Amy described a scenario where the University would claim student IP ownership, explaining "the university will outwardly own something if the student was paid to do the research," and also added the caveat "which you don't find in undergraduate students, it's very rare." In a comment similar to Amy's, Ryan explained "if a faculty member is doing research and it's sponsored…and they hire a student to work on it and there's some intellectual property that is developed in the course of that sponsored project, the university perspective will be that they [the university] own the rights to that intellectual property."

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The University Risk code contained comments largely related to money and IP protection costs. Mick pointed out "You know it's going to cost you a million dollars in roundabout numbers from one patent in seven jurisdictions from the time you file it to the time it expires." Ryan described how the university invested in an IP discovery from his department, commenting "you know they put a lot of money into it…lawyer's fees and filing fees, and travel to places to talk about the IP and to try and commercialize it." Amy added to the risk code, stating "we have to invest time and money upfront. It's kind of a gamble what we do you know."

The Valuing IP code was addressed primarily by Mick. In the final open-ended interview question, he shared several comments related to how he believes IP commercialization is viewed on campus. He noted that on some U.S. research campuses, you could "walk into any lab off the street and ask them 'You guys developing IP?' I almost guarantee you they'll say 'Yes, and we're going to patent it'."

Mick acknowledges "not everybody loves what they do, of course, but it is a culture point." In addressing the way IP is valued on the campus of his employ, Mick claims "I think that an important thing to consider here is that we're still developing it…I hope to be there for the ride and see it pan out."

Communication Inadequacies

The Communication Inadequacies category saw the largest number of code instances and related comments, and includes components from all three interviews. The five codes in this category were: *When Students Make Contact*; *Students Do Not Know IP*; *Student Information Sources*; *Information Hard to Find*; and *Surprised by*

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Results. The When Students Make Contact code was applied to comments concerning student-initiated activity with the Technology Transfer Office. For instance, Amy explained "occasionally I'll get students that come in and they either want to disclose an idea, maybe not an assignment to the university, but just get my feedback." She noted how sometimes students are well-prepared for these meetings, adding "I've had people come in who've talked to their family attorney prior to coming in." In addressing how students get information, Ryan clarified "Occasionally there's students who have actually talked to the Tech Transfer Office staff, but that seems to be a minority."

The code titled Students Do Not Know IP is one of the more prominent codes in the interview analysis. It was created as a result of collapsing several related codes during the coding iteration process previously described. All three interviewees added content to this area. Ryan proposed one possible reason students may not understand that campus IP policy, saying "I think the information they get makes them somewhat confused about what the actual policy is." In responding to a question about whether or not students seem to understand IP policy on campus, Mick agreed that some students are "just unaware that those types of policies exist in an institution." Amy also agreed that students are sometimes "confused about inventor-ship versus ownership, who inventors are, which is something that faculty, everyone is confused by that… (laughs)."

Student Information Sources is a code that identifies how students are introduced to information about campus IP policy and technology transfer functions. In one of her responses, Amy said bluntly, "I go into classrooms and I'll talk to students,

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usually either in engineering or aerospace. Those are the only two departments I really got into…outside of my outreach, I really don't know." Ryan noted that he sometimes has a student who will "come by for advice on developing their business and ask me questions about intellectual property as well." When asked about other student sources of information, Ryan added "in my experience, I think they hear from other students." This is a particularly useful comment, especially in light of the fact that most students surveyed indicated they know very little about campus IP issues.

In the Information Hard to Find code, Amy shared that information gathering can be a challenge for students, acknowledging "It's on our website, but we have a weird name. I don't even know people know the name of the office to be perfectly honest." Adding to this code are comments about the usefulness of published IP information. Amy describes the IP policy, explaining that "they kind of re-did our policy a few years ago, it was previously 20 pages long and they got it down to six pages and it did not read well. It was very attorney-esque…it's not very clear." In responding to the difficulty students can face in finding digestible IP information, Mick adds "what makes it, I think, hidden, is IP commercialization…or tech transfer…is buried in the research division. That's very typical and that's not unique to (us). Students are a long way away from that in general."

The final code in the Communication Inadequacies category is titled Surprised by Results. This code is juxtaposed by another code titled *Not Surprised by Results* (The Not Surprised by Results code is in the Student IP Disconnects category). Mick's comments are the only ones found in the Surprised by Results code (Amy and Ryan's related comments are found in the Not Surprised by Results code). When asked to

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respond to the low levels of student campus IP knowledge as indicated but the survey results, Mick expressed surprise. Mick responded, saying "Yeah, it does surprise me actually, especially today, not maybe 10-15 years ago, but today, students know where and how to get information." Responding to student comments concerning their interest in the campus proactively providing more IP information, Mick added "I'm surprised at that and when you say students are looking for more information: I'm not sure in what format, what does that mean? Because it's all available, the information's available."

Student IP Disconnects

The third and final interview data category is titled Student IP Disconnects. This category is composed of four codes: *Unreasonable Expectations*; *Students Do Not Know Research*; *Students Critical*; and *Not Surprised by Results*. In the Unreasonable Expectations code are several highly-consistent comments rebuffing the student viewpoint that paying tuition entitles them to access almost all university resources, including specialized assets such as technology-rich lab equipment. When asked if she thought student expectations in this regard were unreasonable, Amy replied directly "Yeah, I would probably say they're being unreasonable." In explaining his position that he also believes students sometimes have unreasonable expectations about what tuition entitles them to access, Ryan said "if you look at the revenue from the university, you know, maybe a fourth comes from tuition, a fourth comes from the state; the rest of it is a mix of federal grants and contracts…so it's a complex organization." Mick's comments complemented both Amy and Ryan, and he added "if a faculty member uses his or her expertise, his or her blood, sweat, and tears, his or her relationships with others to solicit third party funding…I don't think there's a clear

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connection between students paying tuition and allowing them access to things that have been sourced from other areas." Ryan used the analogy of student as customer to make an additional point, noting "when you're a customer…you're paying for something specific. You go into a business and you buy this item and you pay for a service. That doesn't entitle you to everything the company owns."

The Students Do Not Know Research code was an unexpected result that emerged from the interviews. Ryan and Mick both made points in this area. In responding to the student survey results showing students fear the university owning their IP, Mick described how he wished students were more involved in research, stating "…students don't get exposed to the creative process enough in my humblest estimation…I think we should be asking students to be more involved in research." In a related comment, Mick noted his belief that "we ought to do a better job…finding ways to bridge that gap between academic study and scholarly research." Ryan also addressed what he sees as a gap in student understanding that university IP ownership typically surrounds research discoveries, adding "the student working just in a class on a project, and they might talk about it, share it with the instructor. Their instructor might give them some pointers…I don't think that's something that the university under its current policy would even try to capture."

Several statements were organized into the Students Critical code. These statements primarily concern negative opinions and attitudes expressed by students about the campus IP policy and IP commercialization office. Interestingly, some of the negative positions students have taken, according to the interviewees, may or may not be based on actual policy. Amy responds to what she sees as a myth or misperception

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about the Technology Transfer Office looking to own IP from student classroom projects, noting "I don't know how this myth got out there though. I'm very confused by it, but not surprised by it, because in the classes that I do talk, this is always the question. This is the very first question." Mick directly addresses the issue of the university owning student IP, stating "the university does not claim IP ownership of the student, it doesn't. It does when there's an employment situation, whether they're part of a grant or contract and so forth." Mick then adds, animatedly "I get this question a lot you know; why is the university stealing IP? We're not stealing anything. It's crazy; that's a crazy notion, and you can tell I'm agitated by it." Ryan adds to the code, stating his belief that "students don't see the university IP office as a resource to help them, but rather as a kind of roadblock or hindrance."

Finally, the Not Surprised code was created as a result of statements exclusively from Amy and Ryan. Both of these interview participants commented several times about their lack of surprise at the student survey results. When asked near the end of the interview if she would like to add anything else to the conversation, Amy responded "Not really. It's pretty much what I expected. I think that if you were talking to students or faculty or staff or anyone, it's not on a lot of people's radar. So, I'm not really surprised." Ryan added an insightful caveat (complementary to his statement in the Student Information Sources code) concerning students' low levels of IP knowledge, stating "I'm not surprised that that number is so low…but it seems the number one source of information for most students is other students." The implications of this student-to-student information chain is developed more fully in Chapter V.

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Based on the codes and the resulting categorization, three themes emerged from the qualitative interviews (Creswell & Plano-Clark, 2011). The first theme represents the IP Culture of Campus category, the second theme represents the Communication Inadequacies category, and the third theme represents the Student IP Disconnects category. The three qualitative themes read as follows:

Theme 1: The Technology Transfer Office is not broadly seen as a student IP resource, preventing the development of a more transparent and productive student IP culture on campus.

Theme 2: The campus IP policy and IP commercialization processes are not consistently or effectively communicated to students.

Theme 3: Misunderstandings exist between students and the technology transfer office, concerning the intentions of campus IP policy and IP commercialization efforts.

Tying all three themes together into a single, comprehensive assertion (Glesne, 2011), led to the creation of the following qualitative research discovery:

Assertion: University inadequacies in communicating IP policy and processes to students perpetuate misunderstandings between students and the Technology Transfer Office, impeding the development of a more transparent and productive student IP culture on campus.

A large body of research results has been presented from both the qualitative and the quantitative components of this mixed-methods project. As a final step in the analysis process, the qualitative and quantitative results are mixed, synthesized and

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interpreted (Creswell & Plano-Clark, 2011) in Chapter V. This interpretation of

research results includes implications, recommendations, and final thoughts.

CHAPTER V

SUMMARY, DISCUSSION, RECOMMENDATIONS, AND FINAL THOUGHTS

Summary

The purpose of this study was to capture student perspectives on one Midwestern university concerning campus intellectual property (IP) issues and present the results to experienced university IP professionals for their reactions. The main student IP issues included student IP knowledge (or lack thereof), and student attitudes and expectations about IP policy and IP commercialization processes. The study was framed using a component of Expectancy Theory, a well-known employee motivation model conceptualized by Vroom (1964) and contributed to by many others over the years (Daft, 2012).

Student IP was defined and introduced in Chapter I. A highly-publicized student IP ownership conflict at the University of Missouri was presented as an illustration of the importance of the topic and the study. A related review of the IP literature was presented in Chapter II. This review focused on historical and philosophical underpinnings, forms of IP protection, and the application of IP issues in the higher education setting. Described in Chapter III is the explanatory-sequential mixed-methods design used in this study. The mixed-methods approach included the use of a

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student survey (*N*=226) and in-depth interviews with a faculty member and two IP commercialization office staff members.

The quantitative and qualitative data collected during this study were reviewed in Chapter IV. Several sets of quantitative data results were organized and presented, including: descriptive statistics; means with standard deviations; percentage of agreement; factor analysis; ANOVA; and correlation of constructs. Reliability of the quantitative data survey constructs was addressed using Cronbach alpha tests. Qualitative data from the in-depth interviews was coded, categorized, and themed. Three themes and a related discovery assertion emerged from this analysis process, and a data analysis graphic was created to illustrate these findings. Validity of the qualitative data was addressed using a triangulation strategy. A graphic was created to represent the triangulation components and their relationship to one another. The most important findings of this study included poor communication between students and the university concerning student IP issues, and conflicting IP perspectives between students and the university Technology Transfer Office (TTO).

In this chapter, the quantitative and qualitative data results are mixed, and presented in the context of the study's six research questions. Following discussion of the research questions, several recommendations are proposed concerning IP policy, IP policy communication, and university IP commercialization efforts. Next, the study's limitations are acknowledged, and areas for future study of student IP and university IP commercialization are suggested. The chapter concludes with a reflection from the researcher.

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How much do students believe they know about university intellectual property policy and IP commercialization functions?

The direct answer to the first research question is "not very much." Using several measures, including Likert-type questions and open-ended written responses, students repeatedly indicated that they have little knowledge of the topic area. In many cases, students claimed that they knew nothing at all. These findings link closely to the student IP literature, as reviewed. Although none of the articles specifically addressed student IP from a commercialization standpoint, the small number of student IP-related studies found in the literature did present a picture of low student levels of knowledge and understanding (Lunsford, Fishman, & Lieu. 2013; Thibeault, 2012). As an interesting caveat, the study's interview participants predicted that a survey of faculty would likely produce the same low-level knowledge results.

A recent report from the Association of University Technology Managers (commonly known as AUTM) noted that more than 70% of technology transfer managers believe their offices do a good job communicating with students about IP policies and issues (Association of University Technology Managers, 2012). The survey and interview data as presented clearly indicate that students have a vastly different perspective. Students indicated that they received little or no information about campus IP policy or IP commercialization processes. They also shared their belief that the university has a responsibility to proactively inform students about IP policy and related issues. The interview participants somewhat disagreed with this student assertion, noting that students also share a responsibility for their own

knowledge. Many students, on the other hand, indicated they had never heard about IP policy and commercialization topics before completing the survey. In light of this discovery, it seems unreasonable to expect students to gather information about a topic they do not know exists. In other words, it is unfair to expect students to know what they do not know. Communicating this finding to students and campus IP administrators might prove fruitful, even if the result is that both constituent groups simply become more aware that an expectation gap exists.

Adding to the richness of the results concerning how well students are informed about IP, interviews with campus IP professionals uncovered some additional opposing viewpoints. The two campus IP commercialization experts who work most closely with students were not surprised that students knew very little about campus IP policy or TTO operations. The higher level administrative officer, on the other hand, was somewhat surprised, expecting that students would have known much more about IP issues than the survey results indicated.

In a highly compelling finding that warrants discussion, the lack of student IP knowledge might be feeding into some campus student IP myths. The primary myth appears to be the idea that the university intends to pursue ownership of student creations emanating from classroom activities. During interviews with two IP commercialization staff members, both specifically stated that the campus has no intention of pursuing the ownership of student class-related work. Both interview participants also argued that there is no history of the campus TTO pursuing this type of ownership claim. The faculty member who was interviewed indicated his belief that the IP commercialization office is sincere in these points. Even so, the survey results

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show that students worry about the university owning their ideas. More than 40% of students agreed that they fear the university might own their classroom projects, even if the university IP policy states that it will not. Either the students do not believe the IP policy will be administered as written, or they have not been clearly and consistently informed.

Research Question II

What university resources do students believe paying tuition entitles them to access, without having to relinquish IP ownership?

Overall, students indicated a belief that their tuition dollars entitle them to access a wide range of university resources, including faculty expertise and lab spaces or other physical assets. Campus IP professionals did not see the issue of resource access in the same way. All three interview participants argued that the funding model for a university is complex, with multiple revenue sources, many of which have nothing to do with student tuition (e.g., a faculty member writing and administrating a large federal grant to outfit a lab space for scientific testing purposes). As such, the interview participants argued that it is unreasonable for students to believe they are entitled to access all of these campus resources. Communication between students and the university concerning this topic needs improvement, but it is unclear whether more information or explanation from the university would sway student opinions on this matter.

In the open-ended portion of the student survey, several students referenced the high cost of tuition, and how the paying of these fees ought to be "enough" for the university. One student noted "If I am paying high tuition to attend school here and put

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forth substantial effort on an idea of creation why would the university own some of it?", while another student added "We pay our dues to come to school and use resources here. Further debt to the school is unfair." There is more than a hint of cynicism in these student responses. In the end, students take a strong position that since they pay tuition to access the campus educational and other offerings, what they create should be theirs, regardless of the campus resources accessed (including faculty expertise).

A final point of interest is related to the student survey question concerning what constitutes faculty members "doing their jobs." More than 60% of the students agreed that even significant inputs from a faculty member on a student project with commercial potential is simply part of the job. Drawing the line between faculty job responsibility and IP ownership of a project is a seemingly difficult proposition. It can become particularly challenging for non-patent IP forms. For instance, if a faculty member in a Graphic Arts program helps a student significantly with the design of a logo for his/her own company, should the faculty member (and ultimately, the university) be entitled to some IP ownership of the resulting trademark? While the literature addressed copyright and trademarks (Sun & Baez, 2009), the IP commercialization literature was dominated by studies concerning patenting of research discoveries, as enabled by the Bayh-Dole Act (Colaianni & Cook-Deegan, 2009; Sampat, 2006; Kumar, 2010). This focus on patenting was also evident in the interviews conducted as part of this study. A bias seems to exist, both in the literature, and on the campus of this study, that IP commercialization opportunity primarily

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surrounds patenting. The significant shortcomings of this mindset are addressed in the final section of this chapter.

Research Question III

Does intellectual property policy affect student willingness to bring their best ideas to campus or the classroom?

The literature robustly addressed the Bayh-Dole Act of 1980 and its many impacts regarding IP commercialization on American research university campuses. One of the impacts is the fact that most research university campuses now have formalized IP policies and IP commercialization processes (and dedicated offices) in place (Nelson, 1998; Thursby & Kemp, 2002). The research university campus selected for this study is no different, with a campus policy in place that specifically mentions students. This study illustrated that students worry about bringing their best ideas into the campus setting. More than three in four students agreed that they would advise a friend to keep their money-making ideas away from the university. More than 60% of students indicated they worry that the university might own their classroom projects if they have commercial potential. Whether or not these student fears about IP ownership are warranted, if students fear the outcome, they might be discouraged from engaging or will simply circumvent the system. One student specifically expressed the intention to circumvent the system, writing "I won't be informing anyone until I leave [the university] before publishing or going public with my ideas that can potentially make money."

Findings from this study related to student fears have the potential to add to the literature in the area of Expectancy (Chen, Gupta & Hoshower, 2006; Goldsmith, Tran,

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Smith & Howe, 2009; Ham, Zamboanga, Olthuis, Casner & Bui, 2010). While the students are not employees, they might be categorized as "quasi-employees" in the context of IP ownership as they are included in the university IP policy. The student responses were a fit with the theoretical framework. Students expressed their dislike of the potential outcome (only 22.2% of students agreed that the university should be entitled to some ownership of student IP); furthermore, they indicated that they would not likely pursue a project with commercial project in the campus environment (as previously described). This finding should raise concerns for IP policymakers and others involved in developing and supporting entrepreneurship-related programming.

Research Question IV

Are there differences in student knowledge and attitudes about university IP policy depending on major field of study, year in school, or entrepreneurial interests?

Students overwhelmingly indicated that they did not know much about campus IP policy or IP commercialization processes, and shared an overall negative attitude about the idea of a university owning student IP. These student positions were best represented by the mean scores and percentage of agreement numbers to the several knowledge and attitude related survey questions, as presented in Chapter IV. The interview participants affirmed the validity of these quantitative findings by expressing their lack of surprise at the results.

One compelling and statistically significant finding related to this research question concerned the testing of students who had and had not read the campus IP policy against the Fear construct. This test yielded a statistically significant result (as presented in Chapter IV); students who had read the IP policy were more fearful of

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university IP ownership than those that had not read the policy. The IP administrator, responding to this finding during his interview, laughingly stated "well they should have read the policy three years ago!" He also offered a potential explanation, arguing "there are few university policies that wouldn't do that to a student." He may be correct in his assertion on student reactions to complex university policy documents, yet it is important to consider other explanations as well. Another possibility is that students were simply confused by the document, and as a result, were anxious about how it might affect them. During her interview, the IP office staff member noted her experience helping ease these types of student fears about the campus IP policy, explaining "I've had students come into my office with the policy and will sit down and talk about it, and I feel that after I discuss it with them…they're very relieved."

Research Question V

How much do faculty and administrators involved with technology transfer activity know about the student perspective on campus IP issues?

The IP professionals with the closest ties to students were highly in tune with the student survey results. Even if they did not agree with the student perspective (i.e., what tuition entitles students to access, as previously described), they were not surprised by the student position on the survey topics. Alternately, the interview participant with a more administrative focus, who works less often with students, was more surprised, and even a bit frustrated, by the student survey results. In other words, the further away a campus IP expert was from students, the less aware they seemed to be of the student perspective. The finding sheds light on the difficulty students might face in trying to make their voice heard concerning student IP. As a promising sign of

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administration openness to the survey results, the IP administrator agreed that the "numbers suggest there are ways to improve the information flow, that's for sure" and, "I think it's an area we can clearly be better at."

As previously described, this study was designed to emphasize the student perspective and present those positions to campus IP experts for their response. Although the research model emphasized students, and part of its intent was to help IP administrators learn about the student perspective, it would be unfair to say that students have nothing to learn from IP professionals. The individuals interviewed during this study seemed concerned about student success and made compelling points that students should consider, including how truly difficult and expensive it can be to protect and commercialize IP. The literature is clear on this point as well. Just because IP is created (or in this case, just because a student creates IP) does not mean the IP will have commercial value (Jelininek & Markham, 2007; Barr, Baker, & Markham, 2009). In other words, the successful transition of IP from the campus to the marketplace is not accomplished by simply securing IP protection (i.e., a patent).

Research Question VI

Are there misperceptions between students and the IP commercialization office?

During his interview, the IP administrator commented that he did not like the term "misperceptions" regarding student IP issues, because it "suggests that they've been misled in some way, shape, or form." Setting aside this issue of intent, there does appear to be a level of tension between students and the TTO. Much of this tension might be due to poor, incomplete, and inconsistent communication between the two groups. In the absence of student IP-related information, students might be developing

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their own interpretations, or adopting the interpretations of other students, as noted by the faculty member during his interview.

Interviews with three campus IP commercialization professionals revealed a perception that many students do not seem to care about IP issues (as evidenced by the IP Apathy code in the interview data analysis). This perception is not supported by the student survey data. Students indicated high levels of interest in the IP topic and also shared many strong, written opinions through the survey's open ended questions. Nearly 40% of students indicated they currently had a money-making idea. The data from this study showing low levels of student IP knowledge is consistent with the small number of student IP studies found in the literature (Lunsford, Fishman, & Lieu. 2013; Thibeault, 2012). It might be that an absence of student knowledge was perceived as apathy by the TTO professionals interviewed as part of this study.

Finally, it appears that perceptions exist among students that this Midwestern university wants to "take" their ideas. One student commented sharply about campus IP policy, claiming "I have no idea what it is, but the trend is that universities "steal" ideas from students or demand compensation." All three interview participants noted this misperception and its prevalence on campus. The notion that students might see the TTO office as the "enemy" is an important finding. The interview participants from this study all expressed their interest in helping and informing students, and a desire for students to see the TTO office as a resource. The quantitative results from this study did not indicate students perceive the TTO office as a resource. There is one piece of survey data which provides hope that this type of mutually beneficial relationship might

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emerge: More than 42% of the students agreed that the TTO was a good place for a student to go for help protecting an idea (i.e., securing a patent).

Recommendations

Several practical solutions are available that have the potential to address the lack of student IP knowledge on campus and to potentially remedy many of the "disconnects" found in the study. One student respondent suggested that the IP policy, or reference to the policy, be included on all course syllabi, just as other important campus policies that impact students are included. This suggestion might be implemented quickly and simply. By including student IP information on all syllabi, the university would also be proactively working to make students aware of the topic and issues (addressing one of the student complaints). Additional upgraded information-sharing options include student IP information links on the BlackBoard system and in prominent locations on the university website. Expecting students to find the IP policy as it is currently located seems unproductive. The IP office staff member interviewed as part of this study noted how challenging IP policy and commercialization information is to find, including the fact that the office name is "weird."

While more contact points are a good beginning, an additional challenge to the lack of student knowledge is the fact that information is often hard for students (and faculty) to understand. The faculty member interview participant suggested that the university create an FAQ section on its website, where different scenarios or short examples might be provided to clarify the campus IP policy implications for students. The key to success with all of the communication recommendations presented is frequency. Students need to be proactively reminded regularly about their IP rights and

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the IP rights claimed by the university. In this way, misperceptions are significantly reduced, and transparency is enhanced.

More faculty knowledge of campus IP policy and commercialization processes might also be beneficial. Through the survey, students indicated that they are not receiving very much IP-related information from faculty members. As one of the primary student contact points, faculty might play a major role in providing students with guidance about where to get more IP information. Enhanced faculty IP knowledge might be addressed through an augmented training program. A recommendation is to make IP education part of required faculty training, similar to harassment, student rights, and other topics. In doing so, the university has an opportunity to help faculty grow in the area of IP understanding, adding to the culture of IP on campus (as addressed by the IP administrator during his interview). A well-designed IP training program may also prove attractive to other institutions. This type of training enhancement would ultimately benefit students as well.

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Limitations

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This study was conducted on a single campus, and as the specific area of inquiry is largely unexplored, it is recommended that the survey instrument be tested in additional campus locations in the future and on campuses from a range of Carnegie classifications. Based on the usefulness of the qualitative data from this study, a mixed-methods project similar in design would be ideal, yet even the collection of student survey data and responses from the open-ended questions (as presented in Chapter III) would prove fruitful in continuing to test the model and address reliability. The overall and consistently low levels of student IP knowledge also made comparisons between

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groups less meaningful (e.g., comparing campus IP policy knowledge between business students and engineering students). A wider range of variability in these categories would be needed to warrant more exploration of these types of group differences.

Recommendations for Future Research

Along with re-testing the survey instrument, it is recommended that several related lines of inquiry be explored, including:

1. Gender influences on intellectual property attitude;
2. Student cynicism concerning intellectual property policy;
3. Graduate student intellectual property knowledge;
4. Faculty intellectual property knowledge;
5. Faculty intellectual property in student projects with commercial potential;
6. Patent bias in intellectual property commercialization.

Nearly all students (97.8%) thought that engineering, business and other technical students need to know the campus IP policy, but far fewer (83.3%) thought that art, theater, or liberal arts students had a need to know. While students studying in areas like engineering or business may have a higher likelihood of engaging in a project with commercial potential, the IP policy impacts are no greater. For example, if a music student writes a song with the aid of campus resources (e.g., computers, software, musical instruments, or faculty expertise) and that song becomes a major hit, the campus IP policy and its implications will quickly become critically important to that student. As such, the issue of assumed disparate impacts of IP policy in various academic program settings is a topic that also warrants future exploration.

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Final Thoughts

I have been intrigued by the topic of student IP since my first days teaching entrepreneurship in a business college setting, more than a decade ago. This mixed-methods study provided critical data that I believe has the potential to help students and IP commercialization professionals work together more closely and more effectively. Nonetheless, I am compelled to add three final thoughts on the topic of student IP in higher education.

First, it is clear from the literature and the interviews I conducted with campus IP experts, that campus IP commercialization is fixated on patenting. While patents may have high value, they are only one of the many potentially valuable IP tools available. In practice, and in my experience, students are more likely to create IP in the areas of trademarks and copyrights (e.g., creating a unique company or product name). Both of these IP tools have long life-spans (i.e., trademarks can be held in perpetuity if used and managed appropriately), while patent life spans are relatively much shorter. The idea of "patent bias" is a topic area that needs more study, and has potential applications in both the university setting and the private sector.

Second, in the literature it was evident that the success rate of commercializing patented discoveries from a university-held portfolio is low, while the costs are typically high. The faculty member I interviewed hinted at this literature theme of hit-and-miss campus IP commercialization success, when he noted that many universities are "waiting for that big blockbuster to come along, and you know, it may not ever." He concluded that his campus will probably not be one of the lucky few, stating "the likelihood we're going to win the lottery is pretty low." The IP administrator also

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concurred with the literature, noting the powerful impacts of Bayh-Dole on the university IP environment, and the surge of activity it spurred. An important question must be asked in response to these realities. Just because Bayh-Dole provides universities the opportunity to pursue IP commercialization, does that mean it should be pursued? This difficult and potentially controversial question is one that I believe many universities should reconsider, especially in light of all that has been learned about campus IP commercialization over the past three decades. The "should we" question is one that may not have been fully considered by many universities as they rushed to join the IP commercialization environment, induced by Bayh-Dole.

Finally, it is clear from the literature, and from the results of this study, that IP is a messy, complex topic, and largely devoid of straight-forward "right or wrong" answers. I often tell my students that the most reasonable response to almost any IP question is "it depends." In my estimation, it would be nearly impossible to provide students with a comprehensive and absolute guide on how to navigate any respective campus IP policy. Student participants in this study indicated very low levels of campus IP knowledge, and they worried about working on ideas with commercial potential in the campus environment. I believe these low levels of student knowledge and high levels of worry are a significant problem. Adding to the concern is the fact that students with more campus IP knowledge indicated higher levels of fear concerning campus IP ownership than those students with less knowledge. As such, I assert the most appropriate approach to student IP policy is to expressly exclude students. Unless students are formally and directly employed by the university, anything they create should be theirs, regardless of the university resources utilized. This is not to suggest

that all university resources must be made available to students. The student exclusion from IP policy should be openly, directly, and frequently communicated across campus. In this way, students might be encouraged to pursue IP creation, free from any university IP ownership worries. If a university openly and freely supports student innovation and IP creation with all the resources it can, it is my belief that students will enthusiastically reward the institution for helping launch their entrepreneurial dreams.

APPENDICES

APPENDIX A

STUDENT SURVEY INSTRUMENT

Student Intellectual Property

Thank you for taking a few minutes to complete this short survey on student intellectual property. Your participation is voluntary and all responses will remain anonymous. No incentives or rewards are being offered to complete this survey and you may stop at any time or simply choose not to participate. Your honest answers and participation are greatly appreciated!

_____

Gender: Male_____   Female_____   Age_____

Year in School: Freshman___   Sophomore___   Junior___   Senior___   Graduate Student___

Major Area of Study: _____

I would rate my level of intellectual property knowledge as: None___   Low___   Medium___   High___

I have read the university intellectual property policy: Yes___   No___

I currently have a product or company idea that I think has money making potential: Yes___   No___

	Please respond to the following statements by circling the number that best represents your level of agreement or disagreement.	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1.	I can describe the difference between patents, trademarks, and copyrights.	1	2	3	4	5	6

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No.	Statement						
2.	I can describe what the term "technology transfer" means.	1	2	3	4	5	6
3.	I have been provided clear information about the campus intellectual property policy.	1	2	3	4	5	6
4.	I have been provided clear information about the campus intellectual property commercialization process.	1	2	3	4	5	6
5.	My professors have helped me learn about the intellectual property policy on campus.	1	2	3	4	5	6
6.	My professors have helped me learn about the intellectual property commercialization process on campus.	1	2	3	4	5	6
7.	Information about the university intellectual property policy is easy to find.	1	2	3	4	5	6
8.	Information about the university intellectual property commercialization process is easy to find.	1	2	3	4	5	6
9.	I can clearly describe how the university intellectual property policy relates to students.	1	2	3	4	5	6
10.	If I worked on a team project in class to develop a product or business idea, I would be unsure about who owns the project if it turns out to be profitable.	1	2	3	4	5	6
11.	I worry about the university owning my ideas.	1	2	3	4	5	6
12.	Since students pay tuition, the university should not be able to claim any ownership of student product or company ideas, even if students use university equipment and spaces to develop their ideas.	1	2	3	4	5	6
13.	If a student develops a new product or business idea on campus, it is fair for the university to have partial ownership.	1	2	3	4	5	6
14.	If a professor creates a new product or business idea on campus, it is fair for the university to have partial ownership.	1	2	3	4	5	6
15.	If my friend had a product or business idea with money-making potential, I would advise them to keep the idea away from campus so the university can't claim ownership someday.	1	2	3	4	5	6
16.	I worry that if I work on a potential money-making idea as part of a class, the university might own some of it.	1	2	3	4	5	6
17.	If a professor helps a student significantly improve their product or company idea, that is part of the professor's job and the student should still own the entire idea.	1	2	3	4	5	6

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18.	Even if the intellectual property policy states that the university will not claim ownership of an idea created by a student as part of a class, I still worry about sharing my ideas in class.	1	2	3	4	5	6
19.	If a student creates a new product idea, I think the intellectual property commercialization office is a good place for them to go and get help protecting it.	1	2	3	4	5	6
20.	I would not share or work on a potential money-making idea anywhere on campus because I worry that the university might own some of it.	1	2	3	4	5	6
21.	If a student uses a specialized university resource like lab space or high-tech equipment to develop a new product idea outside of a class, I think it is reasonable that the university should be able to claim some ownership.	1	2	3	4	5	6
22.	I think students in majors like engineering, technology, or business need to know about and understand campus intellectual property policy.	1	2	3	4	5	6
23.	I think students in majors like music, theater, and the liberal arts need to know about and understand campus intellectual property policy.	1	2	3	4	5	6
24.	In the future, I can see myself as a business owner.	1	2	3	4	5	6
25.	In the future, I can see myself inventing something that has money-making potential.	1	2	3	4	5	6

If you could share one comment with a top university administrator about the campus intellectual property policy as it relates to students, what would it be?

_____
_____
_____

Do you have any additional comments you would like to share concerning student intellectual property?

_____
_____
_____

Thank you for your participation!

APPENDIX B

INFORMED CONSENT

THE UNIVERSITY OF NORTH DAKOTA
CONSENT TO PARTICIPATE IN RESEARCH

TITLE: Intellectual Property Ownership, Technology
                                        Transfer, and Entrepreneurship Education: A Mixed
                                        Methods Study of Student and Administration
                                        Perceptions at a Research University

PROJECT DIRECTOR: Craig Silvernagel

PHONE #   701-777-2463

DEPARTMENT: Entrepreneurship

STATEMENT OF RESEARCH

A person who is to participate in the research must give his or her informed consent to such
participation. This consent must be based on an understanding of the nature and risks of the
research. This document provides information that is important for this understanding.
Research projects include only subjects who choose to take part. Please take your time in
making your decision as to whether to participate. If you have questions at any time, please ask.

WHAT IS THE PURPOSE OF THIS STUDY?

You are invited to be in a research study about student intellectual property on the university
campus because you have experience working with intellectual property commercialization.
The purpose of this research study is to learn about student and administration perspectives,
attitudes and beliefs concerning the interface between universities and student generated
intellectual property. It is expected that this study will identify areas of commonality and areas
of disconnect between these two groups and provide data that can be used to develop, affirm, or
adjust intellectual property and/or technology transfer policy to address the needs of both
constituent groups (students and administration).

Date: _____
Subject Intials:_____

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HOW MANY PEOPLE WILL PARTICIPATE?

Approximately *3-4* people will take part in interviews for this study at the University of North Dakota.

HOW LONG WILL I BE IN THIS STUDY?

Your participation in the study will last *approximately 30 minutes*.

WHAT WILL HAPPEN DURING THIS STUDY?

This mixed methods study uses an explanatory-sequential design to look at student and administration knowledge and perceptions about intellctual property (IP) ownership policy at a midwestern research university. In the first phase, UND students were asked to voluntarily complete a survey and answer questions about their demographics, level of IP and technology transfer knowledge, and attitudes concerning university IP policy. In this, the second phase, you are being asked to voluntarily participate in 30 minute interview to discuss the results of the student survey. This interview will be recorded and transcribed so that it can be coded, categorized and themed. You are free to skip any questions you would prefer not to answer.

WHAT ARE THE RISKS OF THE STUDY?

There may be some risk from participating in this study. Some of the questions may make you feel uncomfortable or frustrated. Some questions may be of a sensitive nature, and you may become upset as a result. However, such risks are not viewed as being in excess of "minimal risk." If, however, you become upset by questions, you may stop at any time or choose not to answer a question.

WHAT ARE THE BENEFITS OF THIS STUDY?

You will not benefit personally from being in this study. It is hoped that in the future other people will benefit from this study, as the results may provide data that can help students and administrators learn and understand more about each other's perspectives regarding student created intellctual property. It is hoped that his study will also help universities create, modify, or affirm intellectual property policies that are most beneficial to both constituent groups.

ALTERNATIVES TO PARTICIPATING IN THIS STUDY

You may choose not to participate in this study. There is no penalty for not participating.
WILL IT COST ME ANYTHING TO BE IN THIS STUDY?

You will not incur any costs for being in this research study.

<div align="right">

Date: _____
Subject Initials:_____

</div>

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WILL I BE PAID FOR PARTICIPATING?

You will not be paid for participating in this research study.

WHO IS FUNDING THE STUDY?

The University of North Dakota and the researcher are receiving no payments from other agencies, organizations, or companies to conduct this research study.

CONFIDENTIALITY

The records of this study will be kept private to the extent permitted by law. In any report about this study that might be published, you will not be identified. Your study record may be reviewed by Government agencies, the UND Research Development and Compliance office, and the University of North Dakota Institutional Review Board.

Any information that is obtained in this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by using pseudo-names for all interview participants and by keeping the digital recording of the interview in a locked drawer in a locked office. You have the right to review the digital recording if you wish. After three years, the digital recording will be erased so that no trace remains. If a report or article is written about this study, we will describe the study results in a summarized manner so that you cannot be identified.

IS THIS STUDY VOLUNTARY?

Your participation is voluntary. You may choose not to participate or you may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Your decision whether or not to participate will not affect your current or future relations with the University of North Dakota

CONTACTS AND QUESTIONS?

The researcher conducting this study is Craig Silvernagel. You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Craig Silvernagel at 701-777-2463. You may also contact his study advisor, Dr. Myrna Olson, at 701-777-3188.

If you have questions regarding your rights as a research subject, you may contact The University of North Dakota Institutional Review Board at **(701) 777-4279**.

- You may also call this number about any problems, complaints, or concerns you have about this research study.

Date: _____
Subject Initials:_____

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- You may also call this number if you cannot reach research staff, or you wish to talk with someone who is independent of the research team.
- General information about being a research subject can be found by clicking "Information for Research Participants" on the web site: http://und.edu/research/resources/human-subjects/research-participants.cfm

I give consent to be audiotaped during this study.

Please initial: _____ Yes _____ No

I give consent for my quotes to be used in the research; however I <u>will not</u> be identified.

Please initial: _____ Yes _____ No

Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Subjects Name: _____

_____   _____
Signature of Subject   Date

I have discussed the above points with the subject or, where appropriate, with the subject's legally authorized representative.

_____   _____
Signature of Person Who Obtained Consent   Date

Date: _____
Subject Initials:_____

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