

RESEARCH FACULTY, ENTREPRENEURSHIP AND COMMERCIALIZATION: THE  
CASE OF KANSAS STATE UNIVERSITY

by

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## **Abstract**

Interest in commercialization of university research has accelerated since the Bayh-Dole Act (1980) granted authority to universities and federally-funded nonprofit institutions, among others, to obtain patents, grant licenses, and transfer custody of patents with the explicit purpose of promoting the utilization and marketing of their inventions. This interest is supported by these institutions' need to expand their funding sources as growth in their traditional funding has lagged their needs. This study seeks to assess the level of understanding of research commercialization and entrepreneurship aspects by the faculty researchers nearly 10 years after Bayh-Dole Act using a survey of university faculty. The results show that there is indeed the desire to move research from universities to the marketplace through technology commercialization and entrepreneurship, but there is need for educational programs to enhance the current perceptions about the commercialization and entrepreneurship among faculty. We show that this need is independent of the demographic characteristics of faculty but influenced the university's policies covering intellectual property and commercialization.

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# CHAPTER 1 - INTRODUCTION

## 1.1 Introduction

Technological advancement is a very critical component of human progress and the transformation of technological ideas into products that enhance the quality of life is a good measure of the progress a society makes. In the years before 1980, the U.S. federal government retained ownership of all the patents that were generated through federally funded university research activities. By the year 1980, the federal government had accumulated more than 30,000 patents of which only 5 percent were in use to develop new and improved products.

The Bayh-Dole Act was passed in 1980 to allow universities and institutions to retain the title to invention(s) even when federally funded. The expectation was that it would increase the commercialization of technologies. Prior to the Bayh-Dole Act, fewer than 250 U.S. patents were issued to universities each year. After the implementation of the Bayh-Dole Act in 1980, many research universities started giving priority to their technology commercialization efforts. Since 1993, U.S. universities averaged more than 1,600 U.S. patents annually, according to Association of University Technology Managers (AUTM). In the late 1990s, patents issued to U.S. universities have exceeded 2,000 patents. The interest in technology commercialization is reflected also by the growth in the membership of AUTM, which stands at more than 200 universities today, eight times more than in 1980.

In 1999, technology commercialization activities, particularly the licensing of inventions by U.S. universities, teaching hospitals, research institutes, and patent management firms, added about \$40 billion to the U.S. economy and resulted in the generation of 260,000 jobs (BIO Annual Report, 2004). In addition, AUTM (2000) report shows that for the period 1991 to 1999,



there were a 198% increase in new U.S. patent applications and a 133% increase in licenses from U.S. universities. The foregoing indicates that these institutes have responded to the Bayh-Dole Act.

This new development encouraged universities to enhance their research capabilities and commercialize those inventions. The Bayh-Dole Act also facilitated the flow of targeted research resources into universities. For example, NSF academic research and development indicators (2004) show that funding (in 2000 dollars) for university R&D in the life sciences increased 6 percentage points between 1980 (\$6.06 billion) and 2003 (\$22.4 billion), from 53% to 59% of total academic R&D. Also, the number of patents issued to universities and companies started by universities formed have been increasing over the last two decades. Between 1990 and 1999, the number of gene patents granted increased from 400 in 1990 to 2800 in 1999, and universities share increased from 55% to 73% (Moses and Martin, 2001). Also the total number of U.S. biotechnology patents granted in grew from 1,765 in 1990 to 7,763 in 2002 (Schacht, 2005). This growth in patenting has offered universities more avenues to pursue commercializing for potential returns to their research by directing their patenting efforts toward technologies that are effectively transferred through market mechanisms (Shane, 2004). At the same time, funding structure for research and development across universities has undergone some changes and induced universities to look for alternative sources of revenue to keep up the research activities and fund the future research projects.

Where as literature (Renault, 2006; Etzkowitz, 1983) cited the decline in federal funding as one of the primary reason's for universities growing interest in commercializing their research. Factors like declining share in federal funding, reduced industry funding for research and development activities in universities, and universities own development through internal

resources have firmed up universities commitment to look for possible means of commercializing their research for securing revenue to enhance their research capabilities. In the due process of commercialization, faculty involvement has promised them with more opportunities of embracing entrepreneurship and we attempt to understand this in the context of Kansas State University and also the influence of university intellectual property policies on faculty entrepreneurship and research commercialization.

## **1.2 Research Question**

By allowing universities to commercialize their research outcomes, the Bayh-Dole Act stimulated technology commercialization and entrepreneurship judging by the number of licenses and start-ups (AUTM, 2000). A review of the literature shows that some universities do better at commercialization than others (Slaughter and Leslie, 1997; Etzkowitz, 2003) and this may be a function of their commercialization policies that encourage entrepreneurship (Etzkowitz et al. 2000; Goldfarb and Henrekson, 2003).

Such discussions have always been conducted with reference to single university or multi-university studies. But very few studies have focused on the university policies that govern academic entrepreneurship and research commercialization with emphasis on demographic characteristics. Kenny and Goe (2004) observed that entrepreneurship is influenced by social relationships and institutions, and faculty is embedded in a nested structure of institutional layers each of which may influence their involvement in entrepreneurial activity. We believe that these nested institutional layers in a university context are the policies, formal institution rules, general ethos for faculty involvement in commercialization activities and by reward incentives, personal expectations and motivations (Argyres and Liebeskind, 1998). In this study, we attempt to

emphasize on the faculty characteristics that influence their perceptions and interpretation of the policies that are concerned with entrepreneurial and commercialization activities.

### **1.3 Objectives**

The overall objective of this research is to determine the demographic and other characteristics of researchers and faculty members and their orientation toward the commercialization of their research given institutional policies at Kansas State University. We chose to focus on K-State because there have been fewer studies with emphasis on faculty entrepreneurship at K-State and the data from AUTM annual surveys have shown the performance difference of university commercialization process. We seek to understand through a survey of faculty and researchers for insights on effect of faculty entrepreneurship and intellectual property policies on commercialization process.

The specific objectives are as follows:

1. Assess the relationships between the demographic characteristics of researchers and their perspectives on entrepreneurship and the commercialization of their inventions.
2. Analyze the relationship between faculty perception of university intellectual property and commercialization policies and their entrepreneurial orientation.
3. Develop recommendations for enhancing commercialization effort at Kansas State University based on the results of the study.

### **1.4 Research Approach**

Three principal methods were used to address these objectives: (1) Literature review, (2) Survey, and (3) Statistical analysis. We reviewed the literature for directions on the research questions and our objectives and also provide context for the results of KSU. Our literature covered academic research publications, industry case studies, secondary data and journal

articles from professional organizations like Association of University Technology Managers (AUTM) and historical statistics from government agencies like National Science Foundation (NSF). We surveyed faculty and researchers at Kansas State University. The second method was an electronic mail survey of faculty and researchers at Kansas State University. The survey collected information about faculty members and their attitudes and perceptions on entrepreneurship and commercialization activities. It also sought information about their understanding of intellectual and commercialization university policies structure in their orientation. The survey was divided into four sections capturing information on demographics, research involvement, entrepreneurship and commercialization understanding of the respondents. This provided the primary data used in this research. We analyzed the data using SAS (9.1 version) statistical package.

## **1.5 Structure of this Study**

The remainder of the study is organized as follows. Chapter 2 presents literature review of the technology commercialization in universities and entrepreneurship in the academic community. Chapter 3 discusses the data collection and methods of analyses. We also present the hypothesis that are tested in this study and discuss their theoretical foundations. Chapter 4 presents and discusses the results and Chapter 5 summarizes the study and presents the conclusions.

## **CHAPTER 2 - LITERATURE REVIEW**

### **2.1 Research Commercialization in Universities**

#### ***2.1.1 Definition***

Technology commercialization can be defined as the “transformation of knowledge into products and services with practical application and/or valuable use” (Amanor-Boadu, 2006).

Technology commercialization may be viewed differently from a government or private sector perspective (Kremic, 2003). From the government perspective, technology commercialization is critical for enhancing economic development and ensuring the competitiveness of the domestic economy. Companies, on the other hand view technology commercialization as a necessity for keeping their own competitiveness and their ability to create value for their shareholders.

Slaughter and Leslie (1997) in their study of higher education and growing interest in entrepreneurial orientation found that research universities challenged with reductions in traditional sources of funding such as federal and state grants have sought to reduce dependencies on these sources by increasing their involvement in commercial activity and universities are able to obtain greater control over these resources. Powers (2003) argues that institutions or organizations seek to minimize their dependence on these traditional resources of income and leverage on institutions capabilities such as intellectual assets, capabilities, processes, etc. modeled on the basis of resource based theory of a firm. Powers (2003) also identified that important these are the resources for entrepreneurial activity that occur with university technology commercialization efforts.

Technology commercialization is the final step in a process that begins with researcher idea. The first step in the commercialization process is the research activity itself, the

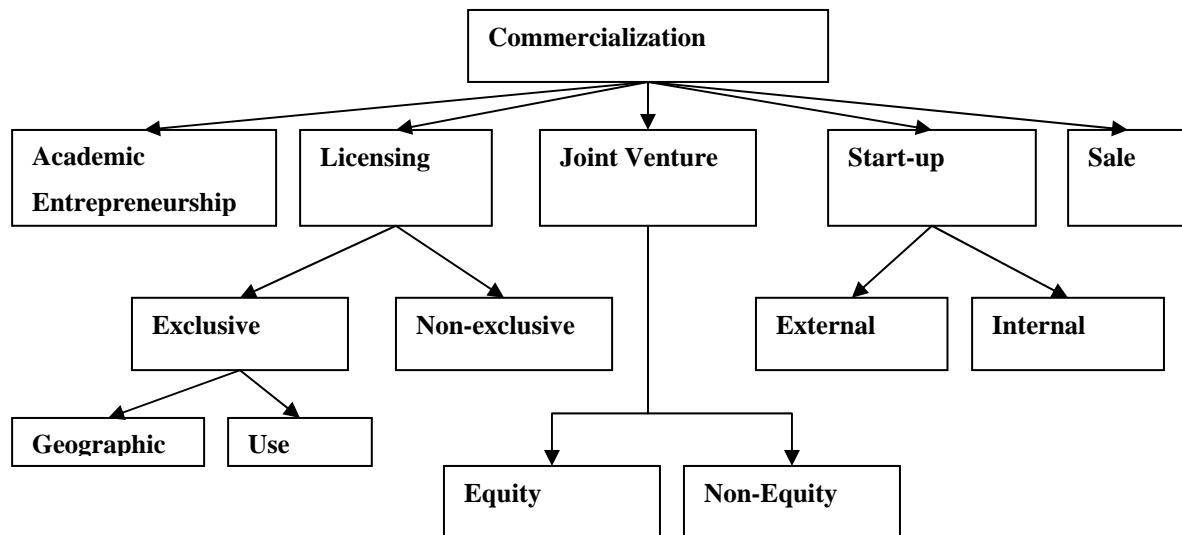
intellectual investment contributed by the faculty, researchers and students. The researcher is expected by the university to disclose it to the institution's technology commercialization office. The researcher's disclosure allows the technology to be evaluated for commercialization potential.

The researcher idea becomes a research activity which is supported monetarily by federal and state government agencies, industry, the institution as well as grants and donations from other sources. When the research leads to an invention, the inventor(s) are expected to disclose it to the appropriate institutions' authorities, often the University's technology commercialization office, which then evaluates the commercial potential of the disclosed invention. If the invention is deemed to be of commercial value, then the institution applies for intellectual property protection, e.g.; a patent. A patented invention may be commercialized through a number of avenues (Figure 1). A patented invention can be licensed or sold to an organization/firm or the university may spin-off a company based on the technology. When it spins out a company, it often involves the inventor and some form of academic entrepreneurship to which provides payments for the use of rights as Royalty. While patents offer ownership of the invention, they do not confer a right to use. Many universities chose to license their patents to companies with the use capability for their inventions. These companies may be start ups, spun out by the university (for the purpose of commercializing the invention) or some other third party organization.

From the university research commercialization standpoint, it is important to consider the technologies licensed and generating revenue successfully. Technology Licenses Yielding Income is a good measure that indicates the success of the commercialization process. Licensing is again classified as exclusive or non-exclusive depending on the access rights of the technology

to more or more licensees. Licenses are granted either to established corporations or to Start-up Companies with limited operating history. As a compensation for the licenses the university may either prefer royalty or in rare cases it might prefer an equity position in the company along with considerable management control. Some of these start-up companies are joint-ventures with private companies or the inventor can himself be the owner becoming the academic entrepreneur, who is governed by the university conflict of interest policies and its prior disclosure for universities approval.

**Figure 1: Types of Commercialization paths**



Academic Entrepreneurship lets the inventor take a more active part in the commercialization process by spinning off a company that uses the invention. Licensing is a contract type option where the parties come together on mutually agreed clauses for the exchange of the product or process technology for a set monetary value. Licenses may be exclusive and non-exclusive. Exclusive licenses limit the use of license to only one party in the agreement or to a location. More than one party is a beneficiary in a non-exclusive license. Joint

ventures are partnerships formed by the university and another organization to commercialize the discovery or invention. A joint venture can involve university taking equity in the company where the IP would be used taking some other form of compensation. The Start-up option involves a new company that is entirely based on the technology that is licensed or sold by the university and the company might be owned by the university and/or by the inventor(s). The Sale option involves the university completely transferring ownership of the technology to the buyer for a selling price and relinquishing all rights to future benefits.

Technology commercialization is a detailed process involving several factors like time, number of parties, payment requirements, and information exchange, sale of intellectual property or services or equipment. Universities with technology commercialization interests have policies guiding research commercialization activities. The policies are often determined by the type of research that is being done at the institution. Inventions closer to basic research often require different patterns of commercialization than those in more advanced stages.

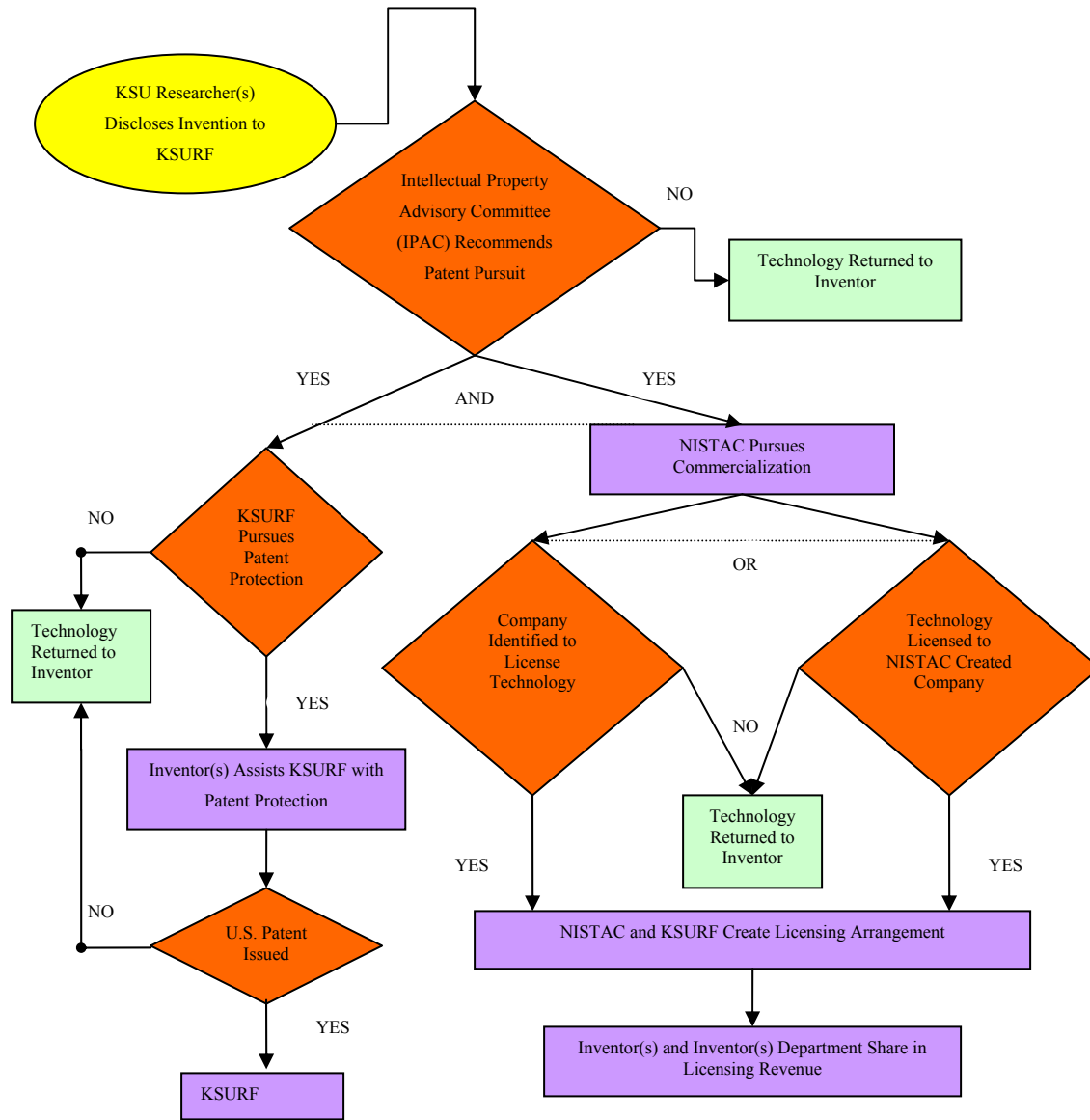
### ***2.1.2 Kansas State University and Technology Commercialization:***

Kansas State University has been involved in technology commercialization for many years under the auspices of KSU Research Foundation (KSURF). Inventions at K-State are owned by the K-State Board of Regents. The Board's interest at K-State is overseen by KSURF, where the mandate is to protect, license, and commercialize research outcomes from K-State. It was established in 1942 and has been employing 0.5 Full Time Equivalents (FTE) professional staff since then (KSURF, 2005; and AUTM Annual Survey, 2004).

Figure 2. illustrates the flow of research outcomes from an inventor to the commercialization stage and various options available in case the invention is deemed not viable for commercialization.



**Figure 2: Flowchart of K-State Technology Commercialization Process**



**Source: Kansas State University Research Foundation**

However, while the protection of the intellectual property is done by Kansas State University Research Foundation, another organization National Institute for Strategic Technology Acquisition and Commercialization (NISTAC) takes care of the commercialization.

NISTAC is a not-for-profit corporation contracted by KSURF to market and commercializes university technologies. NISTAC (earlier known as Mid-America Commercialization Corporation, MACC) uses any of the commercialization paths discussed above to get technology to market. It would identify potential customers for the technology to be commercialized through any of various forms of commercialization means discussed above. NISTAC serves as the state's technology based economic development entity, and K-State. NISTAC's mission is to provide business incubation services, pre-seed capital and technology transfer support activities for entrepreneurs and to commercialize intellectual property emanating from K-State (Source: NISTAC, 2007).

Not all disclosed inventions and discoveries are patentable or have any significant commercial potential. Under these circumstances, the university may waive its rights to the technology, at which point the technology or invention reverts to the inventor and the inventor is free to pursue the patenting and/or commercialization of the invention. In other words, Kansas Board of Regents intellectual property policy defines, "if the university decides that the invention does not warrant patenting, the inventor is free to patent it and in such case, the university does not relinquish any of the data obtained in the research project. However, if the university decides not to further the use of the invention, they shall assign all the rights to the inventor," this is again governed by the Conflict of Interest policy that requires proper disclosure of commercial interests if the inventor(s) desires to commercialize the invention.

KSURF has a generous royalty sharing policy, but is still behind many of the leading research universities like MIT and Stanford University which have 33% of net royalties as the share of inventor(s). At K-State, any revenue that is obtained by the KSURF from the licensing of any patent, not less than 25 percent of revenues will be paid to the inventor(s). This revenue

sharing will begin only after the KSURF recovers all of its expenses incurred while patenting the invention. The remainder of revenue, less a portion that is retained by the KSURF to fund its operation, will be used to sponsor further research and research related activities in the University (Source: KSU Office of Academic Services IP policy, 2002).

There have been several start-up companies (Table1) using KSU technologies and licenses, and a few acquired by NISTAC from companies that donate them. Some of the companies originating from K-State technologies started by NISTAC are:

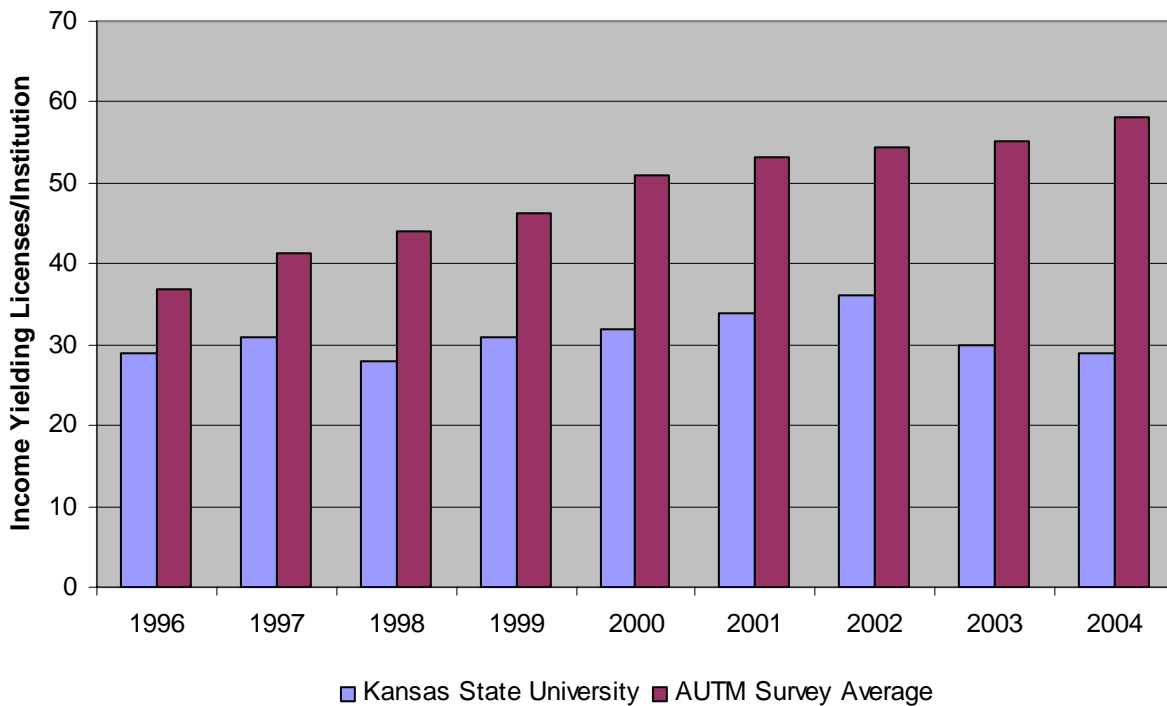
**Table 1: Start-up companies at K-State**

<b>Company</b>	<b>Year Formed</b>	<b>Company</b>	<b>Year Formed</b>
NanoScale	1997	KSU Stem Cell	2006
AgRenew, Inc.	1999	Sunflower Integrated Bioenergy, LLC.	2007
NutriJoy, Inc.	2001	PHARMCATS Bioanalytical Services	2007
SCAVENGETECH, LLC.	2006	GTL Petrol, LLC.	2007
Veterinary Diagnostic Lab	2006	Global Lipidomics, LLC.	2007

AUTM conducts an annual survey of the licensing activity of its member institutions. The graph (Figure 3) below shows the patenting and licensing trends at Kansas State University and other institutions through AUTM annual survey of technology commercialization offices. AUTM annual survey report (2004) indicates that total number of licenses and options executions reported by respondents to the AUTM survey increased from about 1,230 to almost 4,800 between 1991 and 2004. The average number of executed licenses and options per respondent more than doubled from 11.3 to 24.2 over that period, growing at an average annual rate of about 5.3 percent over that period. The number of institutions responding to the survey with income yielding licenses and options per institution increased from a little over 23 to about 58 between 1991 and 2004. But, comparatively the licenses and options yielding income have

been stagnant over the period 1991-2004 for Kansas State University. This does not align with the average of other universities licensing, according to AUTM survey, 2005. The AUTM 2002 Licensing Survey report tells that the total number of active licenses and options increased 13.7 percent when compared to 2001, while that of KSURF is below 10 percent.

**Figure 3: Number of Licenses and Options Yielding Income per Reporting Institution vs. KSU**



**Source: Association of University Technology Managers, 2005**

The decrease in licenses and options beginning 2002 was caused by fewer disclosures per year, lag time between inventions, disclosures and IP protection. The reasons for reduction are also attributed to university policies that put less emphasis on educating faculty about disclosures, individual department policies, reward options for publishing and patenting, unaccountability for tenure and incentives for disclosures/patenting (Survey of the KSURF & Administration, 2006).

Table 2 below compares the annual licensing revenue obtained by K-State for the years 1996 to 2004. Out estimates show that K-State’s annual income is about 20% of the average income of AUTM respondents’ income per institution. Also, K-State had fewer income-yielding licenses per year (29 in 1996 to a maximum of 36 in 2002) than the AUTM universities average income-yielding licenses (about 31 in 1996 and increased to 49 in 2004).

**Table 2: Comparison of Licensing Income at K-State and AUTM Survey Universities**

Year	Kansas State University		AUTM Universities		
	Licenses and Options Yielding Income	Gross License Income Received	Licenses and Options Yielding Income	Gross License Income Received	AUTM Survey Respondents
1996	29	\$ 363,911	4,949	\$ 364,941,642	159
1997	31	\$ 271,094	5,635	\$ 480,822,470	159
1998	28	\$ 202,186	6,006	\$ 613,554,537	159
1999	31	\$ 258,063	6,683	\$ 675,957,625	170
2000	32	\$ 297,536	7,517	\$ 1,099,886,997	167
2001	34	\$ 423,695	7,715	\$ 868,283,344	170
2002	36	\$ 555,227	8,490	\$ 997,830,761	186
2003	30	\$ 547,979	8,976	\$ 1,033,609,726	194
2004	29	\$ 1,071,464	9,543	\$ 1,088,469,003	196

Source: Association of University Technology Managers, Annual Surveys 1996-2004

## 2.2 Academic Entrepreneurship in Universities

Academic entrepreneurship is a form of commercializing technology from research universities. This model of entrepreneurship has become more prevalent in recent years as researchers or scientists are getting increasingly educated about the vast resources available to them to take the initiative in transforming their research in to a marketable product.

Entrepreneurship in the context of university commercialization process known as academic or faculty entrepreneurship is defined as an effort to generate revenue for themselves or for their universities through their involvement in commercial research activities. It has become one of the important features of the university academic culture (Fairweather, 1989 and Powers, 2003).

Louis, et al. (1989) distinguished academic entrepreneurship into five types, mainly: engaging in

large-scale science, earning supplemental income, gaining industry support for industry research, obtaining patents or generating trade secrets and commercialization by forming or holding equity in private companies based on researchers own invention.

Toole and Czarnitzki (2005) considered U.S. Small Business Innovation Research program as a policy fostering academic entrepreneurship. They identified two characteristics that make the SBIR program attractive as an entrepreneurship policy: early-stage financing and researcher's participation in commercialization process. Using data from National Institutes of Health and data on researcher-linked and non-linked SBIR firms, the authors found that biomedical researchers used SBIR financing to develop firms based on early-stage university technology and found that the trend is on the rise for since 1991.

Louis, et al. (1989) examine academic entrepreneurship defining it as an attempt to improve personal and professional profit and influence through the development and marketing of new research based product or process. They found that university policies and structures have little effect on academic entrepreneurship. From a survey of life science faculty working in 40 different U.S. universities they concluded that individual behavior in entrepreneurship depends very much on whether the policies are reinforced by individual expectations. They also note that local norms have more influence on faculty's entrepreneurial orientation and relationship between formal institutional policies and performance of academia is still unclear. In another study, Etzkowitz (1989) observe that among some faculty members, entrepreneurship and development of marketable research outcomes are a form of professional achievement as opposed to general perception among critics who say entrepreneurship is a way of renouncing the ethics of professorship.

Academic entrepreneurship results in faculty, researchers and students being more effective in the creation of research based ventures either individually or collectively. Doutriaux (1987) studied the growth and success of new business ventures created by university professors, technicians or students. He studied a sample of Canadian high-technology companies to see how successful companies were in relation to the faculty's affiliation to the university with teaching and research responsibilities and faculty who left the university at an early or later stage. Entrepreneurs were still working as full and part-time associate professors on university payroll. The study showed that companies with faculty who left the university after certain period of time grow at a faster rate than those with faculty working at the university. This may be due to the lack of full attention when the founder is also working full time at the university. Thus, like all start-ups university driven companies require more attention from its leadership. The author contends that if a company is to be created then it should be independent from the university or if the venture capitalist or university seems to maximize their revenue out of the technology, then licensing is the best choice.

Bird and Allen (1989) studied faculty entrepreneurship in the context of universities role in economic development, its support of entrepreneurial researchers and its role as an incubator. Based on the survey of two universities in North Carolina, they found that consulting activity is expected to decrease in future years and entrepreneurial activity to increase. They reported that 15.7 percent of the respondents desired to start a firm based on their own or other's research activity. While faculty members showed a tentative interest in entrepreneurship, about 70 percent indicated no interest in altering their relationship with the university should they pursue entrepreneurship. They also found that researchers chose consulting and contract R&D compared to investing their time in new venture creation. They supported the argument that

scholarly life of research and teaching require considerable attention to historical development's in their discipline, while entrepreneurs rarely consider their own or others history, a opinion echoed in others' studies (Bird, 1983; Bird, Hayward and Allen, 1993).

### **2.3 Gender bias in entrepreneurship and patenting**

Gender is an important issue because we have seen differences by gender in patenting, licensing and interest in entrepreneurship in universities Whittington and Smith-Doerr (2005) examined gender disparities in patenting over two decades and found that 30% of male faculty and researchers compared to 14% female had been issued patents. Using patents as a measure of commercial involvement they found that 30% of males compared with 14% of females scientists had ever patented. Across all the cohorts, they found that 48% of industry scientists have patented at least once compared to 18% of academic scientists, and across sectors. However, they found a greater gender disparity in industry: 23 percent of males versus 10 percent of females. They argued that gender disparity in commercial activity varies by industry and that the difference between academic and industrial sectors is largely due to unequal opportunities to engage in such commercial activity rather than productivity differences between the sexes.

Thursby and Thursby (2005) also assessed gender patterns on research and licensing activities of science and engineering faculty, and discovered that women are less likely to disclose inventions even though there are no significant differences in their publication pattern. Using a sample of 4621 science and engineering faculty on the basis of publications, disclosures and profiles from eleven major research universities with long traditions of technology transfer to private sectors between for the years 1983 through 1999, they estimated that 14.8% women representing biological sciences, compared to only 4.7% and 5.3% in engineering and physical sciences, respectively. This is significant taking in the fact the women comprise only 8.55% of



the faculty in the sample. Linking disclosure activity to gender, they found the probability of male faculty disclosing invention is 43% higher than female faculty. For all the years, only 6.74% of the observations on women are disclosure year observations compared to 8.67% for men. In spite of this gender disparity in disclosure, they found that the disclosure activities of females and males show a little convergence over the period, but the probability of males disclosing is 43% higher than the probability that females disclose and using only last 4 years of data for the sample period the probability of was still higher at about 33%. This is, however, in contrast to the findings of Morgan *et al.* (2001), reported that female patent activity share dropped from 8.3% for applications to 6.9% for grants to 6.2% for commercialization.

Marlow and Patton (2005) did a theoretical analysis of gender based on formal and informal sources of funding for women in business and self-employment. They studied female entrepreneurship in regard to societal gender construction and its effect on the success of females in the business environment. They described the difference assuming four propositions: women entrepreneurs experience barriers related to their gender, financial constraints that impede full realization of business potential, efficacy of liberal feminist based policy intervention in removing the structural barriers, and future debates on women entrepreneurs that should establish a conceptual foundation to feminist theory.

The authors indicated that a liberal feminist policy only provides a partial solution to the barriers faced by women in accessing funds for business entrepreneurship. Also, they found that women are less likely to develop a strong track record in terms of financial performance, explaining their difficulty in securing funding from financial institutions. The conceptual analysis of gender characteristics and entrepreneurship through various sources of funding avenues and opportunities supported that women do face barriers for financial freedom in

business environment. And because of these barriers we believe that women scientists would be less oriented towards pursuing entrepreneurship.

There are several factors that encourage entrepreneurship. Some are institutional factors while the other being personal factors. A study conducted by Cromie (1987) found that non-economic motives tend to be more important to entrepreneur than economic motives. Three non-economic motives - autonomy, achievement and job dissatisfaction - dominated the economic motive of making money. Using a psychometric analysis, Cromie observed that there is a difference in motives between the sexes. Women perceive entrepreneurship as a means of managing work and family while men tend to be motivated more by the desire of earning money. The author contends that the reason for different motives might be due to social stratification rather than personal attributes.

## **2.4 Effect of Commercialization Policies and Motivations**

Incentives can be the main motivating factor that would definitely have an impact in encouraging faculty to disclose their inventions, patent them, and take active participation in commercialization and so on. Traditionally, universities are regarded as reliable sources of knowledge dissemination, rather than earning revenue from the sale and licensing of technologies (Vallance, 2001). Lately, this traditional understanding has changed to support wider objectives of achieving economic development through the use of university resources by promoting commercialization activities (Etzkowitz, 2003). However, there are policy issues that work against entrepreneurial activities hindering the pace of research commercialization in universities.

The policies that govern university commercialization activities have considerable influence on research effort and commercialization. Renault (2006) studied the behavioral

characteristics of a sample of professors from a group of southeastern universities in the US and found that university incentive policies and ethical concerns had a negative effect on faculty productivity in technology commercialization efforts. Renault also observed that institutional policies like inventor(s) share of revenue from the commercialization of research do affect faculty decision to patent and spin-off companies.

Owen-Smith and Powell (2001), using qualitative data on two university campuses provided an explanation for difference in new invention disclosures among faculty in different subject areas. They found that faculty base their decisions to disclose on the personal and professional benefits of patenting, perceptions about benefits and cost of interacting with university administration and on the general university's policies guiding technology commercialization. The perceptions of faculty about patent outcomes were protection, leverage, financial benefit and education of negotiating research commercialization. They conclude that, patenting decisions depend on academic and commercial rewards linked to individual university's policy environment. But, according to Vallance (2001) most academic science entrepreneurs appear to be primarily motivated by the intrinsic rewards of their research and their scientific career progression rather than the pursuit of profit. They tend to view their primary function as 'teaching, research and scholarship' rather than the pursuit of commercialization. Vallance found that the benefits brought to the university research activities by faculty disclosures, patents and commercialization is a successful approach and justifies their digression from the fundamental duties of the university as a research institution.

Though motivations appear to be very important in encouraging faculty and researchers to involve in taking their inventions a step further in realizing the true benefits, but incentives that surround the research, for example, rewards for publishing over patenting, benefits and costs

associated with the involvement still remain unresolved. The fact that they differ across universities and varied perceptions among researchers requires the need for further study of these motivational factors.

Traditionally, universities have always encouraged and supported strong interaction between faculty, researchers, students, etc with other public and private institutions. While these external relations increase greater understanding of research avenues, they also create potential conflicts between professional and personal interests. Conflicts of interest arise out of shared resources among university faculty and the sponsoring company, intellectual property developed from the sponsorship and the potential of the research outcome that is of most value to the inventors, co-inventors and sponsors.

Bird et al. (1993) surveyed science faculty at top R&D universities and entrepreneurship faculty at the Academy of Management to test how conflict of interest and values in faculty can delay, re-channel and deter commercial applications of research outcomes. Conflict and Value scales were structured to measure faculty's involvement in entrepreneurial activities to study economic, academic and industry conflicts. They found that the conflict scale is negatively correlated with entrepreneurial activity and is significant in most cases, as is also the case with value scale. They observed a change in faculty's status with the university with their involvement and development through commercial activities and only older faculty with less non-academic work are more inclined to a change against younger science faculty who have had less commercial experience. As for entrepreneurship faculty, their teaching responsibilities affect the likelihood of altering their relationship with university. Bird et al. concluded that role conflict scale is negatively related to entrepreneurial activity while economic conflict shows an

insignificant direct relationship. It is understood that academic teaching responsibility is a direct factor impeding entrepreneurial activity among faculty.

## **2.5 Faculty Consulting in Universities**

Faculty consulting in technology commercialization assumes significance as more and more faculty become involved in providing services to industry and individuals to advance various causes. They might be personal or professional, and these are constrained in a university system by conflict of interest and conflict of commitment policies. Also, consulting activities provide faculty with various resources to advance their research interests and help build a strong industry network to collaborate in research activities. Boyer and Lewis (1984) and Carter et al. (1986) found that consulting activities create an interface between academia and industry, arguing that such activities do not hinder academia in pursuing the primary objectives of the university: teaching, research and outreach.

Khamis and Mann (1994) studied the creation of a statistical consulting center at Wright State University. They found that establishing a formal connection between university departments where considerable expertise is available with the clients who require such assistance through the consulting to a win-win outcome and did not violate university policies. They show that the number of professors consulting increased from 42 in 1985-86 with 1465 consulting hours and revenue of \$1,035 to 64 in 1992-93 doing consulting for 2995 hours with a total income of \$17,594. They viewed consulting as more beneficial and well aligned to the university policies.

Boyer and Lewis (1984) examined the potential benefits and costs to the individual, institution and society from consulting. Using a survey sample from National Research Council they observed that 20.8 percent of science and engineering faculty, and 12.4 percent of faculty in

humanities devote some portion of their professional expertise to consulting activities. Overall, only 18.4 percent of faculty is involved in consulting activities, compared to 37 to 54 percent reported by Patton (1980) and Bird and Allen (1989). Boyer and Lewis found the proportion of faculty who consult increased from 19.3 percent to 20.8 percent between 1975 and 1981, and similarly the increase from 5.2 percent to 5.8 percent was observed among faculty who consulted more than a day in a week in the same period. They indicated that supplemental income from consulting activities as a percent of base academic salary is over 10 percent for science and engineering faculty compared to 15 percent for all faculty, similar to previous studies (Marsh & Dillon, 1980; Ladd, 1978). Boyer and Lewis suggested that faculty consulting in general is not appreciated to its fullest and should be considered based on the benefits and costs of their services and also insist that institutional guidelines should be more permissive with more liberal policies and procedures.

In another article, Marver and Patton (1976) used a large sample of college and university teachers from a national Survey of Higher Education to analyze the extent to which academics consult and the kinds of consulting services they engaged in. About 60 percent of their sample devoted sometime to consulting with 37 percent consulting for fees. Of the total paid consultants, 60 percent are located in universities. Of the total academics in Engineering, 62 percent are paid consultants followed by Medicine and Law, and Business with 58 and 50 percent, respectively. Though Humanities accounts for 20 percent of all academics, its share of paid consultants was only 11 percent. Marver and Patton also found that most of the paid consultants represented younger faculty (age of 30-49 years). They observed an increase in paid consultancy with an increase in faculty ranks: 19 percent of instructors, 32 percent assistant professors and 55 percent of full professors. They also found that paid consultants publish more articles: 18 percent of

them have more than 20 articles. They argue that there is a negligible correlation between paid consulting and contact hours that might affect the quality of instruction or service to the university. They conclude that consulting is in the best interest of an institution, stressing the fact that paid consulting may contribute to the professor's ability to teach more effectively in applied courses, regardless of discipline.

In an earlier study, Quittmeyer (1960) argued that institutional policies are the major hindrance to faculty providing paid consulting. The paper was based on a survey of the consulting practices of Academy of Management faculty members. He observed that 60 percent of administrators encouraged consulting. Though the income earned from consulting in the 1960s is not comparable to present day standards, the percentage seems reasonable. Salaries are the important source of income for most faculty, but Marver and Patton (1976) showed that consulting is the second largest supplemental income (18 percent). They also found that faculty consulting fees are about one-half or one-third of what private consulting firms charge, and their availability, ability and recognition in the due course of time make them competitive. Our opinions align with the authors findings that industry does look towards academia when it comes to strength in basic sciences that are fundamental in applied research.

Work (1952) analyzed the policy implications of research and consulting practices of faculty in technical institutes. He stressed that the amount of research to be conducted in private practice should be more towards the applied science than towards fundamental science. Encouraged by policy initiatives at New York University where the author is a faculty member, he concludes that engineering as an applied science and consulting by faculty and students in the industry mostly is in the applied research. He strongly supports that research contracts between

industry and university should be encouraged emphasizing the scope it provides for faculty and students in consulting services.

## **2.6 Effect of Research Collaborations on Faculty Entrepreneurship**

Academics that collaborate with industry do so for various reasons: personal interests in the industry, educational, scientific and/or professional motivations to advance their work related research aspirations. Most faculty are professionally associated with industry, government laboratories and other institutions that facilitate securing adequate financial resources to continue, enhance and strengthen their research activities. Collaboration for research partnerships are a source for faculty entrepreneurship and support invention disclosures, publications, patenting and formation of university-based start-ups (Jensen and Thursby, 2001).

Lee (2000) in his survey of faculty researchers found that their collaboration with industry does provide motivation and throws open more entrepreneurial opportunities. Lee looked at the university-industry collaboration and its contribution to sustaining the national innovation system. The results of a survey of university researchers and industry technology managers involved in the industry-university research activities found that 91% of industry managers were positive in indicating their interest to continue research collaboration because they believe that collaborating research with universities provides access to strong academic (basic) research.

For many years universities have been receiving research projects from different state and federal agencies, industry and other organizations. Industry-University Cooperative Research Centers (IUCRC) supported by National Science Foundation was intended to develop long-term partnerships among industry, academe, and government. These centers conduct research that is of interest to both industry and university and to leverage research and development investments



with multi-university centers. Adams et al. (2001) described the effect of IUCRCs on industrial research and development activities. They observe that the success of IUCRCs depends on R&D labs propensity to patent which is influenced by scientific talent available in the laboratories, the universities in the IUCRCs and the laboratories expenditure on R&D. They conclude that there exists a strong positive association between laboratory membership in IUCRCs and the importance of faculty consultants and co-authorship with faculty.

Thus we perceive that collaboration among university participants in research related activities with industry and other agencies opens broader avenues for faculty and students that leads to a greater interaction and understanding. We think that it does provide faculty researchers having entrepreneurial traits with more opportunities involving themselves in commercial activities, expand their knowledge and experience.

## **2.7 Observations from Literature**

The literature review has shown us some important dimensions on faculty characteristics and studies that highlighted their effectiveness and influence in regard to the university research commercialization. Following are a few critical observations of the foregoing literature:

- Institutional policies are very important as they influence the fundamentals of entrepreneurship and commercialization activities.
- Gender characteristics and their perceptions do affect their decisions of involvement in commercialization of research.
- Universities and faculty have shown greater interest in various commercialization paths, with more prevalence of academic entrepreneurship.
- Conflicts with academic responsibilities still have a bearing on faculty and researchers interest in commercialization.

- Entrepreneurship gains prominence in a university setting where research is a major focus of the institution.
- Incentives and motivations that encourage faculty and researchers to disclose, patent and commercialize the inventions have very strong influence.

The next section discusses our data collection methods, our models and hypotheses.

## **CHAPTER 3 - DATA COLLECTION AND METHODOLOGY**

### **3.1 Data Collection**

The overall objectives of this study were to assess the demographics characteristics and their perspectives on entrepreneurship and commercialization given university policies on commercialization at K-State. We surveyed faculty and researchers at Kansas State University using survey tool Axio. The questionnaire was distributed to faculty and researchers using university's email survey system. The questionnaire employed in the survey comprised 41 questions divided into four segments: demographics, research, commercialization and entrepreneurship (Appendix A). The demographic section consists of: gender, age, education, academic department, current position at K-State, length of service and annual income. The research section consists of: type of research and their allocation of time across various research related activities and functions. The commercialization part of the survey laid emphasis on their understanding of intellectual property (IP) policies; ownership of IPs; extent of familiarity, interest and willingness to pursue commercialization; and motivations and expectations from university policies. And the entrepreneurship section concentrated on their experience in business related activities; effect of institutional policies on their entrepreneurial orientation; and their experience, interest and involvement in consulting services.

The responses were analyzed using SAS statistical analysis software and tested using econometric methods. We separated the demographic, research, commercialization and entrepreneurship variables for the purpose of analysis. We developed several hypotheses that assess the relationships between demographic characteristics and their effect on entrepreneurial

and commercialization orientation of respondents. We test these hypotheses and report the results along with survey analysis in chapter 4.

### **3.2 Hypotheses**

Thus far we have developed a general knowledge on the demographic characteristics influence on faculty entrepreneurship and university policies on entrepreneurship and research commercialization. In this section, we formalize our discussion by developing a number of hypotheses about how the demographic characteristics can interact with each other. Ginther (2001) in her research on gender discrimination in academia indicated that differences in income are attributable to unexplained gender disparities. There is a general belief that women are younger in academic field because they did not enter the academic profession early. This would imply that they would also have shorter lengths of service. But it is possible that women enter academia at an older age than their male counterparts. These perspectives warrant testing whether age and length of service are correlated by gender among faculty and researchers.

But, how are these variables related? For example, does the age and length of service determine the income distribution observed among the respondents? Similarly, do gender dynamics combine with income variables? We are particularly interested in gender effect on age and income, and also their understanding of entrepreneurial and commercialization issues. To answer these questions, we develop and test the following hypotheses:

**Hypothesis 1:** Income, length of service and age: The income is a function of age and length of service. The older the respondent and the longer his or her length of service, the higher income will be.

**Hypothesis 2:** Income and gender: The average income of female researchers is equal to the average income of male researchers.

**Hypothesis 3:** Gender and length of service: The average income of female researchers is equal to the average length of service of male researchers.

**Hypothesis 4:** Gender and age: There is no difference between the average age of female and male respondents in our sample. In other words, the average age of female researchers is equal to the average age of male researchers.

Literature review has provided us with a general overview of the impact of institutional policies that affect entrepreneurial orientation and research commercialization interests among faculty. These policies are significant in the university context in that they influence faculty perceptions on entrepreneurship. Since, there are different perceptions among faculty and researchers in regards to research commercialization, it is interesting to see if gender and age have any influence in understanding these policies. Rosa and Dawson (2006), discuss gender and commercialization in university science, highlighting that female researchers are underrepresented in the commercialization process. The female faculty respondents in their study have indicated that they lack commercial skills and knowledge of commercialization compared to male faculty. Also, senior faculty members are more likely to understand commercialization policies and manage well in commercialization process and entrepreneurial ventures. To understand how commercialization policies differ across gender lines and across length of service, we tested the following hypotheses:

**Hypothesis 5:** Gender and understanding of commercialization policies: There is no difference between male and female faculty and researchers regarding their understanding of the institution's commercialization policies. This hypothesis is based on the assumption that there is no difference between male and female faculty and researchers in their entrepreneurial orientation.

**Hypothesis 6:** Age and understanding of commercialization policies: Younger faculty and researchers have a better understanding of the commercialization policies of the

institution. This is based on the assumption that younger faculty and researchers have a greater interest in securing non-traditional sources of funds to facilitate their research and creative activities.

The next section discusses the results of the above hypotheses and the analysis of the survey of the faculty and researchers.

## **CHAPTER 4 - SURVEY RESULTS AND ANALYSIS**

The review of literature enhanced our understanding that demographics (age, gender, etc.), policies and other characteristics (understanding, interest, motivations, etc.) have considerable influence on academic entrepreneurship and commercialization effort. In this chapter we present the results of our analysis. We received a response rate of 15.6 percent for the online survey conducted on faculty and researchers on campus of an approximate 1200 potential respondents.

We sent out 1195 email surveys to faculty and researchers at KSU. We received emails from a dozen indicating they did not believe the survey applied to them. Assuming that these are the only exclusions in the sample, we effectively had 1183 potential respondents in our survey. We received 192 responses that were usable in our analysis. Thus our effective response rate was 16.2 percent. Compared to similar studies on academic entrepreneurship and commercialization (Bird and Allen (1989) in their study on faculty entrepreneurship in two universities in North Carolina received a response rate of 25% and Callister (2006) received 73% response rate for a survey on faculty gender issues in science and engineering field.), the response rate is low, but we believe it is sufficient to assess the perceptions of faculty of one institution.

### **4.1. Demographics**

We designed demographics to cover seven variables: gender, academic degree, academic department, current academic position, age, years of employment and annual income. We present the summary statistics of these variables in the following sub-sections and following

them with a cross-sectional assessment of the inter-relationships among them. Our rationale is to attempt to understand the influence of the various variables on each other.

#### ***4.1.1 Gender***

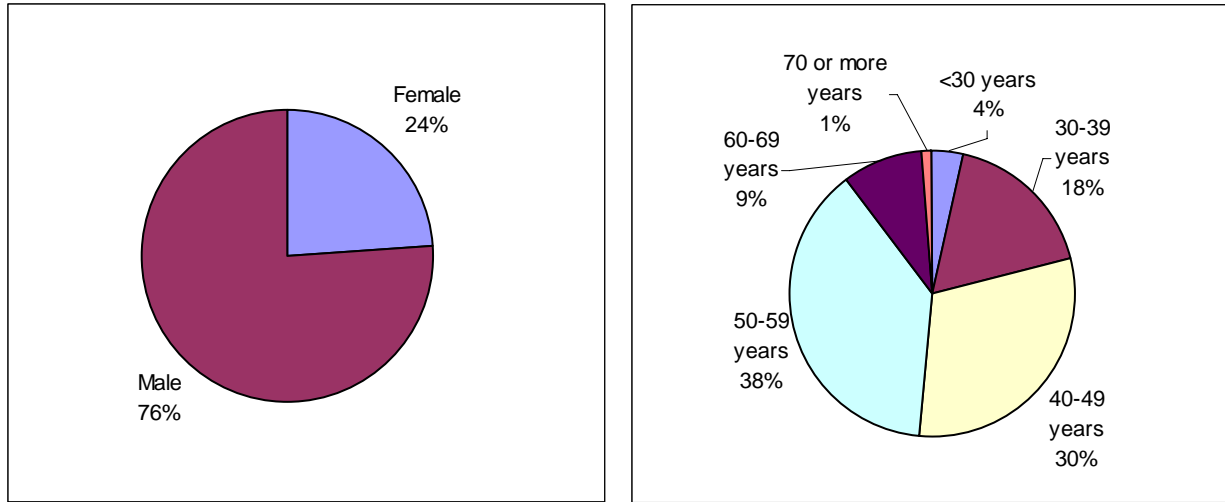
Our data reveals that males comprised 76 percent of our respondents compared to 24 percent females (Figure 4). Data from the Office of Planning and Analysis at Kansas State University show that females account for 29 percent of faculty and males account for 71 percent. We believe the fact that we allowed respondent to self-select and self-classify their entrepreneurial orientation may have contributed to this situation. However, what the results suggest is that a slightly disproportionate share of researchers and faculty who see themselves as having entrepreneurial interest and their work as having commercial value are male.

#### ***4.1.2 Age***

We received input from 192 respondents for age and we divided them into six age cohorts. The cohort and the proportion of respondents are as follows (Figure 4): Under 30 years (4 percent); 30-39 years (18 percent); 40-49 years (30 percent); 50-59 years (38 percent); 60-69 years (9 percent); and 70 or more years (1 percent). Thus, we found that the proportion of respondents in the 40-69 years group was about 68 percent, and this compares favorably with Kansas State University's Board of Regents estimate of 66 percent (KSU, 2005).



**Figure 4: Distribution of Respondents Gender and Age**



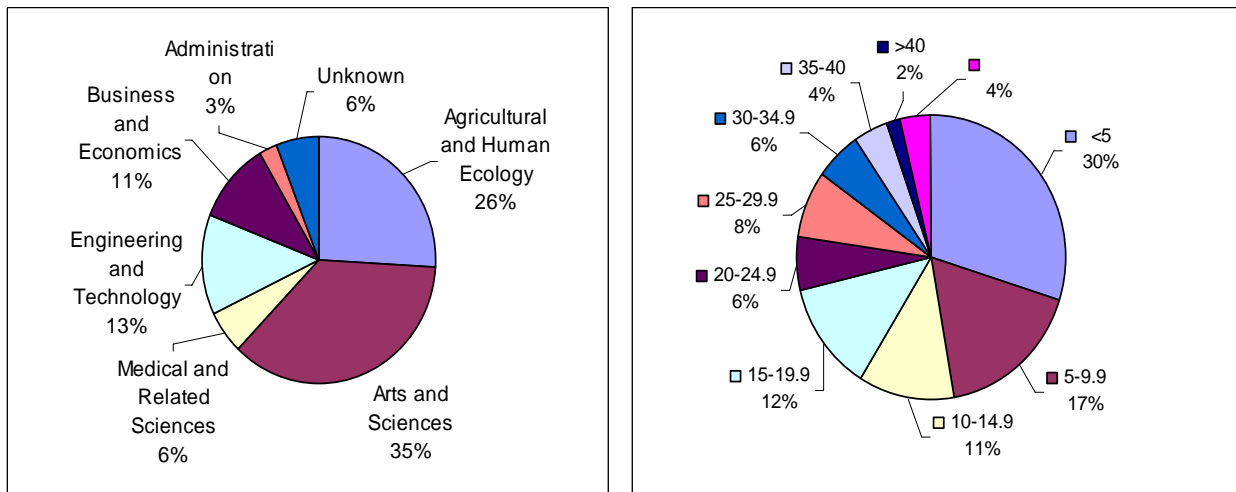
#### **4.1.3 Academic Departments**

In order to facilitate clearer observations, we organized our respondents into six academic groups: arts and sciences; agriculture and human ecology; engineering and technology; business and economics; medical and related sciences; and administration. Figure 5 shows the distribution of the respondents by those groupings. The sample had about 36 percent under arts and sciences compared to 26 percent in agriculture and human ecology, and 13 percent under engineering and technology. Business and economics accounted for 11 percent of respondents, 6 percent for medical and related sciences and 3 percent identified themselves as falling under administration. The proportion of arts and science respondents was similar to the population proportion of 34 percent reported by the Office of Planning and Analysis (2005). However, agriculture and human ecology was over-represented in our sample because the population share is only about 17 percent. Once again, we believe the self-selection and self-identification may explain this departure from the population distribution.

#### 4.1.4 Duration of Service

One hundred and eighty-five respondents indicated their length of employment at Kansas State University. Length of employment ranged from under a year to 47 years. The mean length of employment was about 13 years with a standard deviation of about 11.5 years. We divided them into four cohorts. Cohorts and proportion of respondents are as follows (Figure 5): less than five years (30 percent); five years to under 10 years (17 percent); 10 years to under 20 years (23 percent); more than 20 years (26 percent). Thus, faculty and researchers with 10 or fewer years of service at Kansas State University accounted for 49 percent of our total respondents. We expect this to influence the results of our analyses.

**Figure 5: Distribution of Respondents by Department and Length of Service at KSU**



#### 4.1.5 Academic Degree

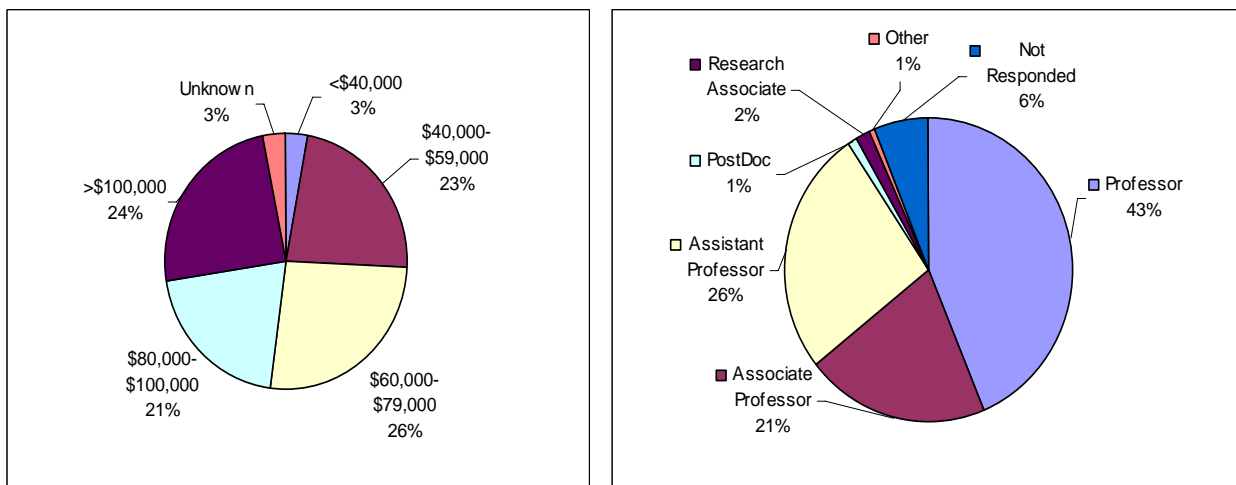
The total number of respondents providing input to the highest academic degree attained question was 192. About 83.33 percent (160) of them had PhD compared to 13.54 percent with masters and 3.13 percent with other degrees. For academic rank, the number of respondents was 180 and the majority of them (46.67 percent) were full professors, 22.22 percent were associate

professors and 27.78 percent were assistant professors. Only 1.11 percent and 1.67 percent of our respondents were post-doctoral fellows and research associates. One respondent (0.56 percent) indicated ‘other’ as academic rank (Figure 6).

#### 4.1.6 Income

One hundred and eighty-six respondents provided information on their total annual incomes in the survey. The average income for respondents was about \$75,718, compared to the average salary for all academic positions at Kansas State University of \$62,927 (Kansas State University, 2005). Therefore, our respondents earn about 20% more on average than average KSU faculty. The standard deviation of total annual income for our respondents was approximately \$20,782. We divided salaries into six groups and each group and its share of respondents is as follows (Figure 6): Up to \$40,000 (3 percent); up to \$59,000 (23 percent); up to \$79,000 (26 percent); up to \$100,000 (21 percent); and over \$100,000 (24 percent).

**Figure 6: Distribution of Respondents by Income and Current Position at KSU**



## 4.2: Assessment of Relationships among Demographic Variables

We developed a number of hypotheses based on the literature and our expectations about the sample. We present the results of our hypothesis testing in this subsection:

### 4.2.1 Hypothesis 1: *Income, Length of Service and Age*

To test the hypothesis that respondent income (Y) is dependent on age (A) and length of service (T), we used the model presented in Equation 1:

$$Y_i = f(A_i, T_i) \quad \dots 1$$

What we are interested in is the sign on the two explanatory variables since we accept that there are more important factors determining the income of research faculty. Therefore, we expected low  $R^2$ . We tested five different forms of equations and selected the double log function based on statistical fit tests.

The results (Table 3) support our hypothesis that income is positively influenced by both age and length of service. As expected the  $R^2$  is 23% and F-value is 27.68. Thus, the model is itself significant, that the t-value on the intercept variable suggests that, indeed, there are other variables more important in establishing the level of income than these two variables of interest. However, despite the parameter estimates of both age and length of service exhibiting a positive sign, the parameter estimate of age is not significant at the 5 percent level in the model. This implies that although we are unable to reject the hypothesis that age positively influence income, that influence is probably insignificant. In short, older faculty and researchers at Kansas State University do not necessarily make more money than younger faculty and researchers. On the other hand, length of service at Kansas State University definitely influences income.

**Table 3: Results of Hypothesis 1 (Income Positively Affected by Age and Length of Service)**

Variable	Parameter Estimate	Standard Error	t-Value	Prob >  t
Intercept	10.853	0.069	155.14*	< 0.0001
Age	0.148	0.075	1.97	0.0501
Length of Service	0.084	0.021	4.04*	< 0.0001
R-Square	0.2393			
Adj. R-square	0.2307			
F-value	27.68			

#### ***4.2.2 Hypothesis 2: Income and Gender***

Various studies on gender and income have been performed with varying results depending on the institution, the methodology used in the study and the focus of the study (Ginther, 2001). For example, Schrank (1977), studying Memorial University in Newfoundland, Canada, noted that although training and experience explain salary differences, there are substantial differences between male and female faculty who seem to be professionally equivalent. Harrigan (1999), studying salary inequality at University of Wisconsin at Madison, found that although salaries differed across colleges between males and females, there was no significant difference between salaries in any college. Similarly, the School of Medicine at Washington University in St. Louis reviewed gender pay equity. Using a two stage modeling approach, the study used 22 variables that were found to explain 77 percent of the variability in income.

Our interest in gender-income relationship is primarily to provide us with information for later analysis as to the influence of gender and income on entrepreneurial orientation. Therefore, we adopt a simple approach, using a t-test of the difference between the mean incomes of the two

groups (Equation 2):

$$\bar{Y}_F - \bar{Y}_M = 0 \quad \dots 2$$

The results are presented in Table 4. They show that the mean income for female faculty is \$66,778 and compared to \$78,636 for male faculty. The standard deviation (SD) of both variables is about \$20,200. The income difference between male and female is found to be significant at the 5 percent level of significance with a t-value of -3.42. This implies that the income of males in the sample was higher than that of females in the sample and the difference of about \$11,858 is statistically significant. Therefore, we are unable to accept our hypothesis that there is no difference between the genders when it comes to income.

**Table 4: Results of Hypothesis 2 (Equal Incomes for Females and Males)**

Variable	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL SD	SD	Upper CL SD	SE	t-Value	Pr >  t
Female	45	60,701	66,778	72,854	16,744	20,226	25,550	3,015		
Male	140	75,250	78,636	82,022	18,136	20,264	22,961	1,713		
Difference		-18,706	-11,858	-5,010	18,375	20,255	22,566	3,471	-3.42*	0.0008

The statistically significant difference between incomes of male and female researchers and faculty may be explained by the distribution of incomes of the respondents by income class (Table 5). The table shows that about 30 percent of male respondents had incomes \$100,000 or over compared to only 11 percent of females. The proportion of males with incomes in the \$100,000 plus category in the total population is about 23 percent compared to 2.7 percent for females. With this uneven distribution of high income respondents, it is not a surprise that the difference between the mean incomes of females and males in our sample is statistically significant.

**Table 5: Cross-tabulation of Income by Gender**

		Income Classes					
		30000	49500	69500	90000	100000	Total
Female	Frequency	2	18	12	8	5	45
	Percent	1.08	9.73	6.49	4.32	2.7	24.32
	Row Pct	4.44	40	26.67	17.78	11.11	
	Col Pct	33.33	41.86	24.49	20	10.64	
Male	Frequency	4	25	37	32	42	140
	Percent	2.16	13.51	20	17.3	22.7	75.68
	Row Pct	2.86	17.86	26.43	22.86	30	
	Col Pct	66.67	58.14	75.51	80	89.36	
Total		6	43	49	40	47	185
		3.24	23.24	26.49	21.62	25.41	100

**4.2.3 Hypothesis 3: Gender and Length of Service**

Are female faculty and researchers more likely to have longer service duration at Kansas State University than their male counterparts? This is what Hypothesis 3 sought to answer. We used a t-test approach to test the difference between the mean service duration for its statistical significance.

$$\bar{T}_F - \bar{T}_M = 0 \quad \dots\dots 3$$

The mean length of service for females was 10.84 years compared to 13.8 years for males and their respective standard deviations were 10.7 and 11.63. The difference between the lengths of service for the two groups at the mean was almost three years and it was found to be statistically insignificant at the 5 percent level of significance (Table 6).

**Table 6: Results of Hypothesis 3 (Equal Duration of Service for Females and Males)**

Variable	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL SD	SD	Upper CL SD	SE	t-Value	Pr >  t
Female	44	7.587	10.841	14.014	8.84	10.702	13.56	1.613		
Male	141	11.866	13.803	15.74	10.415	11.632	13.175	0.979		
Difference		-6.853	-2.962	0.928	10.361	11.421	12.724	1.972	-1.5	0.1348

**4.2.4 Hypothesis 4: Gender and Age**

Since males in the sample were determined to earn significantly more than females but their service duration was not statistically different, we were interested in determining if age could contribute to explaining the observations. This is what Hypothesis 4 sought to answer. We used a t-test approach to test the difference between the mean ages of respondents by gender for its statistical significance.

$$\Delta A = A_m - A_f = 0 \text{ (where, } A \text{ is the mean value of the variable)} \quad \dots\dots 4$$

The mean age for both male and female respondents was between 40 and 59 years. However, the females were slightly younger but the difference between the mean ages was not statistically significant at the 5 percent level (Table 7).

**Table 7: Results of Hypothesis 4 (Equal Age for Females and Males)**

Variable	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL SD	SD	Upper CL SD	SE	t-Value	Pr >  t
Female	46	2.95	3.24	3.53	0.805	0.97	1.22	0.14		
Male	145	3.22	3.39	3.57	0.94	1.05	1.186	0.087		
Difference		-0.498	-0.154	0.19	0.937	1.031	1.147	0.175	<b>-0.88</b>	<b>0.3787</b>

We are confident that the faculty members that responded to our survey are not representative of the total faculty population at Kansas State University. This is not completely



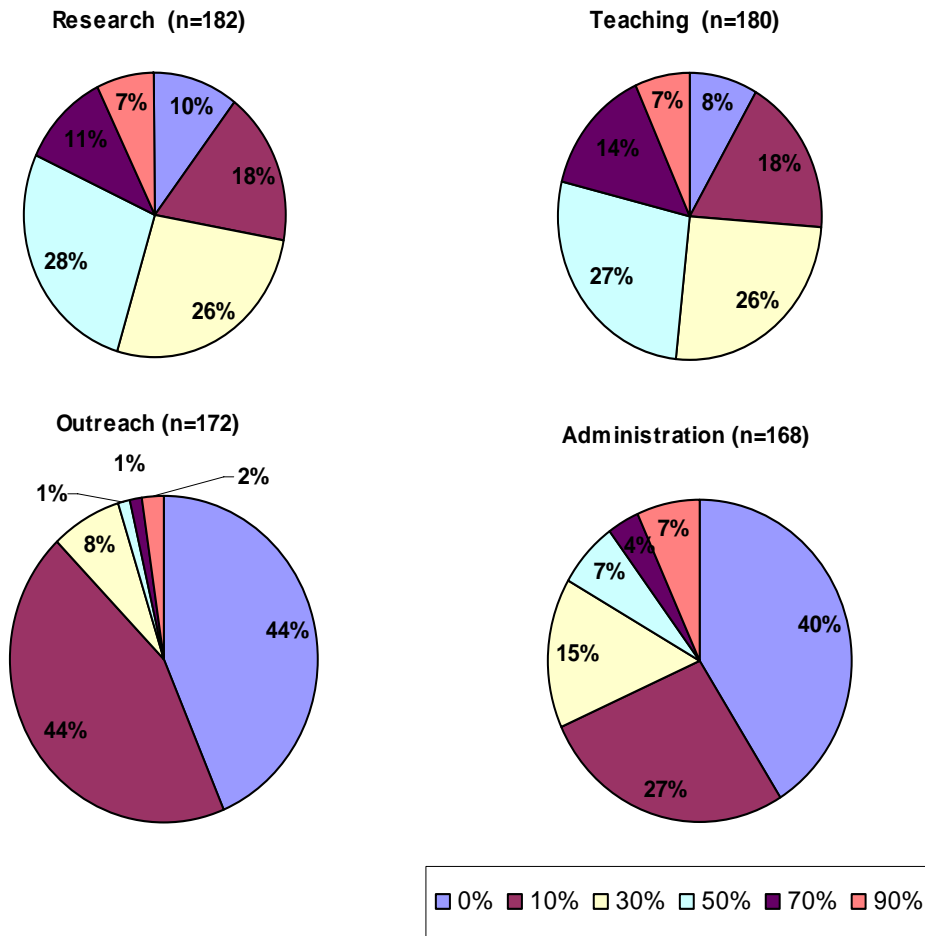
surprising because of the nature of the survey and the participation invitation. We allowed people to self-classify themselves as entrepreneurial and self-determine if their research has any commercial value. The response rate and the results of the respondents' characteristics are informative in indicating the gaps among researchers and faculty members' vis-à-vis entrepreneurship and commercial value of research output. It is interesting to note that with the exception of income, gender was not a differentiating factor among our respondents. This allows us to proceed with the remainder of the analyses with a better understanding of the fundamental characteristics of our respondents and effect of demographics on entrepreneurship and commercialization efforts.

### **4.3 Appointment Characteristics of Faculty**

Kansas State University faculty may have appointments in the areas of research, teaching, outreach and administration. We were interested in finding out the distribution of respondents' time among these different appointments. These are referred to commonly as the appointment tenths. The results show that 10.4 percent of respondents did not have research tenths, compared to 8.3 percent, 43.6 percent and 41.1 percent that did not have teaching, outreach or administration tenths (Figure 7). About 18 percent of respondents had up to 10 percent of their total time allocated to research and teaching while 44 percent of respondents had up to 10 percent of time allocated to outreach. Administration allocation of up to 10 percent time was about 27 percent of respondents. About 50 percent of respondents indicated that they allocated up to 50 percent of their time to research and teaching respectively compared about 8.5 percent and 22 percent of respondents for outreach and administration respectively. About 18 percent and 21 percent of respondents allocated more than 50 percent of their time to research

and teaching respectively while 10 percent and 3.5 percent of respondents had a similar allocation for outreach and administration respectively.

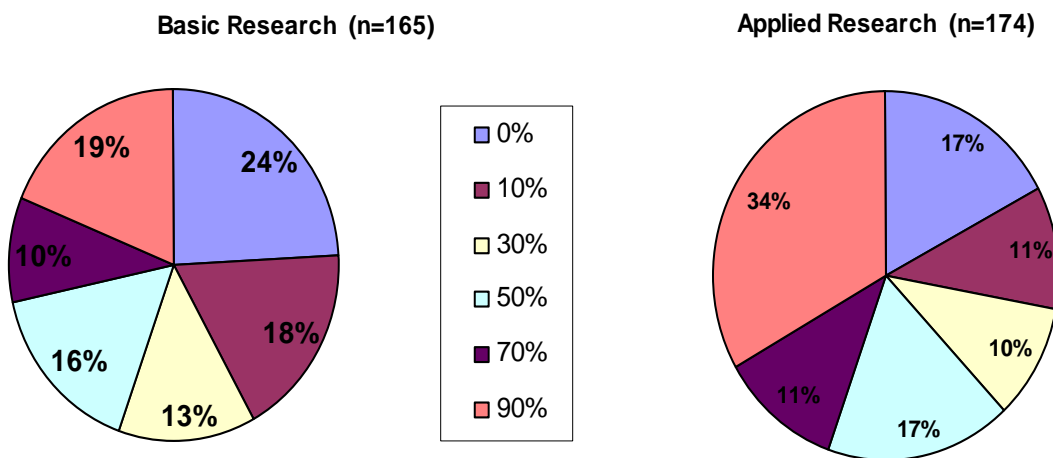
**Figure 7: Distribution of Time among Activities**



For respondents who were conducting research, we were interested in knowing the distribution of their research effort between basic and applied research. We believe that the orientation of researchers towards basic or applied research influences their entrepreneurial orientation and the appreciation of the commercialization effort. Understanding this distribution could help in the development of programs to help enhance entrepreneurial orientation and commercialization initiatives among researchers and faculty. The results show that out of 165

respondents, 24 percent did not allocate any time to basic research, 18 percent allocated up to 10 percent of their time, 13 percent allocated up to 30 percent of their time and 16 percent allocated up to 50 percent of their time (Figure 8). The remaining 29 percent allocated more than 50 percent of their time to basic research. There were 174 respondents for the applied research component of the distribution of research effort. Of these, 17 percent indicated they did not allocate any time to applied research and 11 percent, 10 percent and 17 percent allocated up to 10 percent, 30 percent and 50 percent of their time respectively. The remaining 44 percent of respondents allocated more than 50 percent of their time to applied research.

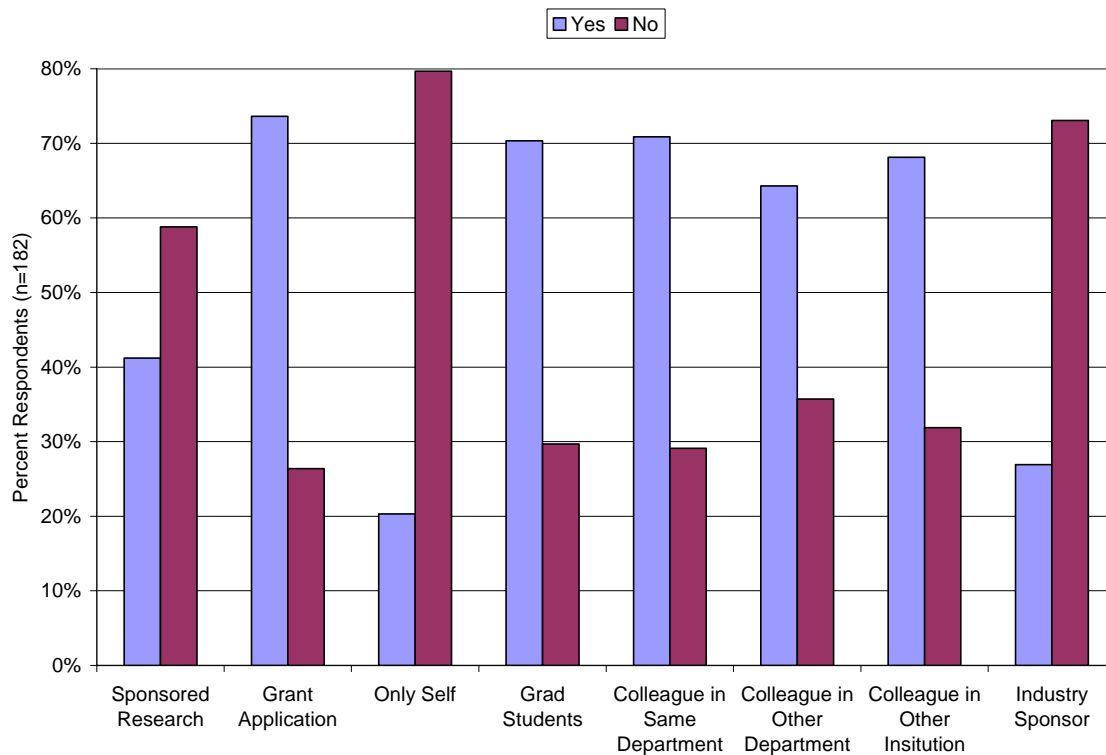
**Figure 8: Distribution of Research Time between Basic and Applied Research**



We wanted to know a number of characteristics about respondents' research relationships. For example, whether they have been involved with sponsored research, been successful with at least one competitive grant application, or involved others in their research effort. The results (n=182) show that about 59 percent of respondents had not been involved with sponsored research in the last two years while 74 percent had been successful with at least one competitive grant application in the same period (Figure 9). Only 20 percent of respondents indicated that they work solely by themselves while 70 percent indicated they work with their

graduate students or a colleague in their academic department. Inter-departmental and inter-institutional research collaboration seems to be high at K-State because 64 percent of respondents indicated that their research effort involved someone from a different department while 68 percent indicated it involved someone from another institution.

**Figure 9: K-State Researchers and their Research Relationships**



#### 4.4 Entrepreneurial Orientation

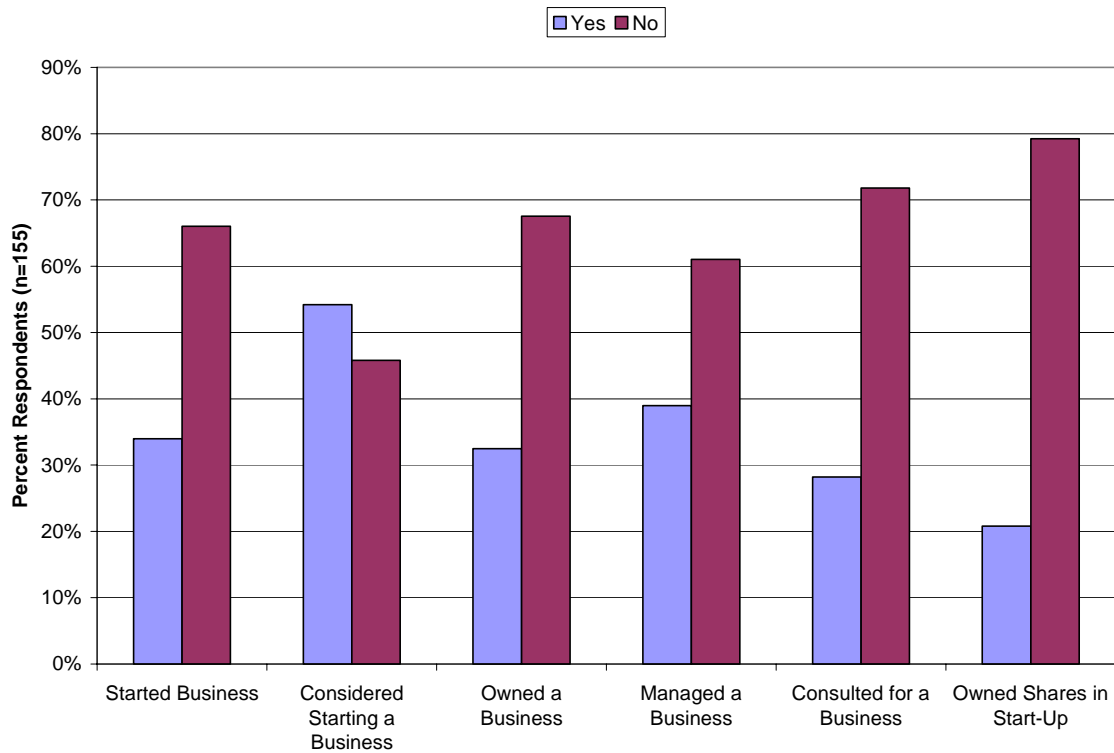
We were interested in respondents' experience with and interest in entrepreneurial initiatives, such as participation in business activities through ownership and/or consulting. They were asked to indicate whether they have been involved in the activities listed on the x-axis of Figure 10. The figure shows that only 34 percent of respondents had ever started a business, but about 54 percent of them have considered starting one. It also showed that 32 percent have owned a business before while 39 percent had managed one. Only 28 percent of respondents

have consulted for pay with a business while 29 percent of respondents have owned shares in a start-up business. We performed a cross-tabulation of these results with the demographic data to improve our understanding of the state of entrepreneurial orientation at Kansas State University. For example, how are those answering in the affirmative distributed among the academic departments and by gender and academic rank? This will help us in the development of a targeted education program to enhance entrepreneurial orientation among research faculty.

#### **4.5 Entrepreneurship and Commercialization Overview**

Assuming that the key factors being interest, motivation and understandability as important for the success of academic entrepreneurship and commercialization by researchers, we test their effectiveness in stimulating the idea among the respondents. Extracting these factors from the questionnaire used for the survey, we were able to gauge the level of understanding of entrepreneurship and commercialization objectives. The first being, business interest: of the total 156 respondents, 34 percent indicated they *started a business*, 54.19 percent have considered *starting a business*, 32.47 percent have *owned a business*, 39 percent of them *managed a business before*, a little over 28 percent have provided *technical or management support to new businesses*, 20.78 percent *owned shares in a business* (Figure 10). Conflict of interest and conflict of commitment policies of the university might be the reason behind the small number of spin-off companies and fewer faculty respondents expressing lower entrepreneurial behavior.

**Figure 10: Entrepreneurial Orientation of Respondents**



#### **4.6 Institution policies and motivation**

The survey questionnaire was designed to capture the motivations, perceptions about existing university policies, apprehensions that hinder entrepreneurship and assess inclinations towards the external business involvement and consulting services. To assess the effect of K-State policies on motivating faculty toward entrepreneurship, the questionnaire was designed to capture faculty understanding about how their research that can be commercialized. To better comprehend the policy issues that the faculty members are concerned about, we used a 5-point behavioral Likert scale in the questionnaire that asked: *“To what extent would the availability of following institution policies motivate you to become more entrepreneurial?”* Interestingly, majority of respondents indicated in the order of their motivation: monetary, personal ownership, managerial expertise, mutual ownership and sabbatical issues to consider entrepreneurial

opportunities in their research areas. For those policies that encourage industry partnerships and provide support services to a faculty member to pursue entrepreneurial opportunities, the scale averaged between 3.1 and 3.2, which places the ranking somewhere between ‘medium’ to ‘medium high’ importance. According to this survey, the respondents gave least importance to the equal ownership partnered with the institution. This reflects their commitment to explore the research opportunities rather than owning the invention. The responses are summarized in Table 8. The above results are in contrast to Cromie 1987 who found that autonomy and monetary expectations are the common motivational factors that are more profound in encouraging aspirants to pursue entrepreneurship efforts, stressing on achievement and autonomy.

**Table 8: Institutional motivation policies for commercialization**

<b>Institution policies</b>	<b>Medium High to High</b>	<b>Mean Rate</b>
Leave of absence to start business	35.9%	2.8
Complete ownership of discovery by researcher	37.9%	2.9
Equal share of ownership with institution	27.6%	2.6
Greater share of ownership between researcher and institution	34.0%	2.8
Encourage to develop industry partnerships	43.1%	3.1
Support to initial capital	48.6%	3.2
Access to experienced management team	52.4%	3.2

#### **4.7 Consulting activities and involvement**

Entrepreneurship, as we define it in the survey is assumed to include any activity which is considered outside of the faculty respondent’s entitled service to the university and which yield monetary and/or non-monetary benefits. This includes dealing and/or holding any position in the business and consulting activities, before or after or during the tenure of the service at the university. Faculty consulting activity is important to academic entrepreneurship for any of various reasons: provides direct contact between industry and academic, involve with

commercial ventures, provides formal research arrangements and may eventually ease the way for entrepreneurial faculty in business venture (Bird and Allen, 1989). About 39 percent of the total 150 faculty respondents have indicated that they provided paid-consulting services in the past two years. Of those who are involved in paid-consulting activities 84 percent are male faculty and 16 percent are female faculty. Further, to delineate the respondents who provided paid-consulting services from those who did not, they have been asked to indicate the type of organization they have been involved with while consulting. From the total respondents providing paid consulting services about 58 percent were Professors, 21 percent were Associate Professors, and 21 percent were Assistant Professors. From our sample population, no Post-docs and Research Associates were doing consulting services.

Respondents were asked to indicate the types of organizations they have provided paid consulting services to in the last two years. The results show that, of the total responses for multiple selections, only about 11 percent of respondents indicated “*in-state*”, about 15 percent said “*large organization*” and 18 percent of each indicated “*not-for-profit*” and “*small organizations*,” whereas 19 percent said “*for-profit*” and 20 percent indicated “*out-of-State*.” Of those respondents the percentage of males in all these organizations is more than the percentage of females that provided consulting services. Table 9 below shows the huge variation in the demographics pertaining to consulting activities.



**Table 9: Gender Distribution of Paid-Consulting Services in Different Organizations**

Type of Organization	Female		Male		Total Respondents
	Frequency	Percent	Frequency	Percent	
For-profit	3	8.11	34	91.89	37
Not-for-profit	9	26.47	25	73.53	34
In-state Organization	5	22.73	17	77.27	22
Out-State Organization	6	16.22	31	83.78	37
Small Organization	4	11.76	30	88.24	34
Large Organization	2	7.41	25	92.59	27

Faculty respondents along with their regular academic responsibilities are believed to be engaged in consulting activities and faculty whose research is funded by industry or external source are more likely to be involved in consulting. The increasing trend in consulting and amount of time spent in consulting services can be seen as a positive approach in faculty perceptions in exploring other avenues of commercializing university knowledge.

Similarly, the success of commercialization activity at the university is attributed to not only the allocation of funding for research, but also to faculty- who actually are the source of the research invention, and the university technology management team – who drive the invention from the university successfully to the maximum productive purpose generating an additional revenue for the university and the inventor. The current university commercialization model pursued as K-State does not reflect the active participation of the inventor in every step of the process of commercializing the invention. The vital part of the process being the inventor(s) as he/she is the appropriate person with the first hand knowledge and understanding of the fundamentals of the research output and could help in the improvement or upgrading the invention and make it suitable for the customer to accept and use the invention most effectively and successfully. Further cooperation is needed between the inventor and the end user. It is

expected to facilitate a better flow of information exchange between the university, inventor and the recipient of the invention.

It is important for us to imagine the future state of consulting by faculty researchers in order to gauge the outreach expectations of the inventors. To indicate their inclination toward consulting activities and their level of getting involved with the consulting activity, we ask faculty to indicate the direction of their consulting activities over the next two years. Of those faculty respondents who answered to this question, about 25 percent agreed that their consulting trend would be increasing over the next two years, 20% indicated a decrease in consulting, and 55 percent see no change in their present consulting activities (Table 10). Of the total 69 respondents, 25 percent of the respondents have indicated an increase in their consulting activities (females - about 6 percent and males – about 19 percent), 20.3 percent of the respondents have indicated a decrease in their consulting activities (females 1.5 percent, males 18.8 percent) and 55.07 percent of them indicated of no change in their consulting activities.

**Table 10: Respondents consulting activities in two years**

Change in consulting activity	Percent		% Total respondents (n=69)
	Females	Males	
Increasing	5.8	18.84	24.64
Decreasing	1.45	18.84	20.29
Remain Unchanged	14.49	40.58	55.07

Of those respondents who indicated an increasing trend in their consulting activities over the next two years, 35 percent see a growth in their consulting activity by ‘less than 10 percent’, while 38 percent of the respondents have indicated a change in consulting services in the range of 10 to 20 percent, and about 27 percent of them have expect an increase of over 20 percent in

their consulting activity. Table 11 below indicates the distribution of male and female faculty respondents to their change in consulting activities.

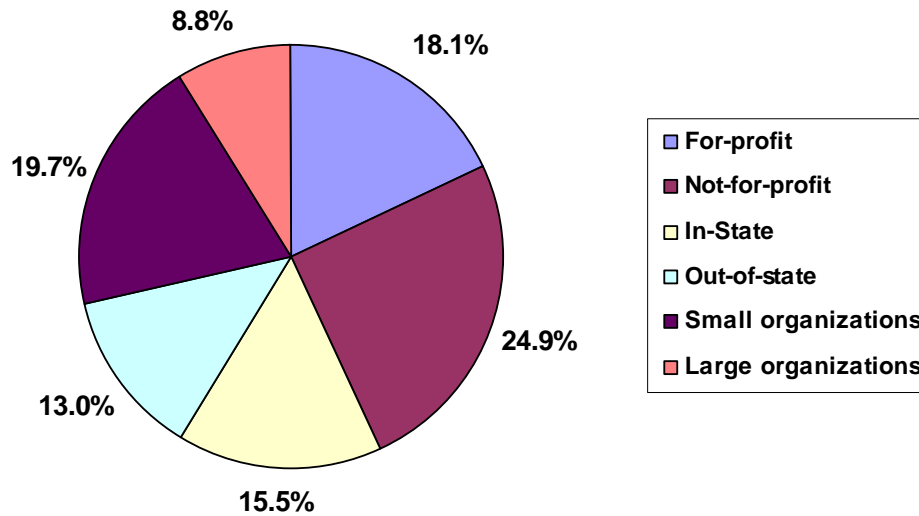
**Table 11: Change in consulting activities by faculty researchers**

Percentage change in Consulting Activities	Percent Respondents		% Total Respondents (n=34)
	Females	Males	
Less than 10%	5.88	29.41	35.29
From 10-20%	11.76	26.47	38.24
Greater than 20%	2.94	23.53	26.47

Faculty are involved with organizations in different capacities that depends on the nature of service sought from them, our respondents were given a choice to select their capacity in the organization they have been involved with over the last two years. Of the total 192 responses who selected multiple options, 5 percent have said they were “Investor,” 8 percent said they were a “Manager,” 14 percent indicated they were a “Mentor,” 15 percent were in “Other capacity,” and about 17 percent have said they were “Director.”

There has been a long history of faculty involvement with different type of institutions for consulting services. Some of them have been in corporations where they work on industry-university research collaborations; with some being the government institutions sponsored research like National Science Foundation, National Institutes of Health, federal research laboratories and so on. Outreach activities of faculty are an important part of consulting services and faculty at K-State did express similar opinion. Of those who responded, about 9 percent of them said they are involved with “*large organization*,” 13 percent are involved with “*Out-of-State*” organizations, around 16 percent were with “*In-State*”, 18 percent were with “*For-Profit*,” about 20 percent have been involved with “*Small organizations*,” and whereas 25 percent were involved with “*Not-for-Profit*.” Figure 11 below shows the percentage distribution.

**Figure 11: Faculty involvement with various organizations through consulting**

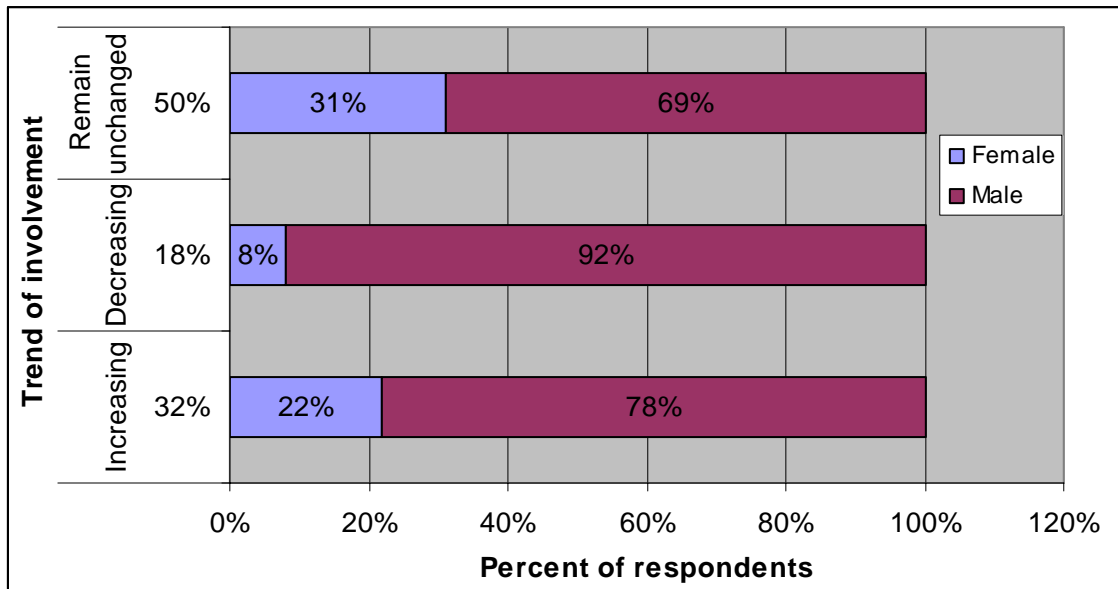


Given that faculty association with these organizations is both short-term and long-term, the success and continuation of research and consulting collaboration is influenced by various factors. Some of these factors that weigh the most are the institutional factors, financial, success of research project, and value outcomes that can be commercialized.

Also, among the respondents who indicated they are likely to increase their involvement with organizations they have worked within the next two years, almost 32 percent have indicated that their involvement would see an “*increasing trend*”, while 18 percent have indicated of a “*decreasing trend*” and 50 percent have indicated of “*no change*” in their present involvement (Figure 12). Of the 32 percent respondents who see an increasing trend in involving with various organizations, about 78 percent are males and 22 percent are females.

In line with the professors consulting service outside the university, it is desirable to provide wisdom to the research faculty in developing industrial relations in line of their research to better promote their understanding of the industry requirements.

**Figure 12: Faculty’s involvement trend with organizations in next two years**



To measure faculty’s future intentions about getting involved with entrepreneurial and commercialization activities, the questionnaire was framed to know if an opportunity is available. The question was framed to determine if the respondent would be interested in consulting if he/she were approached and if the respondent would be interested in serving as a director, mentor, advisor, manager or investor. Of the total respondents (n=145) who were consulting, 84 percent have expressed interest to be associated with a company and those who responded to serving in a position with a company (n=148), 52 percent indicated interest in being a director, mentor, advisor, manager or investor.

#### **4.8 Constraints in entrepreneurial efforts**

Respondents identified several constraints to their entrepreneurial activities. Major constraints highlighted included: lack of availability of time, lack of initial capital for financing, need of proper IP policy and management, lack of entrepreneurial training and understanding and

motivation. Some of the respondents have identified lack of flexibility in the institution's conflict of interest policy and the fact that commercialization does not contribute significantly toward tenure and promotion assessment. Some of them even highlighted personal aspects like risk aversion, lack of interest, inability in understanding the product, market and timing of their research and failure in identifying the right opportunity and academic commitment, as their minor but principal constraints in thinking about entrepreneurship. Below are the constraints the faculty respondents identified that hinder their ability to take entrepreneurial initiatives and are group in to three categories (Table 12):

**Table 12: Respondents perceived entrepreneurial constraints**

Category	Constraints
Self	<ul style="list-style-type: none"> <li>• Lack of time</li> <li>• Lack of understanding about entrepreneurship and benefits</li> <li>• Lack of information on intellectual property policy and its management</li> <li>• Difficulty in finding partner outside academia</li> <li>• Inherent risk averse attitude</li> <li>• Lack of knowledge about suitability of invention to products and its market.</li> <li>• Competition</li> </ul>
Institutional	<ul style="list-style-type: none"> <li>• Lack of motivation and support from university</li> <li>• Expertise and infrastructure</li> <li>• Conflict of interest</li> <li>• Academic responsibilities</li> </ul>
Research/Structure	<ul style="list-style-type: none"> <li>• Seed funding for new ventures</li> <li>• No short-term rewards for disclosures, patenting, etc.</li> </ul>

These entrepreneurial constraints reflect the informational gap and respondents are unaware of policies concerned with IP, product and its market comprehension. The above table shows that personal and institutional factors are of major concern than the research issues. Creating a structured program that addresses these issues would be a possible solution and help

faculty researchers overcome the constraints. Yet, it is quite vague whether the personal or the professional factors that affect these entrepreneurial constraints and our analysis through hypotheses would strengthen our argument that indeed the lack of information on these issues is the major factor discouraging faculty researchers on entrepreneurial initiatives.

#### **4.9 Commercialization Knowledge and Effort**

People respond to incentives, and university faculty is like other people in this respect. If the rewards associated with participating in a commercialization initiative exceed its perceived costs, then people will have strong economic incentives to participate.

The issue of commercialization in universities is complicated by the competing reward structure highly dependent on publication of creative outputs in academic peer reviewed journals. This is well understood by faculty and encouraged by many institutions and has well-defined measurement indicators. For example, journals are ranked by tiers, encouraging researchers and faculty to target their creative works to outlets that fit their expectations. It is against this clarity that the fuzziness of commercialization rewards is pitted. For this reason, it is extremely important that organizations and institutions that seek to maximize the benefits from their creativity consciously invest in developing the understanding and appreciation of commercialization and the associated net benefits that come along.

Against this backdrop, therefore, it was proper for us to begin our assessment of commercialization knowledge by assessing the level of understanding faculty and researchers have about the institution's commercialization policies and programs. We asked respondents to indicate, on a scale of 1 (do not understand at all) to 5 (understand very well) the university's discovery disclosure policies, intellectual property policies, creative output ownership policies

and the distribution of commercialization rewards policies. The results, presented in Table 13, show that overall, the level of understanding is low. For example, more than 40 percent of respondents (n=164) indicated that they have little or no understanding of invention disclosure, intellectual property protection and ownership rights policies. When it came to the distribution of rewards associated with the commercialization of their creative outputs, nearly 53 percent indicated having little or no understanding of the policies. Only about 8 percent and 3.7 percent of respondents respectively said they understand invention disclosure and rewards distribution policies of their institution very well. This indicates there is a very low knowledge and awareness and understanding. To stimulate entrepreneurship among K-State researchers and faculty, there is an urgent need to address this barrier.

**Table 13: Respondents' Understanding of their Institution's Commercialization Policies**

Rank	Invention Disclosure	IP Protection	Ownership Rights	Rewards Distribution
	Percent Respondents			
1	23.17	20.73	18.90	28.66
2	20.73	20.73	25.00	23.17
3	26.83	26.22	29.27	28.66
4	21.34	21.34	20.12	15.85
5	7.93	10.98	6.71	3.66
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

How did understanding of commercialization policies differ across gender lines and across length of service? We tested the following hypotheses:

**4.9.1 Hypothesis 5: Gender and Understanding of Commercialization Policies**

“Gender and understanding of commercialization policies: There is no difference between male and female faculty and researchers regarding their understanding of the institution’s commercialization policies.”

We used a t-test method to test if there were differences between male and female faculty and researchers regarding their understanding of the commercialization policies of the institution. The results indicated that while there was no statistical difference between male and female



researchers and faculty in their understanding of the issues (the mean Likert-scale measure was below 3.0 in both cases), there were statistically significant differences between them with respect to their understanding of ownership rights and distribution of rewards at the 5 percent (\*) level (Table 14). Males had a slightly better understanding of these policies than their female counterparts at the mean. The foregoing results were true in all cases under equal and unequal variance assumptions with the exception of intellectual property protection where there was significant difference under the unequal variance assumption.

**Table 14: Understanding of Commercialization Policies by Gender**

Variable	Method	Variances	DF	t Value	Pr >  t
Invention Disclosure	Pooled	Equal	160	-1.59	0.1129
	Satterthwaite	Unequal	65.6	-1.66	0.1017
IP Protection	Pooled	Equal	160	-1.88	0.0615
	Satterthwaite	Unequal	72.2	-2.07*	0.0422
Ownership Rights	Pooled	Equal	160	-2.92*	0.004
	Satterthwaite	Unequal	68.3	-3.12*	0.0027
Rewards Distribution	Pooled	Equal	160	-2.03*	0.0443
	Satterthwaite	Unequal	67.8	-2.15*	0.035

This result will seem to suggest that it is appropriate to assume there is a need for enhancing the understanding of faculty and researchers about the commercialization policies of the institution without treating any gender differently.

#### ***4.9.2 Hypothesis 6: Age and Understanding of Commercialization Policies***

“Age and understanding of commercialization policies: Younger faculty and researchers have a better understanding of the commercialization policies of the institution. This is based on the assumption that younger faculty and researchers have a greater interest in securing non-traditional sources of funds to facilitate their research and creative activities.”

We used a Pearson correlation method to test the assumption that age has an effect on researcher’s understanding of commercialization policies. This is equivalent to running a simple

linear regression of the level of understanding on age. The results show that we cannot accept our hypothesis that age affects understanding of commercialization policies because the correlation coefficient (r) was no significant in all cases at the 5 percent level (Table 15). Therefore, efforts to enhance understanding of commercialization policies must be structured to be independent of the age of the researcher or faculty member.

**Table 15: Testing the Relationship between Age and Understanding of Commercialization Policies**

	<b>Metric</b>	<b>Invention Disclosure</b>	<b>IP Protection</b>	<b>Ownership Rights</b>	<b>Rewards Distribution</b>
<b>Age</b>	r	0.13489	0.13931	0.07449	0.12967
	Pr > r	0.086	0.0761	0.3447	0.099
	n	163	163	163	163

#### **4.10 Respondents’ Research and Commercialization Potential**

Researchers and faculty are not going to disclose their discoveries if they do not believe or know those discoveries have commercial potential. We decided to gain an indication of researchers’ perceptions about the commercial potential of their creative activities by inquiring how many of them believed their current activities could lead to intellectual property protection or commercialization. The results show that in both cases, the majority respondents did not believe what they were currently working on would lead to any commercialization or the procurement of an intellectual property (Table 16). A significant large proportion of respondents indicated that they did not know, leading us to conclude that the lack of knowledge about IP or commercialization potential is real. These results would suggest that there is need for some fundamental education or training for researchers and faculty on how to spot opportunities in their research and when to begin searching for such opportunities. However, when we followed

the foregoing question with whether those who answered in the negative would be interested in learning about it, 55 percent of the respondents (n=74) said they would not be interested.

**Table 16: Belief of Respondents that their Current Research could be Protected or Commercialized**

n=161	Current Research may Qualify for:	
	IP	Commercialization
Yes	41%	37%
No	45%	43%
Don't Know	14%	20%
Total	100%	100%

We tested the strength of the foregoing by asking if respondents will pursue a commercialization initiative if their invention was shown to have a high commercial potential. Overall, almost 72 percent of respondents answered in the affirmative that they are willing to pursue the commercialization of their invention if it can be shown to have high commercial value (Table 17). This response strengthens our opinion that education or professional development programs that have the singular objective of enhancing researchers' and faculty appreciation of the commercialization process will contribute to the development of a more entrepreneurial environment in the university community. Such programs will also improve the opportunity search process used by researchers.

**Table 17: Respondents' Interest in Pursuing Commercialization**

Gender		Pursue Commercialization		Total
		Yes	No	
Female	Frequency	25	13	38
	Percent	15.92	8.28	24.2
	Row Percent	65.79	34.21	
	Column Percent	22.12	29.55	
Male	Frequency	88	31	119
	Percent	56.05	19.75	75.8
	Row Percent	73.95	26.05	
	Column Percent	77.88	70.45	
Total	Total	113	44	157
	Column Percent	71.97	28.03	100

Commercialization and entrepreneurship have a mutual synergetic relationship in the context of university technology outreach. Universities have been active in commercialization by encouraging researchers to be entrepreneurs and using their research output to form ventures (Etzkowitz, 2003). Following is a brief analysis of the resources or avenues researchers look for in order to exploit the potential of their research outputs in a commercial way, what motivational factors further their confidence in venturing into commercialization and explore entrepreneurship aspects of their research. These two concepts have no bearing particularly when faculty start their research, but they assume a greater significance in the latter stages of research activity leading to invention disclosure and patenting.

Table 18 shows the distribution of respondents by their interest in the commercialization of their research. Overall, about 45 percent of these answering indicated that they were interested in commercializing their research if their research has any commercialization potential. This indicates that there is a need for making faculty aware of opportunities regarding the potential use of their research and its applications, and their ability to generate economical and social benefits.

**Table 18: Interest of faculty in commercialization**

Gender		Interest in Commercialization		Total
		Yes	No	
Male	Frequency	9	13	22
	Percent	12.33	17.81	30.14
	Row Percent	40.91	59.09	
	Column Percent	27.27	32.50	
Female	Frequency	24	27	51
	Percent	32.88	36.99	69.86
	Row Percent	47.06	52.94	
	Column Percent	72.73	67.50	
Total	Total	33	40	73
	Column Percent	45.21	54.79	100.00

The primary thing that initiates interest in the commercialization process is the ability of a researcher to think of commercial opportunities that his/her research has to offer before starting their research. We wanted to test if faculty were interested to know the commercial potential of research outcomes. Of the total respondents who responded *yes* to question, 72.7 percent were males who indicated of strong interest compared to 27.3 percent of females (table 18). This is an encouraging number, as this gives us the fundamental strength to our thought that faculty researchers are really interested in knowing the commercial potential their research has to offer. Also, it is interesting to note that more female faculty were interested in knowing if their research has commercialization potential.

At this point it would be interesting to know about the number of respondents who are not only interested in commercialization but also interested in pursuing the commercialization options available to them. Table 19 below shows the frequency distribution of respondents willing to pursue commercialization. About 42 percent respondents who indicated an interest in commercialization are actually willing to pursue the option. We believe it is significant number given the number of respondents (n=72).

**Table 19: Frequency Distribution: Interest vs. Pursuing commercialization**

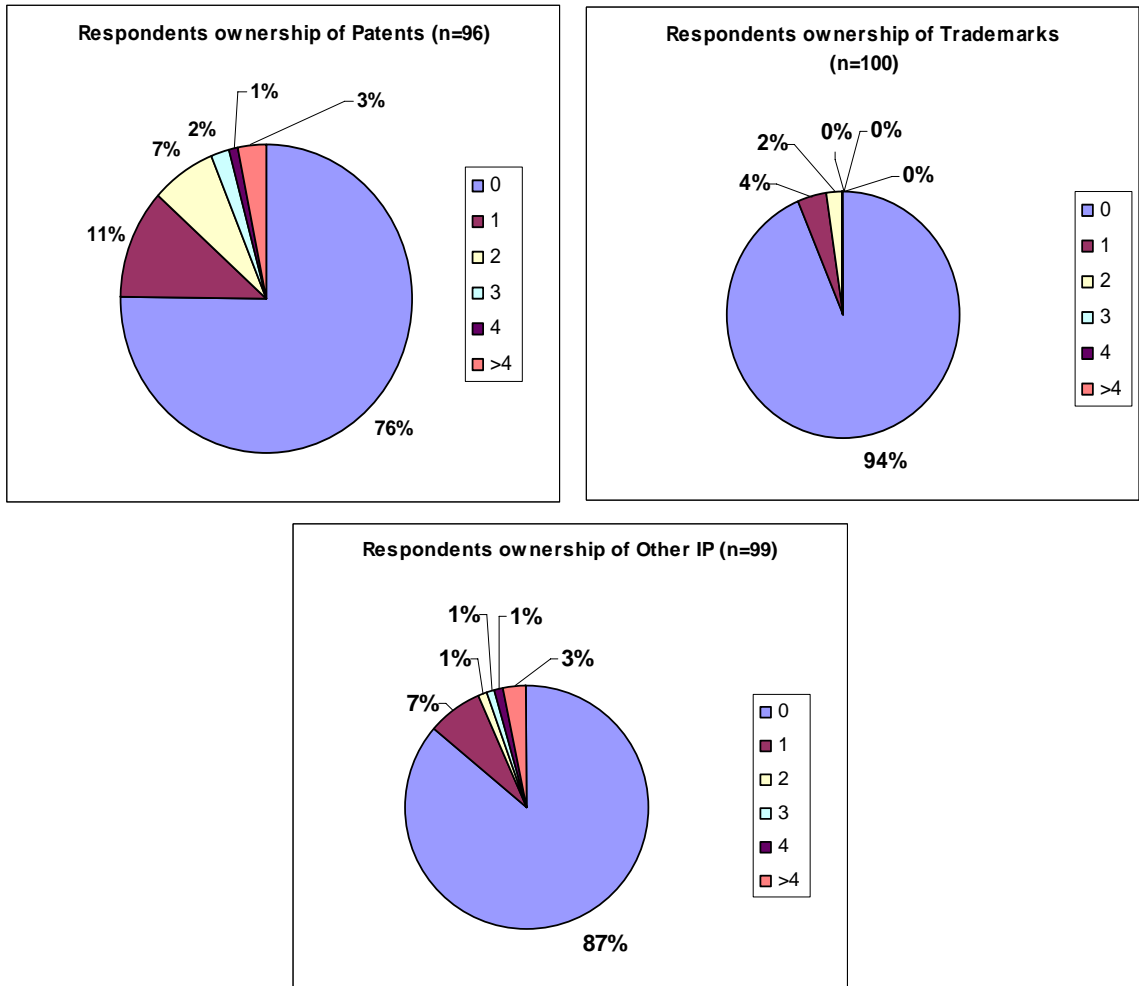
Interested in Commercialization	Pursue Commercialization			Total
		Yes	No	
Yes	Frequency	30	1	31
	Percent	41.67	1.39	43.06
	Row Percent	96.77	3.23	
	Column Percent	61.22	4.35	
No	Frequency	19	22	41
	Percent	26.39	30.56	56.94
	Row Percent	46.34	53.66	
	Column Percent	38.78	95.65	
Total	Total	49	23	72
	Column Percent	68.06	31.94	100

It is important to know that intellectual property that is generated through university research is not necessarily commercialized. Given that, the university research that is commercialized is not necessarily successful in producing desired results. The percentage of university patents issued as discussed in Chapter 2 are far lower than that are expected, based on the Association for University Technology Managers annual reports. Kansas State University has been ranked far below the top state universities even though the university research expenditure is relatively significant with other state universities. This difference in patentable research can be attributed any of the various factors that affect the university process conducting research. Patents, trademarks and other intellectual property have a varied distribution in our sample population (Figure 13 & 14).

The results show that faculty has more patents and other intellectual property compared to trademarks. Of the 96 respondents, 11 percent have at least one patent and 3 percent with greater than four patents, and for other intellectual property it was 7 percent and 3%, respectively. Trademarks seem to be less prevalent among faculty IP activities. Figure 13 shows

that 24 percent of our respondents have greater than one patent and we believe that these patents can generate enough potential provided faculties are encouraged for their involvement in commercialization process and promoting academic entrepreneurship.

**Figure 13: Respondents Ownership of Intellectual Property**



**Figure 14: Success of the IP Commercialization at K-State**

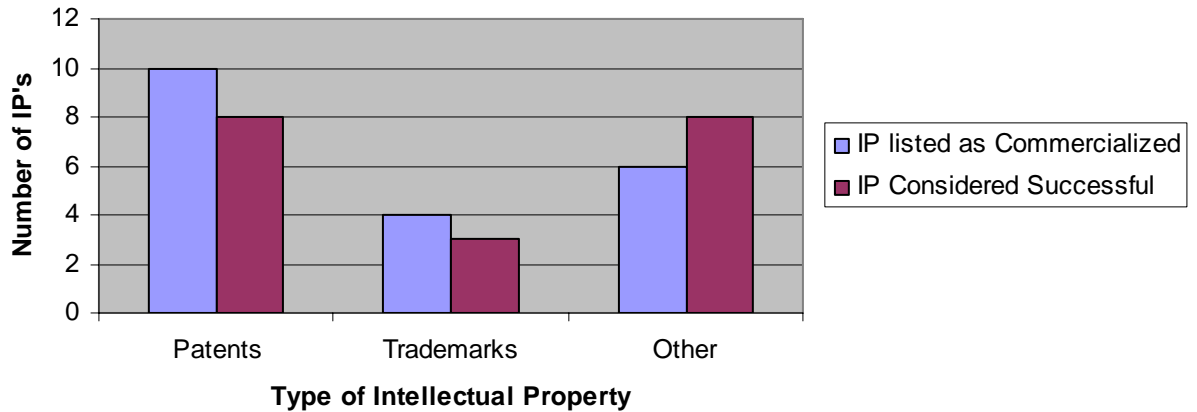
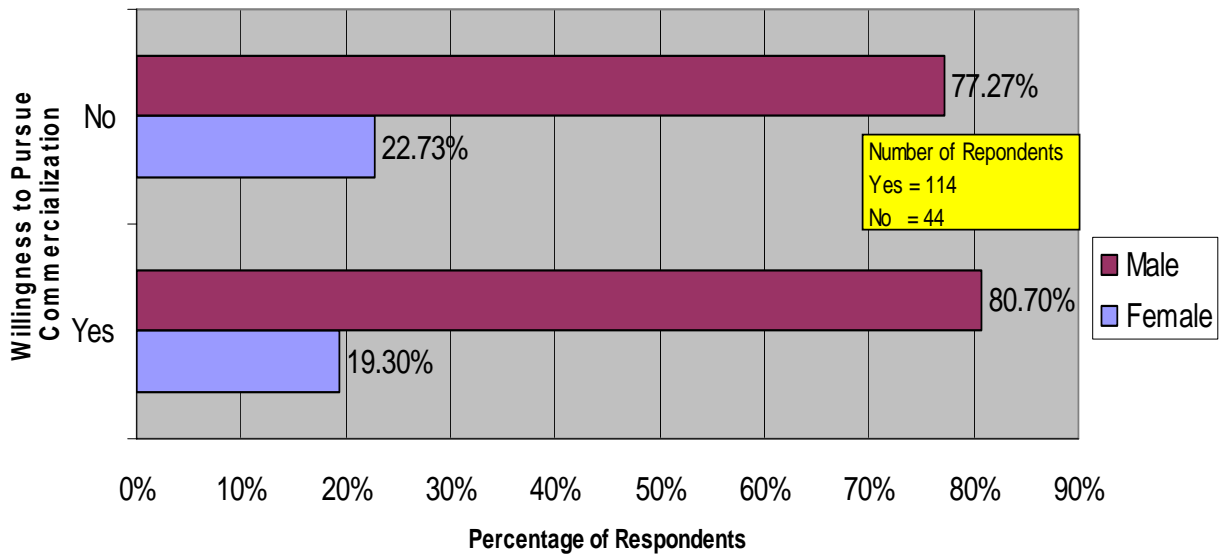


Figure 14 describes the number of intellectual properties that were commercialized and were considered successful at K-State. Though the number is low, the number of IP's that were successful relative to the IP's that were commercialized is substantial. What this tells us is that there is opportunity for commercializing research and that the potential increase in number would bring KSU on par with other state funded universities.

Faculty entrepreneurship is one of the many ways of commercializing the university research. Furthermore, when faculty were asked about their willingness to actively pursue business to commercialize their research outcome if it has high commercial potential and opportunity, 114 respondents responded positively. Of the total respondents, about 81 percent of them were males who expressed high interest in pursuing commercialization process while only 19 percent were females who showed interest (Figure 15). It can be inferred that males are more interested in commercialization process compared to females when it comes to either interest or actively pursue the research outcome for its success.



**Figure 15: Willingness of Respondents to Commercialize their Discoveries**



Researchers’ opinions of the availability of specific services that they would like to see offered, which could encourage them to commercialize their discoveries and inventions were collected to provide a framework or assessment of their needs. About 20 percent thought “Business planning services,” to be highly helpful and 23 percent found it of little help. While 19.4 percent found “Marketing Services” to be helpful, 22.46 percent of the respondents said “Management and Business Strategy Services” would be more helpful and an equal percent of respondents opined that “Commercialization education programs” would be more valuable in educating and imparting the fundamentals and significance of the commercialization process (Table 20).

**Table 20: Services Perceived by Respondents to be helpful in Commercialization Efforts**

<b>Availability of Services</b>	<b>Low help</b>	<b>Low to Moderate</b>	<b>Moderate help</b>	<b>Moderate to High</b>	<b>High help</b>	<b>Number of Respondents (n)</b>
<i>Business planning services</i>	23.02%	10.07%	22.30%	24.46%	20.14%	139
<i>Marketing services</i>	20.86%	10.79%	20.14%	28.78%	19.42%	139
<i>Management and business strategy services</i>	21.74%	7.97%	26.09%	21.74%	22.46%	138
<i>Commercialization education programs</i>	16.79%	10.95%	27.01%	22.63%	22.63%	137

Faculty believes that the role their institution plays in the commercialization effort is important in determining whether commercialization occurs. We investigated this by asking them to rate the importance level for several options that are essential for a successful commercialization process. In a commercialization process, a university’s basic fundamental function is to maintain an IP portfolio that generates revenue not only for the university but for rewarding the inventor(s) which can be an encouraging phenomenon for the faculty as a whole. Without rewards for the effort researchers contribute, further expansion of research in that field is hindered. About 33 percent of the 146 respondents have opined that “*pay for patents and/or other intellectual property*” matters to them and expect the university to play a major role in the commercialization effort (Table 21). About 28 percent of 145 respondents would like to see university to provide help in “*finding business partners.*” A significant number of respondents also wanted have indicated “*licensing invention to the researcher,*” “*spin-off companies to do commercialization,*” “*help in developing a business plan*” in order for their research to be successfully commercialized.

**Table 21: Institutions role in commercialization efforts**

Institution role in commercialization	Response %					Mean Rating
	5 Important Role	4 Somewhat Important	3 Neither/nor	2 Less Important	1 No Role	
<i>Find industry partners</i>	27.6	22.8	22.8	9.7	17.2	3.33
<i>Pay for Patents/IP</i>	32.9	26.7	15.8	8.2	16.4	3.51
<i>Spin-off companies</i>	22.9	16.0	26.4	11.1	23.6	3.03
<i>Negotiate contracts for researcher</i>	21.7	23.1	27.3	9.1	18.9	3.19
<i>Help develop a business plan</i>	23.9	23.9	21.0	10.9	20.3	3.27
<i>Help in Financing</i>	18.1	16.0	23.6	16.7	25.7	2.84
<i>Management Help for Researcher</i>	16.1	17.5	23.8	17.5	25.2	2.81
<i>License invention to researcher</i>	24.1	24.1	27.6	6.2	17.9	3.30
<i>Help determine commercial viability</i>	22.9	25.0	25.0	11.1	16.0	3.27
<i>Help with market development</i>	19.0	19.7	26.1	16.2	19.0	3.03
<i>Negotiate licensing agreements</i>	22.4	27.3	24.5	9.1	16.8	3.29
<i>Sell the invention</i>	17.5	21.0	24.5	10.5	26.6	2.92

Table 21 shows the expectations of faculty and researchers from an institution point of view in helping them advance their commercialization efforts. The mean rating of below 3.0 for financial help, management expertise and sale of invention are considered having low importance for researchers from their institution. While a mean rating of 3 and above for other roles shows their importance for respondents and the need for university administration to reach out to the faculty in addressing their needs. Faculty want more help in securing IPs, assess the commercial value of IP and finding a suitable partner in the industry to promote their invention. It also implies that faculty networking ability with the industry must be enhanced to better market the discoveries.

Faculty members were asked about their willingness to be active participants in the commercialization of research given certain possible choices, but the respondents were very reluctant to give up their current academic rank from the university and equally reluctant to

invest their personal finances in the commercialization of their research. Respondents were positively inclined to take a sabbatical, for help to find industry partners and invite colleagues to partner. This might imply that they prefer to be involved in commercialization activities and would want to seek help in business development and management services.

**Table 22: Respondents Willingness to Commercialization and Entrepreneurial Activities**

Extent of willingness	Invest Personal Finance	Resign Current Position	Take a Sabbatical	Find Industry Partners	Invite Colleagues to Partner
	Percent Respondents				
Unwilling	42.86	62.70	19.84	7.94	7.94
Less unwilling	23.02	21.43	16.67	10.32	14.29
Moderately willing	23.02	7.94	18.25	26.19	26.19
Highly willing	7.14	5.56	21.43	26.19	23.81
Definitely willing	3.97	2.38	23.81	29.37	27.78
Total	100	100	100	100	100

Table 22 shows that 43 percent of respondents are unwilling to invest their personal finances and 63 percent are unwilling to resign from their current position to fully pursue the commercialization of their invention or discovery, but the percentage of respondents willing to take initiative in commercializing their current research is little above 23 percent and this we deem is low. This risk averse approach of respondents is obvious from those who are reluctant to give up their current academic positions and to invest their own personal resources.

Faculty respondents were asked to rank the extent to which institution policies support commercialization efforts into three categories that would develop the potential of their invention: (a) new business creation, (b) participation in new business by faculty, and (c) technology licensing, (Appendix A), Less than 20 percent of them indicated that K-State was

supportive of them in New Business Creation and their participation in new businesses and about 34% indicated that the university was supportive in technology licensing (Table 23).

**Table 23: Faculty Respondents Ranking of Supportive Institution Policies**

<b>Faculty Respondents Activities</b>	<b>Medium to Strong Support</b>
New Business Creation	19.12%
Participation in New Business by Faculty	19.26%
Technology Licensing	33.58%

Commercialization is considered an important way for a university to extend knowledge and exploit research through application. The following factors help us understand the strength of selected motivating factors that affect respondents' decision to embark on commercialization activities (Table 24).

**Table 24: Motivational Factors to Pursue Commercialization**

<b>Motivational Factors</b>	<b>Rank Preferences</b>					<b>Total</b>
	1	2	3	4	5	
<i>Personal Pride</i>	15.13%	26.89%	20.17%	15.97%	21.85%	119
<i>Financial Rewards</i>	34.71%	19.83%	19.01%	11.57%	14.88%	121
<i>Improving Society</i>	39.37%	23.62%	15.75%	11.02%	10.24%	127
<i>Competition</i>	3.36%	12.61%	14.29%	34.45%	35.29%	119
<i>Peer Recognition</i>	9.02%	17.21%	30.33%	26.23%	17.21%	122

We found that financial rewards and societal concerns are more important motivators, in contrast to Cromie's(1987) and Vallance (2001) results which showed that non-economic factors were the dominant motivators. Also contrasting are the results from a study by Vallance (2001) who said that intrinsic rewards of research and career objectives are important than financial rewards.

## **CHAPTER 5 - Conclusions and Recommendations**

### **5.1 Conclusion**

The overall objective of this research was to assess faculty and researchers' understanding of entrepreneurial and commercialization issues and the significance of their characteristics in explaining their orientation. Our review of literature encompassed faculty entrepreneurship, gender issues pertaining to entrepreneurship and technology commercialization concepts. We also reviewed faculty characteristics, motivations with respect to consulting that surround these issues.

To address the objectives laid out in Chapter 1, we developed a set of hypotheses to test demographics influence over their employment, income and understanding of commercialization and entrepreneurial subjects. We also try to capture their willingness and inclination towards these important paths of commercialization and their expectations from university that are suggestive of academic entrepreneurship.

Only about 8 percent and 3.7 percent of respondents respectively said they understand invention disclosure and rewards distribution policies of their institution very well (table 13). This indicates there is a very low knowledge, awareness and understanding. To accelerate entrepreneurship among K-State researchers and faculty, there is an urgent need to address this barrier. We also found that faculty and researchers understanding of the commercialization policies were independent of their gender (though males had slightly better understand than their female counterparts) and age. Though there are less observable differences in the demographics, it is clear that perceptions about commercialization are independent of gender, age and length of service in the university. It is interesting to note that with the exception of income, gender was not a differentiating factor among our respondents. Even the length of service was found to be

insignificant among the demographics. Therefore, any efforts to enhance understanding of commercialization policies must be structured to be independent of gender and age.

A significantly higher percentage of respondents expressed their willingness to pursue commercialization indicating that there is strong keenness among faculty and that enthusiasm can be leveraged with provision of adequate resources for realizing the research potential. Also, about a quarter of the respondents implied that they would like help from the institution in finding business partners, licensing inventions to researchers, and launching spin-off companies. Faculty indicated they would like to increase consulting activities and university policies seem to have constrained faculty expectations in the growth of consulting services. Also, a higher percentage of respondents indicated they would like to be associated with companies and would be willing to serve as directors, mentors, advisors or managers of a business.

Faculty and researchers identified several constraints that hinder their entrepreneurial and commercialization behavior and indicated removal of these constraints would help them achieve a greater success in research commercialization efforts. Lack of time, knowledge of entrepreneurship, and understanding of university intellectual property policies are also seen as constraints by faculty, but they also indicated institutional factors such as: lack of motivation and support from university; conflict of interest and burdening academic responsibilities; as major constraints. Our conclusion points to the fact that effective educational programs that address each of these issues would definitely help increase awareness among faculty and researchers about university academic entrepreneurship and commercialization intellectual property policies.

It is also noted that faculty are inclined to seek short-term rewards (such as publishing their work that is counted toward academic achievements) before they disclose the invention. Also, our survey reveals faculty as having negative perceptions about the risks and rewards of

disclosing and patenting inventions versus publishing research. It is interesting to note that economic motivations influenced K-State faculty's behavior in pursuing commercialization of their inventions. This was contrary to Cromie (1987) who had indicated non-economic motives dominate in embracing entrepreneurship. Thus a better understanding of the fundamental characteristics of our respondents is important for the effectiveness in entrepreneurship and commercialization efforts.

## **5.2 Recommendations**

University policies on commercialization and entrepreneurship are important factors in faculty decisions to become entrepreneurs and pursue commercialization of their discoveries. As a result if K-State wants to increase its commercialization outcomes, it must pay attention to its policies and how they affect faculty and researchers. As noted in the K-State comparison with AUTM members, K-State performance in this regard is below average. Therefore, we recommend that if the university is going to address this below-average performance, understanding the relation between entrepreneurship policies and faculty behavior is important.

Faculty is not interested in resigning academic positions to start their own companies. This would suggest that the university must encourage faculty to continue research efforts, while surrounding them with the necessary management and business know-how and talent to move inventions and discoveries forward. We make the point on the fact that KSURF is under staffed in comparison to other institutions that are very successful in commercialization efforts.

This work focuses entirely on K-State and compares our results with the literature. It would be interesting to compare K-State to other research universities of like size and research efforts. A multi-university study including Kansas State University would help benchmark performance and also help in identifying the improvements needed in current university policies



and provisions. Lack of comparison with similar universities in our analysis might restrict our results for comparison purposes and can be considered one of the limitations. Comparing individual policy issues among universities would lead to greater understanding of the root factors of success in research commercialization. Our research did not address this.

Our study does not attempt to quantify the success of entrepreneurial and commercialization opportunities available, but future studies focusing on this aspect would be of great interest. Further research to determine the causal relationships between entrepreneurship and commercialization could provide insight into how to create a unique environment in an academic setting to achieve success in research commercialization.

The foregoing suggests the need for educational and professional training programs to alter the current, mostly negative perceptions about commercialization in the university community and provide faculty assistance in commercialization efforts. Until such a shift occurs in perception, it will be difficult for Kansas State University to attain the growth rate in commercialization that has been observed in other institutions around the country.

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## Appendix A - Commercialization of Research Discoveries and Entrepreneurship in Universities: A Survey

Funding challenges are causing many research universities to encourage entrepreneurship and commercialization among their faculty and staff. However, there is little empirical information on the extent and depth of entrepreneurship and commercialization in many universities, which limits the development of effective policies and strategies to aid these activities.

This survey seeks to provide the base information required for understanding the commercialization and entrepreneurship situation in research universities. It also seeks to identify faculty perceptions about the opportunities and challenges to commercialization and entrepreneurship with the view to inform policy development.

Your participation is voluntary but encouraged. There are no codes in this survey to link you to your answers. Therefore, your anonymity is assured. We shall also treat all information gathered with the utmost regard to confidentiality. It should take no more than 25 minutes to complete the survey. However, you are at liberty to terminate your participation in the survey at any time.

If you have any questions about this survey, please contact Dr. Vincent Amanor-Boadu at [vincent@agecon.ksu.edu](mailto:vincent@agecon.ksu.edu) or by telephone at 785.532-3520. Thank you.

### I. Demographics

1	I am . . .	<input type="checkbox"/> Female	<input type="checkbox"/> Male		
2	Highest academic degree	<input type="checkbox"/> D.Sc./LLD or similar	<input type="checkbox"/> PhD/DBA	<input type="checkbox"/> MS/MA or similar	<input type="checkbox"/> Other
3	Academic department				

4	Current position/rank	<input type="checkbox"/> Professor	<input type="checkbox"/> Associate Professor	<input type="checkbox"/> Assistant Professor	<input type="checkbox"/> Post Doctor	<input type="checkbox"/> Research Associate	<input type="checkbox"/> Research Technician
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5	Age cohort	<input type="checkbox"/> < 30 years	<input type="checkbox"/> 30-39 years	<input type="checkbox"/> 40-49 years	<input type="checkbox"/> 50-59 years	<input type="checkbox"/> 60-69 years	<input type="checkbox"/> ≥ 70 years
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6	How long have you been employed at this institution?	_____ years
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7	Annual income	<input type="checkbox"/> Less than \$40,000	<input type="checkbox"/> \$40,000-\$59,000	<input type="checkbox"/> \$60,000-\$79,000	<input type="checkbox"/> \$80,000-\$100,000	<input type="checkbox"/> Over \$100,000
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## II: Research

8	How is your time allocated across the following functions?	a. _____% Research	b. _____% Teaching	c. _____% Outreach	d. _____% Administration
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Skip 9 if you do not have any time allocated to research.

9	Please indicate the allocation of your research effort between basic and applied research	Basic	Applied
		a. _____%	b. _____%

10	In the past two years . . . (select all that apply)	Yes	No
A	I have been involved in contract or industry-sponsored research		
B	I have been successful in at least one grant application		
C	My research activities have involved just me		
D	My research activities have included graduate students		
E	My research activities have included others in my department		
F	My research activities have included others in other departments		
G	My research activities have included others in other institutions		
H	My research activities have included industry researchers		

## III: Commercialization Initiatives

11	How would you rank your understanding of the intellectual property policies of your institution? (1 = Not at all; 5 = Very well)	1	2	3	4	5
A	Disclosing inventions/discoveries					
B	Protecting intellectual property (patents, trademarks)					
C	Ownership rights					
D	Distribution of commercial rewards					



12.1	Do you own, or have you ever owned, a patent, trademark or other intellectual property?	Yes	No
12.2	Have you been named as an inventor or developer on any intellectual property, such as patents or trademarks?	Yes	No

Skip to 17 if you answered “No” to 12 and 13.

13	How many patents, trademarks or other intellectual property do you own or have been listed on as an inventor?	a. Patents	
		b. Trademarks	
		c. Other	

14	How many of the intellectual properties you own or have been listed on have been commercialized?	a. Patents	
		b. Trademarks	
		c. Other	

Skip to 17 if none of your intellectual property has been commercialized.

15	How many of your commercialized intellectual properties would you consider successful?	Patents	
		Trademarks	
		Other	

16.1	Do you think any of your current research activities could produce products or processes that qualify for intellectual property protection?	Yes	No	Don't Know
16.2	Do you think any of your current research activities could lead to commercial products or services?	Yes	No	Don't Know

17	If you answered “Don't Know” in 17 and 18, are you interested in knowing if your research activities can be commercialized?	Yes	No

18	How seriously do you think about commercial opportunities in your research at the following stages? (1 = Not at all; 5 = Seriously)	1	2	3	4	5
A	Before starting the research					
B	While doing the research					
C	After completing the research					

19	Would you be willing to actively pursue the commercialization of a product/service you invent if it has a high commercial potential?	Yes	No

20	If you are willing to pursue the commercialization of your invention, please indicate the extent of your willingness to do the following? (1 = Unwilling; 5 = Definitely willing)	1	2	3	4	5
A	Invest personal financial resources					
B	Resign current position					

C	Take a sabbatical					
D	Find industry partners					
E	Invite colleagues to partner					

21	Please indicate the extent of your familiarity with the following commercialization options (1 = Not Familiar; 5 = Very Familiar)	1	2	3	4	5
A	Licensing					
B	Joint venture					
C	Start-up companies					
D	Outright sale of intellectual property					

22	To what extent would you be interested in the following options as vehicles to take your invention to market? (1 = Not at all; 5 = Very Interested)	1	2	3	4	5
A	Licensing					
B	Joint venture					
C	Start-up companies					
D	Outright sale of intellectual property					

23	Please select the response that best describes your situation in the following statements	Yes	No
A	I have avoided disclosing inventions because the process is cumbersome		
B	I have chosen to publish a research article instead of disclosing an invention because I get faster rewards from publishing		
C	I have chosen not to disclose an invention because of other reasons		
D	I encourage my graduate students to publish as quickly as possible any discoveries they make		
E	I believe that publications are rewarded more than commercialization		
F	I believe public research institutions should not be commercializing their inventions/discoveries		
G	I have always disclosed my inventions/discoveries		

24	Please indicate (✓) which of the following factors will motivate you to pursue commercialization of products/services you develop. (Select all that apply)				
	a. Personal Pride	b. Financial Rewards	c. Improving Society	d. Competition	e. Peer Recognition

25	What role do you see for your institution in the following commercialization efforts? (1 = No role; 5 = Important role)	1	2	3	4	5
A	Find industry partners					
B	Pay for patent and/or other intellectual protection					
C	Spin off companies to do commercialization					
D	Negotiate production contracts for the researcher					
E	Help researchers develop a business plan					
F	Raise the requisite financing for commercializing					
G	Recruit management to help the researcher					
H	License the invention to the researcher					
I	Help determine commercial viability for the invention					
J	Help with market development for product/service					
K	Form joint ventures					
L	Negotiate licensing agreements					
M	Sell the invention to the highest bidder					

26	To what extent do you think your institution's policies support the pursuit of the following activities? (1 = No support; 5 = Strong support)	1	2	3	4	5
A	New business creation					
B	Participation in new business by faculty					
C	Technology licensing					

27	To what extent would availability of the following services help you to commercialize products/services you develop? (1 = Low; 5 = High)	1	2	3	4	5
A	Business planning services					
B	Marketing services					
C	Management and business strategy services					
D	Commercialization education programs					

28	Please identify three things that constrain your commercialization efforts.					
	a		b		c	

#### IV: Entrepreneurial Orientation

29	Have you ever. . .	Yes	No
A	Started a business?		
B	Considered starting a business?		
C	Owned a business?		
D	Managed a business?		
E	Provided technical or management support to new businesses?		
F	Owned shares in a new business (i.e., less than 3 years)?		

30	To what extent would the availability of following institution policies motivate you to become more entrepreneurial? (1 = Low; 5 = High)	1	2	3	4	5
A	Leave of absence					
B	Complete ownership for researcher					
C	Equal share of ownership with institution					
D	Greater share of ownership for researcher					
E	Encouragement to develop industry partnerships					
F	Support with initial capital requirement					
G	Access to experienced manager					

31	Please identify three things that constrain your entrepreneurial activities.		
	a	b	c

32	Have you provided paid-consulting services to an organization in the past two years?	Yes	No

If “No”, skip to 39. Otherwise, proceed.

33	Please select the types of organizations you have provided paid consulting services to in the last two years (Please check all that apply)	<input type="checkbox"/> For-profit	<input type="checkbox"/> Not-for-profit
		<input type="checkbox"/> In-state (local)	<input type="checkbox"/> Out-of-state
		<input type="checkbox"/> Small organizations	<input type="checkbox"/> Large organizations

34	Roughly, how many hours per month have you spent in the last two years consulting?	hours
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35	Please indicate (✓) the direction of your consulting activities over the next two years.	Increasing	Decreasing	Remain Unchanged

If you selected “Remain Unchanged”, skip to 40. If not, proceed to the next question

36	By how much do you see your consulting activities changing over the next two years?	<10%	10%-20%	> 20%

37	Would you be interested in consulting if you were approached?	Yes	No

38	In which of the following capacities have you been involved with at least one organization over the last two years? (Please check all that apply)	<input type="checkbox"/> Director/Advisor	<input type="checkbox"/> Manager
		<input type="checkbox"/> Investor	<input type="checkbox"/> Mentor
		<input type="checkbox"/> Other	<input type="checkbox"/> None

If you selected only “None” above, then proceed to 43.

39	If you have been involved in some way, please select the types of organizations with which you have been involved (Please check all that apply)	<input type="checkbox"/> For-profit	<input type="checkbox"/> Not-for-profit
		<input type="checkbox"/> In-state (local)	<input type="checkbox"/> Out-of-state
		<input type="checkbox"/> Small organizations	<input type="checkbox"/> Large organizations

40	Please indicate the direction of your involvement with these organizations over the next two years.	Increasing	Decreasing	Remain Unchanged

41	Would you be interested in serving as a director, advisor, mentor, manager or investor for a new company?	Yes	No

Thank you.