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## **RECRUITING AND TRAINING FUTURE SCIENTISTS: CONVERTING INTELLECTUAL CAPITAL INTO INTELLECTUAL PROPERTY**

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Recruiting and training graduate students is becoming ever more challenging and costly. Maintaining a competitive edge is difficult in states like Kansas where monetary resources are in short supply. As a result, Kansas State University is continually searching for areas of competitive advantage—unique experiences and educational opportunities that might interest motivated students as much as extra cash. One such area that is being explored currently involves the commercialization of intellectual property (IP). The infrastructure for IP commercialization that has been developed offers an opportunity for recruiting and training future scientists with interests in entrepreneurship.

### *The Bayh-Dole Act*

With the enactment of the Bayh-Dole Act in 1980, American universities have become increasingly involved in technology transfer—the protection and licensing of IP originating from the institutions' research endeavors. Prior to 1980, the federal government retained title to IP created on federally funded research projects, and the IP was lost to commercialization as a result. The Bayh-Dole Act changed that by allowing universities to retain title and requiring that commercialization efforts be explored. The federal government retains rights for use of the IP.

Most universities that have benefited financially from the Bayh-Dole Act have done so by patenting inventions emanating from the institution's sponsored research projects and licensing those inventions to major corporations. In optimal situations, the royalties and other revenues derived from those licenses exceed the expenses incurred in protecting and licensing the IP, but few such technology transfer operations are highly profitable.

### *K-State Technology Transfer*

Kansas State University has been involved in technology transfer for many years, and the KSU Research Foundation [KSURF, an affiliated 501(c)(3) founded in 1942] facilitates these efforts. IP created at K-State that has the potential to be protected, licensed, and commercialized is assigned to KSURF. However, because there is no way to predict with certainty which technologies

will be successful, a portfolio approach is used, i.e., technologies are screened for commercialization potential and the IP portfolio is “shopped” to potential licensees. Some technologies end up being licensed; some don’t.

Since 1995, KSURF has worked in collaboration with the Mid-America Commercialization Corporation [MACC], one of three innovation centers in the Kansas Technology Enterprise Corporation [KTEC] economic development network. The stakeholders that created MACC include KTEC, the City of Manhattan (with the Chamber of Commerce), and K-State. MACC’s mission is to promote technology-based economic development in Manhattan and the region, principally by facilitating technology transfer and the start-up of new, technology-based enterprises. To fulfill those tasks effectively, MACC must have access to K-State technologies with commercial potential, so teaming with KSURF was an obvious first step.

In the partnership that developed, MACC focuses on external activities by assisting KSURF in identifying potential licensees for K-State IP and negotiating the licensing terms on KSURF’s behalf. KSURF focuses on internal activities, primarily on identifying and protecting K-State IP and on managing the IP and license portfolios. In practice, though, the relationship between KSURF and MACC is transparent and seamless with staff from both entities working as a team across all interrelated activities.

During the early phases of the KSURF–MACC partnership, the traditional university approach to technology transfer was followed most often, whereby technologies are licensed to major corporations. There are problems with this approach, however, since most university research produces early-stage technologies that require significant investments in further development prior to successful commercialization. Many companies are reluctant to make these investments when they don’t have close working relationships with the inventors; K-State is at a disadvantage with so few major corporations nearby.

### *The TADAC Program*

Fortune 500 companies commercialize only a small portion—perhaps 5%—of the IP that they have created, often investing considerable resources in research and development along the way. The reasons are many and varied for so little being commercialized, but the result is that the economic potential of the IP is lost or significantly reduced. Therefore, MACC launched the Technology Acquisition, Development, and Commercialization [TADAC] program in 1998 to acquire dormant or underutilized corporate technologies by way of tax-deductible donations. The intent is to foster the further development and commercialization of IP in the TADAC portfolio for local, regional, and national economic gain. In some cases this may be done via cooperative research with K-State. The rationale for a company to donate a technology is based on the potential tax advantage that can ensue.

Since the inception of TADAC, more than ten Fortune 500 companies have provided technologies to MACC, with the resulting portfolio having a valuation for tax purposes at the time of donation around \$400 million. Comments from the IRS suggest that's about 40% of all patent donations nationally. The IP obtained to date falls generally in the categories of environmental quality, life sciences, information/communication, material science, manufacturing, and transportation. The technologies are available to scientists at K-State and other universities for research purposes, and they are available for licensing.

An example of a research opportunity emanating from the TADAC program involves an herbicide donation by *DuPont*. K-State agronomists have demonstrated extensive weed control for crabgrass and creeping bentgrass with the patented compounds. Corn and sunflowers are unaffected. The donated herbicide can be produced at low cost, and it can be applied at lower rates than many existing commercial products. As a result, the product offers significant commercial potential, and K-State research will be critical to realizing this potential. Accordingly, MACC is treating the technology in a manner similar to K-State technologies, with any royalty returns being shared with the researchers and their departments, as well as with KSURF.

### *Focusing on Start-up Companies*

KSURF and MACC have focused more attention in recent years on licensing to local start-up companies as an alternate approach to licensing to major corporations. This method directly addresses MACC's local economic development/job creation mission, and in many cases it offers greater potential for significant financial returns on K-State IP. However, it does so at greater financial risk.

In this alternate model, KSURF or TADAC supply the technologies upon which the venture is based, and MACC provides business leadership for the start-up until the company matures sufficiently to employ its own management team. Most entrepreneurship models nationally are deficient in this aspect, and MACC's role in this regard is critical to the success of the venture. When K-State IP is involved, the creator of the IP usually has some role in technology development within the company. By launching a venture with K-State IP, KSURF and MACC secure equity positions in the company based on their contributions. If TADAC IP is involved, KSURF may or may not have a role and an equity position.

One difficulty with company start-ups is that KSURF and MACC must defer repayment of their expenses for many years—or permanently if the venture fails, as many start-ups do. The investments by KSURF and MACC often amount to tens of thousands of dollars, so there is considerable risk in pursuing

this approach. Moreover, because of the magnitude of the investments and the associated risks, it is difficult to undertake a large number of start-up ventures simultaneously.

### *Launching Start-ups with SBIR Awards*

The federal Small Business Innovation Research [SBIR] program is a key component of the start-up company model that has developed, and without it, the commercialization of K-State IP locally would be nearly impossible. The intent of the SBIR program is to facilitate the development of early-stage technologies to allow their commercialization. As such, SBIR funds can serve some of the functions of very early stage seed capital but with the advantages of not diluting KSURF or MACC's equity positions or having to be repaid. SBIR Phase I awards provide up to \$100,000 for six months of work to establish proof of concept. Depending on the federal agency, Phase II awards provide from \$300,000 to \$750,000 or more for two years of additional development work.

K-State, KSURF, and MACC have been exploiting the SBIR program to launch local start-up ventures since 1996, and the cumulative funding from this source exceeds \$10 million. Initially, the start-ups may be "virtual" companies, having no dedicated facilities or company-paid employees. Procedures are in place to allow start-up company employees to conduct early portions of the work in K-State laboratories, with the costs for use of the facilities covered by the SBIR award. In the first ventures of this type, a new Kansas company was created for each different technology. However, because these efforts often fail at the proof of concept stage, a technology development company has now been created to facilitate these efforts—Kansas Advanced Technologies, LLC.

### *Role of the Technology Development Company*

**KANSAS ADVANCED TECHNOLOGIES [KATS], LLC.** — KATS serves as a technology development enterprise focused on securing early stage funding, primarily SBIR awards, for KSURF and TADAC IP. As technologies mature with the infusions of SBIR funding and other resources, decisions are made as to the future potential for commercialization. In some instances, it may be appropriate to license the enhanced technology to a major corporation. In other cases, rolling the technology out into a separate start-up venture is the better choice. Either way, the value of the IP will have been enhanced.

### *The KEC Technology Incubator*



The Kansas Entrepreneurial Center [KEC] serves as a business incubator, providing facilities and administrative support for technology-based start-up companies in Manhattan. The KEC is a controlled affiliate of MACC, with sponsorship by the City of

Manhattan, the Manhattan Chamber of Commerce, Riley County, Pottawatomie County, K-State, and the KSU Foundation. The offices of KSURF and MACC are located within the KEC at 1500 Hayes Drive, Manhattan, KS 66502-5068. In optimal situations, start-up ventures will mature and “graduate” from the KEC into larger facilities locally, in some cases to facilities in the K-State Research Park.

### *Start-up Company Overview*

Each start-up venture is unique. That said, in a “typical” scenario:

1. KSURF works with the K-State researcher(s) to patent a new invention;
2. KSURF, MACC, and the K-State inventor(s) determine whether a start-up venture is feasible and desirable;
3. MACC works with the K-State inventor(s) to develop one or more SBIR proposals;
4. A Phase I award is received by the company (normally KATS in the future);
5. The proof of concept work is carried out in the campus laboratories of the inventor(s) with facility use paid by the SBIR award;
6. A subsequent Phase II award is received by the company, and the project is moved from campus laboratories to the KEC; and
7. Venture capital and/or private investment money is obtained to move the development forward.

In most cases, recent K-State graduates are key staff on these start-up ventures.

### *The K-State Research Park*

The K-State Research Park was developed in 2001 to promote cooperative relationships between K-State and private individuals, companies, and corporations. The primary activities conducted in the Research Park must be related to the teaching, research, service, and/or technology transfer activities at K-State. The KSU Foundation and K-State are developing the Research Park in a cooperative effort. The land on which the Research Park is located is owned by the Foundation and is contiguous with the K-State campus on Manhattan Avenue. This provides a potential site for companies to move from the KEC.

### *Start-up Venture Capital*

MACC manages a seed capital investment fund, Manhattan Holdings, LLC, which can infuse early stage funding into new start-up ventures. This provides a source of funds for some costs not covered by SBIR awards. KTEC, the City of Manhattan, and the KSU Foundation are investors in this fund and, as a result, all share in returns on the investments. Monetary returns have already been realized on some early ventures.

## *Graduate Intern Program*

A graduate internship program has been developed at K-State to provide students with practical experience in technology transfer. Sponsored by the Graduate School as part of the MBA Technology Entrepreneurship track, a limited number of MBA interns are currently taking part. They are participating in various aspects of the process at K-State (receipt of grants and contracts and disclosure of IP), KSURF (protecting and licensing IP), and MACC (IP assessment and facilitating local start-ups). The program is being expanded to include graduate students from various science and engineering disciplines, so the number of interns participating in the program should grow substantially over the next few years.

## *KSURF IP Start-up Ventures*

**NANOSCALE MATERIALS, INC.** — *NanoScale* was the first start-up venture launched by KSURF and MACC, originally under the name of *Nantek*. Based on the work of University Distinguished Professor of Chemistry Ken Klabunde, *NanoScale* produces reactive nanoparticles with broad applications in environmental remediation and detoxification of hazardous chemical and biological agents. Started in 1995 as a virtual company, the first employee was hired in 1996 when an SBIR award was received. Since that time, *NanoScale* has received millions of dollars in SBIR awards and private venture funding; the company employs numerous K-State graduates. *NanoScale* moved into a newly constructed corporate headquarters and research facility in the K-State Research Park in 2002, becoming the anchor tenant there.



**AGRENEW, INC.** — *AgRenew* was organized in 1998 to develop and commercialize superior products and/or processes based on the use of agricultural waste products and byproducts. *AgRenew* presently has two primary commercialization targets. One is derived from the research of Dr. Susan Sun in the Department of Grain Science and Industry, and it involves composite products made from wheat straw and soy protein adhesives. The initial product is focused on edible, biodegradable containers for livestock feed supplements, and it is being developed in a strategic relationship with the industry leader in this field. The other target is derived from the research of Dr. Alex Mathews in the Department of Civil Engineering, and it involves the use of fermentation processes to produce environmentally benign, non-corrosive, biodegradable road deicers that can help protect the transportation infrastructure.

**NACELLE THERAPEUTICS, INC.** — *Nacelle* was incorporated in 2000 to develop and commercialize treatments for cystic fibrosis based on the research of Dr. John Tomich in the Department of Biochemistry and his collaborators at the University of Kansas Medical Center. Dr. Tomich's research team developed a novel family of transmembrane, ion channel forming peptides that show great promise for cystic fibrosis therapy. Current work at *Nacelle* is being undertaken with collaborators at the University of Alabama, Birmingham, who have developed specialized animal models to assess treatments for the disease.

#### *TADAC IP Start-up Ventures*

**NUTRIJOY, INC.** — Founded jointly by MACC and KSURF in 2000, *NutriJoy* was launched to commercialize a beverage technology from *Procter & Gamble*. The patented process allows milk protein and fruit juice to be mixed, yielding a shelf-stable product. One of the inventors, Dr. David Yang, was recruited from *P&G* to serve as the president of *NutriJoy*. *P&G* also included the rights to a proprietary calcium formulation that delivers a highly palatable calcium supplement that is more bio-available than any other form. It offers the only calcium nutritional supplement confirmed in clinical studies to increase bone mass in senior citizens. The first product taken to market by *NutriJoy* is *Cal-C*<sup>™</sup>, a calcium and vitamin C supplemented "smoothie" beverage available in four flavors. *Cal-C*<sup>™</sup> has shown strong customer satisfaction in marketing efforts launched in Kansas and Arizona. *Cal-C*<sup>™</sup> is also the subject of clinical research in K-State's Department of Human Nutrition to determine its effect on bone density in pre- and post-menopausal women.

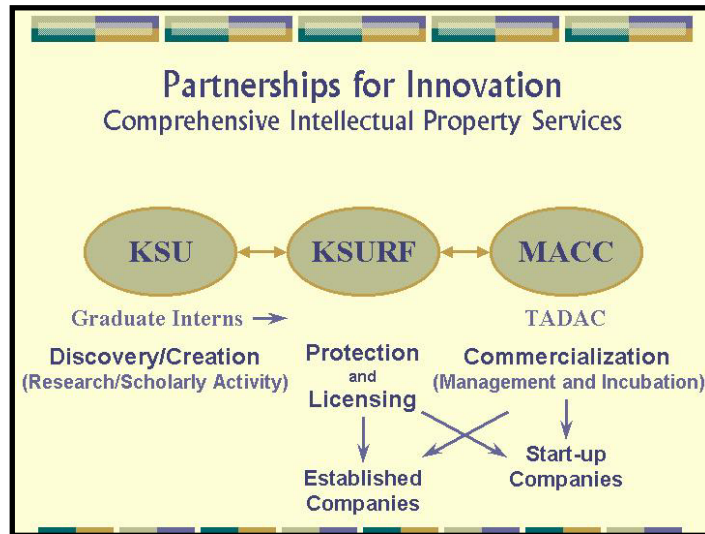


**COMPACT ENGINE COMPANY, INC.** — The *Compact Engine Company* was created in 2002 to pursue the further development and commercialization of the compact compression ignition [CCI] engine. The patent rights to the CCI engine were acquired via a donation from *Caterpillar*, and the exclusive rights are licensed to the *Compact Engine Company* — a "virtual" company initially, with no dedicated funding or paid employees. The opposed-piston compression ignition engine provides improvements in emissions, power density, fuel efficiency, size, weight, and fuel tolerance. While the CCI engine could fit any market from chainsaws to automobiles, a more immediate customer need has been identified in unmanned aerial vehicles for the Department of Defense. As a result, initial efforts are being focused there.

#### *Commercialization Overview*

The overall process for commercializing IP is summarized in the following flowchart. The discovery/creation of IP occurs within K-State or via donation in

the TADAC program. KSURF focuses on the protection and licensing of IP, while MACC concentrates on commercialization activities. The graduate interns can gain experience in all aspects.



### *Converting Intellectual Capital into IP*

At K-State, one new approach for recruiting and training future scientists is to offer graduate students the opportunity to participate in the varied technology transfer activities that are ongoing. Aspiring scientists with entrepreneurial interests have the opportunity to experience the full range of IP services and commercialization practices—from academic theory to real world applications. Although it is still too early to assess the overall success of the graduate intern program, the results to date appear promising. Hopefully, some of the would-be entrepreneurs will utilize the intellectual capital they bring to K-State to create IP they can then commercialize. That would be a definitive measure of success.

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