

# The KNEED Program: A Novel Model for Small High-Tech Business and University Cooperation

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**Abstract** – Initially, the vast majority of participants in the University of Kentucky’s engineering cooperative education program were placed outside the Commonwealth, primarily with large companies. Many of these students accepted positions with their co-op employers, leaving the state. To address this brain-drain, the Kentucky New Economy Engineering Development program was established. The program utilizes engineering / computer science co-ops to assist high-tech start-up companies within the state. For a prospective company, the KNEED program addresses their technical needs without requiring them to hire a full-time engineer by providing labor cost subsidies. In return, the company educates the student about the business and leadership aspects of running a small, tech enterprise. An objective of the program is to improve the participants’ understanding of running a company and increase their likelihood of accepting employment from such companies. The paper will present the motivations, implementation, peripheral support methods, and preliminary evaluation of the program.

*Keywords:* Cooperative Education, Co-op, Entrepreneurship, New Economy, Knowledge Economy

## INTRODUCTION

The cooperative education (co-op) model was created by Herman Schneider and first implemented at the University of Cincinnati in 1906. Since 1906, many derivatives of Schneider’s experiment can be found at the university, college and community college levels. The cooperative education model at the University of Kentucky is an optional model and is subscribed to by approximately 33% of the eligible engineering and computer science students. The program started formally in 1985, at which time roughly 80% of the co-op placements were outside of the Commonwealth of Kentucky and primarily with large companies or government labs. Many of these students accepted full-time positions with their co-op employer and consequently left the state.

To address this brain-drain and to encourage potential co-op students to consider employers who are within the state and are high-tech, small businesses, the Kentucky New Economy Engineering Development (KNEED) program was established at the University of Kentucky in 2003. Funded via a grant from the Kentucky Office of the New Economy (now the Department of Commercialization and Innovation), the KNEED program utilizes University of Kentucky engineering and computer science co-op students to assist small, high-tech start-up companies within the Commonwealth of Kentucky.

For a prospective high-tech company, the KNEED program can address their technical needs without requiring the company to hire a full-time equivalent (FTE) engineer or IT specialist. By subsidizing half of the KNEED co-op student’s wage, small, high-tech start-up companies can employ a full-time apprentice engineer or computer scientist

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at rates of \$7 – \$9 an hour. In return for the subsidy, the company educates the KNEED student about the business and leadership aspects of running a small, tech business. The KNEED student brings knowledge of and experience with engineering research conducted at the University of Kentucky to his or her employer. The KNEED student gains knowledge of and experience with pioneering industry and entrepreneurial practices.

An educational objective of the KNEED program is to have UK engineering and computer science graduates become more familiar with small, high-tech companies. By understanding the business and leadership aspects of running such a company, KNEED students will be less reticent to accept permanent job offers from high-tech start-up companies. Long-term goals of the program are for KNEED students to accept full-time jobs with their small, high-tech, co-op employer and, eventually, to start their own high-tech companies and create employment opportunities for future engineering and computer science graduates.

The following sections will discuss in detail the motives for starting the KNEED Program, the features of the program as implemented, the methods and avenues of program support, and a dialogue on the KNEED program's successes and shortcomings.

## **MOTIVATING A KNEED**

As we move forward in the 21<sup>st</sup> century, a number of names have been given to the economic paradigm shift we have undergone since the early 1990s. The continuing trend towards a “New Economy”, “Knowledge Economy”, or “Information Economy” has great implications on the need for and education of our high-tech workforce. As the principals of our economy continue to evolve, the Progressive Policy Institute (PPI) has attempted to identify the changes and measure the adaptive progress of the states. One critical economic change has been a shift in the typical sources of competitive advantage—from access to cheap inputs (raw materials, labor, transportation, available markets) to innovation-based productivity improvements [Atkinson, 1]. With an increased focus on the gains afforded from innovation, the most important assets for many firms are the innovators. The increased need for a talented workforce results in a new economic development strategy that requires leaders to focus on attracting skilled workers to live in their state rather than attracting businesses through incentives that reduce production input costs, a shift from “hunting and gathering” to “gardening” [Atkinson, 1]. It has been posed that a student's likelihood of enrolling in an engineering program of study is correlated to the student's perception of the personal financial gain resulting from a profession in engineering [Heckel, 4]. One can then infer that failing to attract and supply an educated, innovative workforce in a knowledge economy would lead to a decline in new economy job opportunities within the region and ultimately fuel a continued reduction in student enrollment in science, engineering, and technology degree programs, especially at institutions within one's region.

In examining the economy of Kentucky, the PPI found the following national rankings: 47<sup>th</sup> in workforce education, 47<sup>th</sup> in per capita scientists and engineers, and 42<sup>nd</sup> in knowledge economy jobs [Atkinson, 1]. These alarming metrics for Kentucky's knowledge economy contrast the metrics of its manufacturing economy: 10<sup>th</sup> in manufacturing workforce education, 12<sup>th</sup> in online manufacturers, and 13<sup>th</sup> in foreign investment [Atkinson, 1]. With all measures pointing towards an industrial economy, the state of Kentucky and its universities are faced with many challenges in attracting, recruiting and preparing the next generation of the information and technology workforce.

It is not surprising that from the dawn of the University of Kentucky's engineering cooperative education program in 1985 and into the early 1990s, approximately 80% of the student co-op placements were with large firms and government agencies outside of the state. Currently, it is estimated that 75% of the co-op students begin their professional careers with their co-op employers, one of many contributors to the brain-drain experienced throughout the state. Historically, roughly 75% of the college's engineering graduates initially find employment outside the state.

To address this brain-drain problem, a number of innovative approaches have been instituted that embrace entrepreneurship. The Kentucky New Economy Engineering Development (KNEED) program is one such endeavor. The authors' entrepreneurial Engineering Summer Program is a separate activity addressing this issue with Kentucky's high school students [Feinauer, 3], potentially creating a pipeline of future KNEED participants. It has been said that “the best form of university knowledge or technology transfer is a pair of shoes” [Bramwell, 2]. In this

spirit, the KNEED program attempts to bolster the entrepreneurial spirit within the college's student body all the while attracting innovators to start their endeavors in Kentucky and engage the university community through a labor cost incentive method.

### **KNEED, A BEST FIT**

The cooperative education program at the University of Kentucky's College of Engineering is a traditional, academic option for undergraduates and serves all seven departments of the college: Biosystems and Agricultural, Chemical and Materials, Civil, Electrical and Computer, Mechanical, and Mining Engineering as well as Computer Science. Students are eligible to begin participation in the program following their freshman year. Most co-op students work a total of three, full-time semesters alternating with semesters of study on campus, effectively extending their junior level coursework across two years while completing twelve months of on the job experience. As compensation for their work, UK co-op students see salaries ranging from \$10 to \$27 per hour with an average hourly compensation level of \$14 – \$18. The work assignments must compliment academic programs and must increase in challenge and responsibility as the participants progress through the program. It is desirable for both the students and the employers when co-ops complete all three terms, each of increasing difficulty and significance, with the same company. Students in the program retain full-time status while on work rotations by paying tuition for one hour of experiential credit.

Approximately one-third of UK's eligible engineering and computer science students elect to participate in the formal co-op program. Additionally, about one-third of our students work either part-time with local industry or find engineering / computer science related summer job opportunities or internships. Typically, ninety percent of UK's co-op graduates have received job offers before receiving their diplomas. The starting salaries of UK's engineering co-op graduates are consistently in the 75th percentile of starting salaries being reported nationwide by the National Association of Colleges and Employers. Upon graduation, approximately fifteen percent of co-op graduates continue their educations in pursuit of advanced degrees.

With access to such a reputable and accomplished cooperative education office, the KNEED program was established to operate through the cooperative education model as seamlessly as possible. High-tech, start-up engineering and computer science employers work through this office to establish a relationship and attract students as any prospective employer would. Through the office, the burgeoning companies are availed of the KNEED opportunity. On-the-job visits by our co-op staff, student debriefings upon completion of each co-op term, student work reports, student position appraisals and student performance evaluations by the employer are a few quality control measures in effect to ensure that a student's co-op experience is of value. The KNEED employers and co-op students are required to participate in these same activities. As such, the KNEED employer not only has first access to the Commonwealth's engineering and computer science talent, they also have access to the business and human resources experience of our co-op staff.

Although the KNEED employer's relationship is managed through the cooperative education office, the college's Associate Dean for Business and Innovations Management promotes the program and uses it to attract and support high-tech start-up companies throughout the state all the while increasing the number of co-op opportunities available to the college's student body. The program offers a prospective start-up first access to Kentucky's tech talent with a labor cost incentive by subsidizing half of the wage for the student employee. This incentive combined with the University of Kentucky's business incubator program as well as the possibility to access the college's faculty help create a more complete support system to attract or keep innovative companies in Kentucky.

In establishing the KNEED program, it was desirable to preserve the value of the co-op experience for the student. Most aspects of the KNEED employer / employee relationship are required to be on par with that of the more traditional co-op employers. However, due to the institutional models for business relationships and the university restrictions on funding and payments, the payroll distribution for the KNEED student had to be creative. Under the model, the co-op student receives payment based on half of his or her hourly wage directly from the KNEED employer on their payroll schedule. Under the formal co-op program guidelines, the student employee remains a full-time student throughout the work session. As such, the KNEED employee receives the remaining half of his or her compensation directly from the college of engineering as a student employee on the university's bi-weekly pay

schedule. This method minimizes the “red-tape” and also minimizes the overhead expenses of the support. Assuming the KNEED student is compensated at the average level among the various disciplines, the subsidy will cost \$7 – \$9 per hour with an associated total cost of \$14,560 to \$18,720 for a student completing three co-op work terms. To date, 14 students have completed 21 co-op work rotations through the KNEED program.

All reports of student work experience with KNEED employers have revealed that the students are most definitely engaged in meaningful engineering projects and experiencing hands-on involvement in cutting-edge industry endeavors, perhaps even more-so than they would experience with larger corporations. In addition, the students become more familiar with the many aspects and requirements of running a successful business. It is the intention of the program that this experience and mentoring relationship will serve a number of purposes: first, to increase the likelihood of the student to consider a job opportunity from a less secure company or in a burgeoning industry; second, to increase the likelihood of the student to eventually start his or her own company, increasing high-tech job opportunities for future generations in this state; and lastly, to generally increase the entrepreneurial spirit and discussion throughout the college of engineering.

The basic contract signed by both the employer and KNEED co-op student is simple in nature. In addition to the requisite contact information, there is a section about the size, history and nature of the prospective company. This is to ensure that the company qualifies for the KNEED program and that there is sufficient technical content in the core business of the company to warrant a full-time co-op student. The remaining part of the KNEED contract concerns the technical, business and leadership assignments that the KNEED student is expected to experience during the semester tour. The following is an excerpt from this last section (3<sup>rd</sup> part) of the contract:

### *III. Planned Technical and Business Student Activities*

- *Provide a list of the technical tasks / assignments expected to be accomplished during the 15– week co-op session.*
- *Provide a list of the non-technical student enhancement activities related to the operation of a small business intended for the 15-week co-op session.*

Examples of non-technical enhancement activities vary from writing portions of SBIR proposals to weekly business and executive planning meetings to seminars and workshops on business and leadership.

## **IN KNEED OF SUPPORT**

The KNEED program was initially funded by a development grant from the Kentucky Office of the New Economy, an agency appointed to address the changing aspects of a knowledge based economy throughout the state of Kentucky. That office has since become the Department of Commercialization and Innovation and has continued to support the KNEED program. With the volatility that is characteristic of politically derived funding sources, it is the hope of the authors that the program will receive continued support.

While it is the goal of the KNEED program to have the participants bring an excitement and aptitude for the business and technical aspects of running a small, high-tech company, it is important to create an environment that will foster this entrepreneurial spirit as the students return from their co-op placements. Students at the University of Kentucky have access to a wide entrepreneurial support system through an entrepreneurial student organization (the E-club), an on campus business incubator and a university center for entrepreneurship as well as access to the community venture and IT forums and organizations. The KNEED program coordinator works with the KNEED students and employers to connect them to these resources, furthering a network of support that can increase the likelihood of success for both the start-up company and the KNEED program.

However, many of the KNEED students initially found networking with business owners and community leaders daunting. As a result, the KNEED program committed support to a number of university-wide events geared specifically at students and the university community. In the winter of 2005, the KNEED program co-sponsored a university-wide, intensive workshop designed to instruct students on the process of assessing, developing and proposing business ventures. The outcome of the workshop was the creation of a number of entrepreneurial teams to participate in the University of Kentucky Idea Fair. In addition to supporting the *Venture Quest<sup>TM</sup>* workshop, the

program funded the enrollment of KNEED students interested in participating. Subsequently, the program co-sponsored a National Collegiate Inventors and Innovators Alliance (NCIIA) *Invention to Venture* workshop and subsidized the enrollment fees for KNEED participants to attend. The paper authors have also provided the university community with a number of workshops on idea generation and business idea assessment. The goals of all of these programs are to enhance the entrepreneurial activities on the University of Kentucky's campus, to continue to engage the KNEED co-op students in entrepreneurial activities during their academic term and to create opportunities for the KNEED participants to network with other students, transferring their knowledge and recruiting future students into the program pipeline.

## MEETING A KNEED

As the KNEED program approaches its fifth anniversary, a comprehensive review of the program is being conducted. At the time of this paper, all survey responses from both students and employers have been overwhelmingly positive. However, the limited number of program participants compounded with the current survey response level necessitates an anecdotal discussion of the program and its successes that is based on personal responses from individual student and entrepreneurial business owner participants who received support through the KNEED program.

When asked to reflect about his experience on a KNEED co-op rotation, one student stated, "After a previous job experience, I decided to look for another co-op position so that my electrical engineering knowledge and skills could be used. It was important to me for this co-op to actually allow me the opportunity to gain valid experience so that I could grow as an engineer in order to kick-start my career. This is when [KNEED company] was brought to my attention as a possibility for my next co-op tour... [On that tour] I, being one of only three engineers at the time, was handed that task and had to design, implement, and test the system on my own as a respected design engineer. It was that experience which not only helped me to decide the direction I wanted to take with my electrical engineering career but has given me the knowledge and confidence to become a lead embedded / electrical engineer in a private, start-up space company."

Another KNEED student, working with a very small, Kentucky-based biomedical company, stated the following, "Participating in the KNEED program provided valuable assistance and experience to my employer and me respectively. Through the program, I was able to perform hands on work in my area of interest as well as learn the business model and processes as a whole."

One student commented about his inclination to start his own business, "Yes, I am more likely to start my own company as a result of my KNEED experience. Actually, I helped my wife and a friend start up a small venture. Our friend also has two small businesses, so our experiences made the initial "jump" less rough and should help us prosper in the future. I currently work at [company] in Versailles, Kentucky, a small business who designs, manufactures, and sells electric transformers. I work in the marketing / engineering department and am able to apply many of the principles I learned during my KNEED experience (new product development, marketability, scalability, etc.)."

A KNEED employer/entrepreneur stated, "[My company] benefited from the KNEED program through financial support for two cooperative education students from the University of Kentucky's College of Engineering for a total of three semesters from the fall of 2003 through December 2004. These students are excellent future engineers who contributed significantly to [my company's] goals. Both leveraged their cooperative education experiences to secure high quality industry positions after completing their degrees. The KNEED program has been a welcomed support mechanism for [my company] as project budgets are often tight. The salary support provided by the program has allowed [my company] to provide co-op opportunities that may not have been otherwise possible." The employer credited the program as a contributing factor to his company's expansion as follows, "[My company] could not have expanded if it were not for the KNEED program. I am an engineer by training and was doing all the engineering and technical development for my biomedical-based company. While there were business opportunities to pursue, because of a lack of technical assistance, I could not commit to pursuing these and growing my business. Through the KNEED program, I was able to hire a near-engineer who was very enthusiastic and trainable on the current projects in my company. This gave me the bandwidth to pursue new technical projects and grow my business."

The KNEED employers were also asked to comment on the technical and business aspects of the projects and experiences afforded to the co-op students through the KNEED program as well as the perceived value of the projects in terms of student development. One employer commented, "Clearly, my company benefited from the KNEED program. But I also feel that the KNEED students benefited greatly. For example, the initial project that I gave to my KNEED student was written about in an IEEE student paper contest by the KNEED student. The student won first place in the contest and received significant remuneration as a result. I hasten to add that the KNEED student also received and accepted a full-time employment offer at the time of his graduation. This was partially due to the growth and expansion of my company as a result of the KNEED program but also due to the student becoming not only an integral technical resource for my company but also due to his business savvy and leadership skill both of which were greatly enhanced during his KNEED experience." The employer provided specific details on the projects completed by the co-op students and noted that, "[My company's] co-op students are given responsibilities to do "real" engineering work, which challenges them to apply their classroom knowledge and often learn new skills that have not been covered in class work. Students additionally experience a greater breadth of work in the small company environment, including software, hardware, prototype fabrication, and evaluation. Students are provided ample support and exposure to experienced engineers to assist with project work and career guidance. Additionally, students are exposed to an atmosphere where they observe business operations such as fund raising, contract negotiation, purchasing, accounting, recruiting/hiring, and client interaction on a daily basis."

Lastly, to highlight the current sentiment for the KNEED program that the authors are identifying in the survey responses, one student commented, "It's my pleasure to fill out your survey. I believe the KNEED program was and is a great program to place engineering students into a hands-on environment where their engineering skills are needed, enhanced, and respected. If you ever need any help to continue this program or for any other endeavor, please just let me know."

In summary, as the KNEED program approaches its fifth anniversary, a few things are quite evident. The KNEED program should be considered as a model for engineering colleges and schools that have a traditional co-op program in which most students want and accept tours with large, established corporations. With the vast majority of co-op students receiving job opportunities directly from their respective co-op employers, methods for addressing a "brain drain" problem should involve increasing the number of regional co-op opportunities. If the school is in a rural state (such as Kentucky) and there is an interest in growing and recruiting high-tech companies, the KNEED program can especially benefit students who want to stay local and experience more than working on a small part of a large project. Our results indicate that such students appear more likely to work for a smaller company than typical co-op students and that the small companies greatly benefit from the student tours, even more so than traditional co-op employers. Currently, the KNEED program is actively seeking a renewal of its program funding and the authors hope to report success in this quest at the time of the presentation of this paper.

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David received his BSEE degree from the University of Kentucky in 2003. As an undergraduate, he was honored as the outstanding junior and senior in the Electrical & Computer Engineering Department. David is currently pursuing his Ph.D. at UK in the area of symbolic controls. As a graduate student, he has served as a research, graduate and teaching assistant, and co-authored seven research publications. David currently serves as the ECE department's

representative to UK's Graduate Student Congress. He has served as the IEEE Student Branch Chair, and is a recipient of three graduate fellowships. David is the co-founder and Associate Director of UK's entrepreneurial Engineering Summer Program. His academic interests include: educational and community outreach; entrepreneurial education and tech transfer; and control design specifications that incorporate logic or decision-making.

#### **Donna Hewett**

Donna Hewett received both her Bachelor of Science and her Master of Mathematical Education degrees from the University of Kentucky. Shortly after receiving her masters degree, Donna was hired by the College of Engineering at the University of Kentucky to start a formal Cooperative Education program in 1984. She served as Director of the University of Kentucky co-op program until 2007 when she returned to her roots of mathematics education. This past Fall, Donna taught two sections of Calculus to at risk students in the College of Engineering, the results of which will appear in a future ASEE article. In her spare time, Donna enjoys owning and riding horses in the horse capitol of the world, Lexington, Kentucky.

#### **Bruce Lanier Walcott**

Bruce Lanier Walcott received his BSEE, MSEE, and Ph.D. from Purdue University. Since 1987 he has been on the faculty at the University of Kentucky where he is currently Associate Dean of Commercialization and Economic Development and is the first ever College of Engineering Alumni Professor. He is the college's advisor to the University of Kentucky Entrepreneurs Club, Tau Beta Pi, Triangle Fraternity, and the Society of Hispanic Engineers; he oversees entrepreneurial and economic development activities and initiatives within the college. He recently assumed the role of Director for the UK Center for Manufacturing and is also the co-founder of the UK Center for Visualization and Virtual Environments. He started the New Economy living-learning community for engineering and business majors at UK, which includes a unique "Entrepreneurial Engineer In-Residence" program.