AC 2012-4890: THE HELPING HANDS DENSE NETWORK: A COLLABORATION ACROSS MULTIPLE UNIVERSITIES

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The Helping Hands Dense Network – A Collaboration Across Multiple Universities

Inspired by the Kern Entrepreneurship Education Network's (KEEN) mission of educating a new type of entrepreneurially minded engineer who will "catalyze a transformation in the workforce and build economic and technical commerce in their communities,"[1] four member universities of the KEEN joined together to form the Helping Hands Dense Network (HHDN) with a three-year plan of work that:

- Leverages industry ties to develop a deep understanding of intrapreneurship and develop collaborative intrapreneurship end-to-end education (IE3) curricula that will enrich the student learning experience
- Employs intercollegiate student projects (ISP) that are impactful and multi-disciplinary, with diverse student teams as a central element of an exciting new intrapreneurial culture

The IE3 curriculum development will be led by two of the institutions (Baylor University and University of Detroit Mercy) and will consist of:

- An in-depth study of intrapreneurship
- Development of three modules on innovation in a corporate context
- Creation and presentation of a seminar series, and
- An intrapreneurship-focused opportunity evaluation and venture planning course/workshop called Corporate Intrapreneurship Training (CIT).

The ISP features the development, piloting, and assessment of three types of student project structures and will be led by the other two HHDN institutions (University of Dayton and Villanova University):

- Identical projects run in parallel at each participating school
- Projects where the team members themselves are distributed
- Projects that distribute tasks among teams at each school

Together, these objectives cover most of the experience of turning an unrecognized market need into a product within an established company. In particular, they impart in the students the skills associated with need identification, ideation, conceptual design and refinement, and business analysis as well as detailed design and development. Additionally, this work will develop in the students a wide range of soft skills and professional attributes associated with entrepreneurial engineering and measured using the KEEN-TTI Performance DNA[2]. Just as important, the proposed work will provide the students with a sophisticated understanding of the various corporate cultures as they relate to innovation and intrapreneurship.

This paper will document the design and development of the HHDN, as well as the early implementation of the dense network.

Introduction

Imagine a highly creative, multidisciplinary team of professionals who can collectively recognize the complex patterns and opportunities in the global economy, and who can develop compelling strategies for capitalizing on these opportunities. Imagine a team of people with strong interpersonal skills, language skills, and knowledge of the cultural nuances between countries and regions. Imagine a team of engineering professionals who are not only technically competent, but are also self-directed learners, capable of staying abreast of the rapidly changing technological landscape.[3] According to the National Academy of Engineering Summit Series on the Grand Challenges, these are exactly the type of engineering professionals that undergraduate engineering programs need to train.[4] The challenge then becomes, how do Universities do that while working under the well-known constraints in engineering education: few free electives, little flexibility in schedule, and a financial goal of graduating students in 4 years?

Baylor University, the University of Dayton, the University of Detroit Mercy, and Villanova University, all members of the Kern Entrepreneurship Education Network (KEEN), are building a dense network, the Helping Hands Dense Network (HHDN), based on the concept put forth in James Davison Hunter's book, "To Change the World". Hunter asserts that cultures are changed from the top down and center out through networks of institutions that define the terms and frame the issues of culture change.[5] Sarah Miller Caldicott, in the March 1, 2011 feature blog of the Marketing Executives Networking Group, further states that "It turns out dense networks are crucial for driving change – both how to drive it and how to lead it."[6] Our objective as a dense network is to leverage each other's core competencies to overcome some of the challenges faced in undergraduate engineering programs so that we, as a dense network, can drive many of the changes required to produce the engineers the United States needs to maintain its place as a leader in engineering innovation.

The Formation of the HHDN

According to the Program Director of the Kern Entrepreneurship Education Network, in his recollection of the genesis of the idea to catalyze a dense-network funding strategy within the KEEN:

> *"With the special insights provided by Hunter regarding the concept of dense networks, the KEEN Program Director approached the Foundation president and key board members in testing the notion of whether KEEN could create a novel dense-network funding strategy. The strategy would be that a group of three to six schools would come to the Foundation together to pitch a proposal that would show synergy between the schools. The condition of funding would be that all schools would be funded or none would be funded. This places responsibility of the more KEEN-mature institutions to bring along the newer, less mature universities to raise them to a level of quality that would deserve funding. Further, it would help the institutions identify their own core competencies that would benefit the other members in the dense network of schools."*[7]

The Helping Hands Dense Network was initiated within a one-hour period during the 2010 KEEN Fall conference. The objectives of the one-hour workshop were:

- To identify other like-minded institutions who share common goals and values,

- To identify each institution's s strengths to determine the optimal plan to leverage those strengths,
- To put together a compelling one-minute presentation of vision, mission, and objectives of the newly formed dense network, and
- To present a joint vision to the Program Director, Program Associate, and key board members of the Kern Family Foundation

Upon review of the results, two of the networks were chosen to move forward, develop a detailed proposal of the vision, mission, and objectives, and to present this proposal to Mr. and Mrs. Kern and members of the Foundation's Board of Directors. Under the design of this experiment, the funding decision would be all or nothing. The HHDN was one of the two networks chosen.

At the January 2011 Annual KEEN Winter Conference, in Tempe, Arizona, the five HHDN institutions met to discuss the opportunity to participate in this innovative experiment. In March 2011, the first of two regional conferences was held at the University of Dayton, to begin the forming process. At this meeting, the objective was to come away with the vision, mission, and objectives of the HHDN. After much discussion of on-going activities at each institution, a preliminary list of seven objectives were developed:

- Creation of a dense network of KEEN Faculty Fellows
- Creation of Teaching Teaming
- Establishment of Sustainable Leadership for Institutions
- Intrapreneurship Study
- Development of Collaborative Educational Models
- Design and Execution of Multi-school Projects
- Assessment of HHDN Activities

Although each of these objectives were strongly supported, upon further consideration and under the guidance of both the Program Manager and one of the KEEN Advisors, these seven objectives were weighed and shaped, giving them a laser focus on the vision of the HHDN, "to create engineering graduates who are world changers and who direct projects that change the world," with the result that the best, most effective components of these seven objectives became the two objectives that are part of the current effort.

This storming process took place at the second regional conference of the HHDN in April 2011, at Baylor University. When we began the April meeting we had five universities on this project. It was already clear to everyone else that one of the team member's contributions did not fit the HHDN focus as closely as the other schools. Our potential funding source made it clear that they would either fund all of the universities in the proposal or none of them. This made it important that each university be a relatively equal contributor to the project. Upon a strong recommendation from the consultant, the reluctant decision was made to decrease the number of participating universities from five to four.

Over the next several months, participants from all four universities worked tirelessly to put together a 75-page proposal that included:

- HHDN Vision, Mission, and Objectives
- Position Paper for the two objectives

- Detailed Project Plan for all objectives and sub-objectives
- Detailed Budget for the HHDN proposal
- Individual proposals from each institution to continue the momentum gained from past and current KEEN funding
- Detailed matching funds budgets for each institution

The final proposal was delivered to the Foundation on July 20, 2011, with the presentation of the HHDN proposal to the Kern's and Board Members from the Foundation on August 12, 2011. The decision to fund the HHDN came in late October, with a start date of November 15, 2011.

Igniting an Entrepreneurially-Minded Culture in Undergraduate Engineering: A Dense Network Approach

Inspired by the KEEN mission of educating a new type of entrepreneurially minded engineers who will "catalyze a transformation in the workforce and build economic and technical commerce in their communities," the four member universities (Baylor University, University of Dayton, University of Detroit Mercy, and Villanova University) have joined together to form the Helping Hands Dense Network (HHDN) and to propose a three year plan of work that educates engineers who are capable of strongly contributing to the entrepreneurial/innovative cultures of the companies where they work.

Vision

In seeking to affect a positive change of culture in the way engineers are educated and in the world that will be shaped by these practicing engineers, the HHDN will be guided by the following vision statement: **The HHDN schools will work together to create engineering graduates who are world changers and who direct projects that change the world.**

Mission

The HHDN will transform and sustain a culture of entrepreneurial-mindedness that originates within its member institutions and propagates to industry and corporate America through active and collaborative cooperation between its member universities and local, national, and global industries.

To that end, the HHDN will create, validate, and widely share a new, sustainable, educational model that impacts every student producing entrepreneurially-minded engineers with a servant leader mindset by:

- Creating mutual value for students and clients through innovative multi-disciplinary intrapreneurial engagements, positively impacting the American economy in the process
- Demonstrating voluntary social responsibility through a focus on developing each student's character and sense of calling
- Demonstrating the relationship of personal liberties and free enterprise to entrepreneurship by enabling students and faculty to test their vocation in real-world, experiential learning environments

Objectives

The HHDN member institutions seek to create an improved learning environment for the students. Toward that end, the HHDN member institutions will tap the collective energies and skills of their various constituencies including faculty, students, alumni, and industry connections in support of the following objectives:

- Leverage industry ties to develop a deep understanding of intrapreneurship, develop collaborative **intrapreneurship end-to-end education (IE3)** curricula that will enrich the student learning experience
- Employ **intercollegiate student projects (ISP)** that are impactful and multi-disciplinary, with diverse student teams as a central element of an exciting new intrapreneurial culture

The Intrapreneurship End-to-End Education (IE3) Objective

The IE3 work will proceed along the two complementing tracks of intrapreneurial curriculum development and intercollegiate student projects. The intrapreneurial curriculum development consists of:

- An in-depth study of intrapreneurship
- Three modules on innovation in a corporate context
- A seminar series
- An Intrapreneurship-focused opportunity evaluation and venture planning course/workshop called Corporate Intrapreneurship Training (CIT)

The IE3 objective is spearheaded by Baylor University and the University of Detroit Mercy. The ISP objective, which features development, piloting, and assessment of three types of student project structures, will be led by Villanova University and the University of Dayton. It is important to note that there is direct involvement of investigators from all four HHDN member institutions in all development work.

This project will result in better equipping HHDN and KEEN graduates with the confidence and skills to be innovative and intrapreneurial in a variety of industrial and corporate work environments. The work will provide the students with the hard skills as well as many experiential learning opportunities to help them develop the soft skills and professional attributes necessary for career success.

Figure 1 presents intrapreneurship in the well-known funnel and gauntlet model and shows that the HHDN project will cover the entire experience of turning an unrecognized market need into a product within an established company.

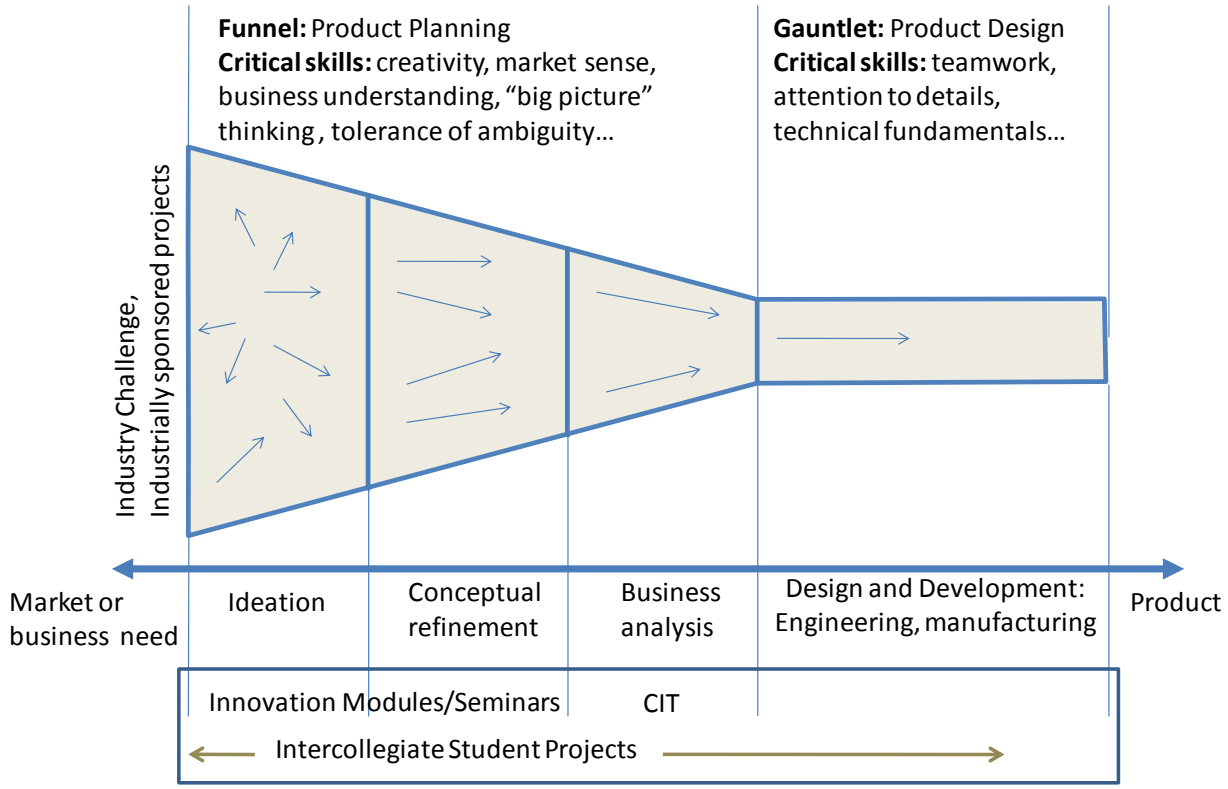

Figure 1–The HHDN project's contribution to exposing the student to all aspects of intrapreneurship, shown here in the funnel and gauntlet model form.

Currently, the learning objectives outline above are met in part and to varying degrees by the HHDN partners, primarily through real-world capstone project experiences. The HHDN partners will leverage their industry outreach to conduct an **in-depth study of intrapreneurship** to precisely define the educational outcomes listed above and map them to a generic engineering curriculum. The HHDN partners will also synthesize their combined experience and practices in industry-connected, project-based learning to create a proven, scalable and transferable set of tools for the proper evaluation of intrapreneurial ventures. This set of tools will be called the **Corporate Intrapreneurship Training (CIT)** and will be structured as a stand-alone capstone course or an eight to ten lecture workshop for incorporation into existing courses throughout the engineering curricula. The plan of work involves the creation of three **instructional modules and video based case studies** on the subjects of product, process and disruptive innovations. Also, the HHDN partners propose to augment the curricular elements by conducting a monthly **internetwork intrapreneurial seminar** series that covers the seven KEEN outcomes:[8]

1. Effectively collaborate in a team setting
2. Apply critical and creative thinking to ambiguous problems
3. Construct and effectively communicate a customer-appropriate value proposition
4. Persist through and learn from failure
5. Effectively manage projects through appropriate commercialization or final delivery process
6. Demonstrate voluntary social responsibility
7. Relate personal liberties and free enterprise to entrepreneurship.

The Intercollegiate Student Projects Objective

Under the proposed three-year effort, several intercollegiate student projects will be piloted and assessed. The student projects will be conducted using three different methods, as described later in this document, to provide effective and exciting student project experiences. Each method will be assessed and refined. The results of the assessments will be published.

A key objective of the proposed initiative will be to develop, pilot, and assess methods to execute highly effective collaborative distributed student projects.

A second key objective of the proposed effort is to use the strength of the KEEN, specifically the industrial relationships found through HHDN and KEEN, to create distributed collaborative industrial student projects, to execute them, and to assess their value to the entrepreneurially minded KEEN engineering student.

While Intercollegiate Senior Capstone Projects will be piloted under the proposed effort, any engineering student project in any course can employ the intercollegiate practices, so that 100% of the engineering student in every KEEN school will be able to benefit from the results of this effort multiple times throughout their college careers.

The Intercollegiate Student Projects will enrich the entrepreneurial and engineering experience of the undergraduate engineering students by developing methods to successfully perform impactful student projects across the HHDN; by helping the students discover opportunities to create industry inspired real-world projects; by piloting a number of such projects throughout the HHDN; and by demonstrating how such projects can be successfully implemented throughout the entire KEEN network.

More specifically:

- **Methods will be developed** to perform three types of undergraduate student projects over the HHDN (the three types of projects are described in a later section)
- For each of the **three types of projects**, samples of impactful, though high probability of success, projects will be designed
- Each of the three types of **projects will be piloted**
- **Assessment** of each of the types of projects will made
- **Lessons learned** will be shared with the KEEN schools

In addition to piloting four intercollegiate student projects, during the first year, a number of supporting elements will be created, such as:

- Project selection criteria
- Team formation and team building techniques across universities
- A collection of standard procedural and legal documents, including non-disclosure agreements, tuition agreements, liability, project sponsor agreements, intellectual property agreements, descriptions of student/mentor/client responsibilities

- A website for the proposed effort and a collaboration web site for use by students, faculty and all those involved in the inter-project student projects
- A directory of network-wide skills to assist in tasks from supervising the projects to providing subject matter experts (SMEs)
- A directory of network-wide resources such as 3D printers, printed circuit fabrication, and machine shops
- Assessment instruments
- A handbook of best practices providing guidance in recruiting and maintaining industrial sponsors to insure that the intercollegiate projects program is sustainable for years to come

The Three Types of Projects

The three types of undergraduate student projects under the proposed effort are:

- Type 1—identical projects run in parallel at each participating school
- Type 2—projects where the team members themselves are distributed
- Type 3—projects that distribute tasks among teams at each school

These project types have been chosen because, based on our experience, they mirror the work environments into which our graduates will move and where they will apply their particular entrepreneurial mindset.

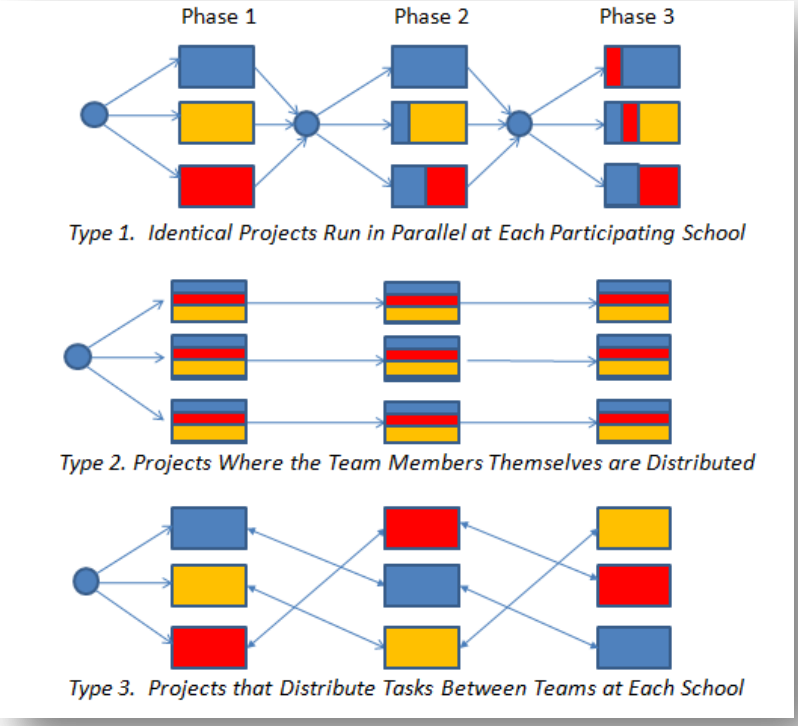

Figure 2–The Nature of the Three Types of Projects

Early Implementation of the HHDN

One of the truly remarkable outcomes of the HHDN development process was the development of collaborative ideas that would happen with or without external funding. There were good ideas, and these ideas would be fun for students from multiple institutions to implement. Two pilots of the ISP objective were conducted between Dayton and Villanova before a funding decision was known. Similarly, with the intrapreneurship study team, one of the first of the IE3 sub-objectives, was begun at the HHDN Kickoff Meeting at Villanova University in November 2011. The Corporate Intrapreneurship Training (CIT) workshop was planned and deployed for three of the four HHDN institutions. In addition, the work with assessment progressed nicely.

Assessment

The principal goal of this dense network is the creation and education of entrepreneurially-minded engineers. That education is guided by the KEEN pyramid and defined by the seven KEEN outcomes. As these outcomes are rooted in social sciences and involve human behavior within environmental and cultural contexts, a sophisticated assessment tool was needed. This was seen as important for the entire KEEN network and not just our own smaller dense network.

The Target Training International (TTI) Performance DNA methodology was chosen for its ability to provide deep insight into a person's:

- Competencies (23 job related aptitudes such as teamwork, diplomacy, empathy)
- Behaviors (how one interacts with others and with one's environment)
- Motivations (these are the why's behind one's actions)[9]

We have begun administering this assessment to the freshmen, juniors, and seniors in our program, and the initial results are promising.[6] We currently have data from two years of freshmen, and by the end of spring 2012 we will also have data from two years of juniors and seniors. While this data will provide us a snapshot of where we are at the present time, it is hoped that we will see changes in students' perspectives and behavior over the course of their four years at the university. The wider KEEN network is also seeking to have practicing engineers to take this assessment as a standard from which to compare.

The KEEN-TTI Performance DNA assessment data will be used, along with other standard assessment tools as used by the individual institutions to answer the following three questions:

- How effective are the intrapreneurship curricular elements and intercollegiate projects at creating entrepreneurially-minded engineers?
- How effective are the intrapreneurship curricular elements and intercollegiate projects from a pedagogical perspective?
- How successful are the HHDN students when viewed through an intrapreneurship lens?

Beta-test of ISP

During the fall 2011 semester, the University of Dayton and Villanova University piloted the intercollegiate student projects objectives by having students from both institutions work on two projects. One project was from Villanova University, sponsored by the National Basketball

Association (NBA), who desired a design for a way for the athletes to become more aware of the shot clock throughout game play. The other project was from the University of Dayton, sponsored by the Air Force Research Labs, who contracted for a design to allow soldiers to quickly, stealthily, efficiently scale a nine-foot wall.

The two critical outcomes from this pilot included:

1. Students from different institutions need more face-to-face interaction. For subsequent ISP projects, we will kick off projects with a meeting of all participants, so everyone has a chance to get to know each other.
2. Students from different institutions need more virtual interaction. We must enable that and force that, to make sure all work elements are on track

For the spring 2012 semester, several more projects will be shared between the students of Dayton and Villanova. In the spring of 2013, both Baylor and Detroit Mercy will add student teams to these projects. In preparation for these, a fall planning meeting will be held to discuss projects, project selection, team selection, "external" (i.e., outside the immediately participating institutions) assessment of the work, as well as how to handle the way that University of Detroit Mercy students must complete their capstone project.

Formation of Intrapreneurship Study Team (IST)

At the HHDN Kick off meeting in November 2011, the Intrapreneurship Study Team (IST) was formed under the leadership of Dean Leo Hanifin from the University of Detroit Mercy, who had developed a draft Intrapreneurship Team charter. This charter is meant to explain the purpose of the Intrapreneurship Team, and to be one of the mechanisms by which corporate members join the Intrapreneurship Team. The IST is currently working on the Intrapreneurship Team membership and the Intrapreneurship Engagement Plan.

Corporate Intrapreneurship Training (CIT) Workshop for HHDN Members

The CIT workshop, designed and developed by Baylor University as part of a KEEN Planning grant and using the SuperCoach® coaching-based commercialization training as a baseline, is a four-day intensive workshop that walks participants through the process of vetting a technology-related idea from many different perspectives (Intellectual Property, Project/Product Planning, Operations Planning, Manufacturing Planning, Financial Planning, etc.). Each team is comprised of a representative from the company whose tech-related venture is being studied, as well as the team of student coaches who will coach them and their project through the process. Three of the four HHDN institutions sent a faculty member, corporate partner, and students to participate in the December 2011 CIT beta workshop. The plan is to offer a four-day workshop to all HHDN institutional teams in May 2012, as we prepare for intercollegiate student projects in fall 2012 and spring 2013.

Once the ideation phase has occurred, and conceptual designs have been selected, the CIT workshop's objective will be to identify any barriers to entry in the marketplace. It is envisioned that this will occur before projects go into final design.

Next Steps / Summary

The HHDN has just begun its official execution, but based on the preliminary work already completed, the outlook is excellent for a series of deliverables that are battle-tested and ready to be deployed to the rest of the KEEN. Here, at the beginning, the HHDN must establish rules by which all members will work and collaborate. The sooner this is done, the quicker we minimize the possibility of misunderstanding and miscommunication. The HHDN will meet face-to-face every 2-3 months, in conjunction with another meeting to which all members usually attend.

Looking back at what has been accomplished, we are quite hopeful for the future. In the halls of academe, it is unusual to see this level of intercollegiate cooperation, and considering the efforts that have gone into the forming, storming, and norming of the HHDN to date, we are very enthusiastic about the approach taken to leverage each other's strengths to bring an extraordinarily rich and substantive experience to all of our students.

The mission of each of our schools closely aligns with that of the Kern Family Foundation's mission "to enrich the lives of others by promoting strong pastoral leadership, educational excellence, and high quality, innovative engineering talent." Further, the HHDN institutions' focus on innovation and leadership is evident throughout the students' curricular, co-curricular, and extra-curricular experience. The outcome of this synergistic intercollegiate proposal will further expose and empower our students to graduate from our engineering programs, immediately ready to integrate, excel, and lead in a corporate/industrial environment.

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[1] The Kern Family Foundation website, Kern Entrepreneurship Education Network (KEEN) mission, last accessed January 11, 2012 (http://www.kffdn.org/default.asp?L1=InnovationPrograms&L2=KEEN)

[2] "Assessing the Entrepreneurial Mindset in Undergraduate Engineering Education: New Methods and Emerging Practices in the Kern Entrepreneurship Education Network," D. Pistrui, NCIIA REE USA Conference, Washington, D.C., March 26, 2011

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[4] National Academy of Engineering of the National Academies, Summit Series on the Grand Challenges, (http://www.engineeringchallenges.org/)

[5] *"To Change the World: The Irony, Tragedy, and Possibility of Christianity in the Late Modern World*," James Davison Hunter, Oxford University Press, USA, Copyright 2010.

[6] "Need to Drive Change? Form a Dense Network," S.M. Caldicott, Marketing Executives Networking Group blog, March 1, 2011, (http://www.mengonline.com/community/newsroom/meng_blend/blog/2011/03/01/need-to-drive-change-form-a-dense-network)

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[8] "Assessing the Entrepreneurial Mindset within Engineering Programs Across the Kern Entrepreneurship Education Network (KEEN)," C.C. Fry, D. Pistrui, 2011 Annual ASEE National Conference & Exposition, Vancouver, BC, June 26-29, 2011

[9] Entrepreneurially Minded Engineers Research Project, TTI Performance Systems, Ltd., Kern Family Foundation, retrieved on January 11, 2012 (http://www.ttikeen.com/research.html)