Building and Enhancing Innovation through Design

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Objective: Our primary objective is to build cross-disciplinary understanding of innovation in design and develop methods for evaluating it in undergraduate student design projects. This in turn will result in defining higher quality projects, result in more innovative outcomes, and transform the design-innovation frameworks of faculty and students for E2020 and beyond.

Background: The decline and commoditization of manufacturing knowledge has caused innovation to emerge as a key area of national importance (George, 2006; NSB, 2007). In the United States, innovation industries account for over half of U.S. exports, represent 40% of U.S. economic growth and employ 18 million Americans who earn 40% or more than the average U.S. wage (Gutierrez, 2007). It is well known that early stages of design processes accounts for a significant portion of the cost committed to design, and is also the stage where significant innovation can occur (Ullman, 2003). We define innovation as a new match between a need and a solution, where the novelty can be in the need (market) and/or solution (technology) or in the new marriage between the two. Consequently, preparing U.S. engineering students to compete globally (NSB, 2007; NAE 2005) through learning design innovation is a growing priority.

Building innovation capacity in engineering students is critically important to our national economic infrastructure. A Kaufmann study of entrepreneurial impact of MIT alumni provides a benchmark of the impact a university can have on the economy. The 25,800 currently active companies founded by MIT alumni employ 3.3 million people and generate annual world sales of $2 trillion, producing the equivalent of the eleventh-largest economy in the world (Roberts 2009). On the other hand analyzing the overall landscape of technology transfer of the 3200 universities only 6 have yielded significant returns from intellectual property rights and most of it in drug or biomedical related patents (Tech. Review 2001). Even for these successes the revenue is a small percentage (2% for MIT) of total research expenditures. Clearly the innovation capacity we build among our students is the most critical long-term investment we can make. In particular, design has been a cornerstone of academic programs and the link between Design and the U.S. economy is just beginning to be understood. Design through Engineering makes an effective link between innovation and creating value from it. The U.S. economy increasingly requires more innovative engineers. Just last week, for example, President Obama announced a new set of public-private partnerships in the "Educate to Innovate" campaign (Obama 2010) committing more than $250 million in private resources to attract, develop, reward, and retain science, technology, engineering, and mathematics (STEM) teachers. Clearly the innovation capacity we build among our students is the most critical long-term investment we can make.

Design and innovation has been a cornerstone of academic programs, but the link between innovation and national economic outcomes is just beginning to be understood. Innovation is a loosely used concept, often confused with invention. "Invention is the first occurrence of an idea for a new product or process, while innovation is the first attempt to carry it out in to practice." (Fagerberg 2005).

The major issues faced in improving student's capacity in design innovation are:

- Design and design process are learned through practice, however, the creation of design ideas and innovation outcomes results from complex multi-disciplinary, non- sequential, interactive, communicative, and highly social processes. In learning design and innovation, students must learn complementary skills from each other (peer-learning), and the underlying communication among the team members is critical during this time. NSF has recently challenged scientists to understand innovation processes, indicating, "new ways need to be developed to capture data on those interactions, and new data need to be developed to characterize the eventual outcomes" (Lane, 2009).
- In particular, current literature reveals that while innovation has been approached from industrial contexts, and international innovation indices have been developed (Oslo Manual), no single paper discusses innovation metrics for design projects in a university context. In order to become real, innovation requires an organization system, vocabulary, a

conceptual framework and a rationale. Innovation for its own sake is not useful and we try to seek value in our innovations (Kim 2005)

- Currently design projects do not involve commitment from industrial partners and vary significantly in scope and nature. Often faculty driven interests drives much of the project definition with little involvement of students. Therefore the opportunity identification and problem definition skills are not well developed in undergraduate students. The primary focus of the design projects is in problem solution.

Our current proposal concerns "design innovation in undergraduate design projects". We will define innovation operationally as a new match between a need and a solution. The novelty can be in the new need or the new solution or in the relationship between an existing need and solution (Terwiesch and Ulrich 2008). Applying such a model combining "opportunity definition" and "value-innovation" to design education has the potential to transform Purdue undergraduate students by stimulating curiosity at a fundamental level, foster risk taking, and provide intellectual space and freedom to explore and evolve ideas to see where they will lead.

Today, Design is synonymous with Innovation in fact the two cannot be separated. With the decline of the manufacturing based economy much of the value we create in products has moved to design stages (Martii 2005). In addition the notion of "design thinking," now transcends products and technology into services, industrial design, social services, entrepreneurship and others. These form the key elements for progress if the U.S. economy. In particular a recent paper in Science on Innovation Policy suggests that creation and transmission of knowledge occur through complex human and social interactions, we need new ways to capture them and characterize eventual outcomes (Lane 2009). Research into design processes began in the early 1960's. In the 1980's research moved into suggesting a series of steps that would lead to a positive design outcome as in the design process models of Cross (1989), Dym and Little (2000), Pahl and Bietz (2001), Pugh (1990) and Ullman (2003). In the educational realm, design was incorporated into the cornerstone and capstone courses in many universities across the nation with Purdue leading some of these efforts (Starkey et al. 1994). Likewise, the Purdue E2020 framework has recognized innovation as one of the core attributes in knowledge required for future engineers. In the past 5 years some universities, notably Stanford, Northwestern, Penn State and Michigan, have started design programs at the Master's and Ph.D. levels; some universities such as IIT-Madras have started Bachelors programs in Product Design. NWU and Stanford have design institutes with masters level program with significant endowments. In addition, Business Week introduced rankings for 30 to 40 design programs globally (Worlds Best Design Programs 2009).

The interpretation of design in the past few years has varied and in that process has created multiple polarities. On the other hand the emergent "design thinking" unifies the views of innovative and divergent aspects with the analytical and engineering frameworks. However, rigorous research into design methods being taught in engineering programs is needed especially at the interfaces of design and value innovation. Our proposal seeks to address a critical need in understanding the process of design innovation by: 1) studying the *ecology* of innovation; 2) defining and measuring innovation capacities as well as outcomes; and 3) creating curricular and academic initiatives that develop and foster innovative thinking, skills, and processes in our engineering students.

Specifically our work addresses the following E2020 attributes that will be enhanced directly:

a. Abilities
    i. Teamwork, communication, decision-making,
    ii. Work in Diverse/multicultural environments
    iii. Synthesize engineering/societal perspectives
b. Knowledge
    i. Analytical skills
    ii. Open-ended design and problem solving skills
    iii. Multidisciplinary within and beyond Engineering
c. Qualities
    i. Innovative
    ii. Ethically responsible in global, social, intellectual, and technical context

iii. Entrepreneurial

Approach:

Our current proposal concerns "design innovation in undergraduate design projects". We define innovation operationally as a new match between a need and a solution. The novelty can be in the new need or the new solution or in the relationship between an existing need and solution (Terwiesch and Ulrich 2009). Applying such a model combining "opportunity definition" and "value-innovation" to design education has the potential to transform Purdue undergraduate students by stimulating curiosity at a fundamental level, foster risk taking, and provide intellectual space and freedom to explore and evolve ideas that may lead to innovative outcomes.

In order to instill in students a design innovation "mindset", we will form a faculty group that will develop a framework from problem definition through solution driven by innovative design thinking in the context of design projects. Our organization of the discussions within our smaller group and beyond will drive how we develop the opportunity defining frameworks, measure innovation in diverse projects, and how we redesign the learning experiences.

TASK 1 - Defining opportunities: One can define an opportunity as a seed that later grows into a design innovation or a hypothesis of how customer value can be created. Without a good opportunity, however good the design, it will not have a significant impact. Currently, most design projects in our curriculum do not have a sourcing framework or pipeline. Since the faculty defines a large portion of the problem, students do not learn or develop skills in identifying, and then developing problem definitions that are linked with opportunity. The work of Ho (2001) and Restrepo and Christiaans (2003) shows that before designers develop abstract relations and concepts, a large number of design issues need to be raised and structured in order for a designer to develop a solution. In addition these issues are complex, because they are interlinked in a non-linear manner. Novice designers often overlook these complex dynamic relationships. Problem definition is important to design quality, earlier design phases have comparatively greater impact, and intermediate design levels falling between concept and detailed designs are important (Sobek 2007). Opportunity identification and problem definition is less studied except in firms (O'Connor and Rice 2001). Our hypothesis is removing problem definition experiences reduces student capabilities for innovation in the real world – an important skill set for E2020 students that has not yet been well developed in our curriculum.

Our intra-disciplinary and cross-disciplinary project team will develop a sustainable methodology for developing a project problem definition pipeline. Sources of opportunity will be identified including internal sources within Purdue (faculty, centers in discovery park, and others), industry linkages, non-governmental agencies, and international sources such as through the Global Engineering Alliance for Research and Education (Purdue GEARE program). One potential development will be a 1-credit precursor to the design projects for problem definition, which will include a ranking of the projects for innovation potential, and the identification of a match between students and the projects. This coupling of opportunity identification with quality sources will lead to better projects and student experiences. Finally a network of mentors, advisors and resources for the projects will be formed through a web-based system. GlobalHUB™ is a potential medium that can support this network formation and its expansion to scale up the opportunity definition.

This task allows us to address several questions, such as: Can (and how) novice design students adopt opportunity identification processes and framework of experts?; and How can exposure to innovative design opportunity identification and improvement in quality of opportunities increase their quality and level of innovation outputs? We will compare design projects in two groups, one that is exposed to the opportunity identification framework and problem definition importance and one that is not. We will then compare the innovation levels in their projects.

TASK 2 - Developing and validating measure(s) for innovation: Although innovation is well researched from a market perspective (Poole 2004) and after the product is successful, innovation

measures developed for industry (OECD 2005), no research has addressed innovation metrics in student design projects. This task is the centerpiece of this proposal. In the past two offerings of ME463 a small group in the School of Mechanical Engineering engaged in a project to determine innovation dimensions. We discussed the innovation award criteria with the team of external judges – all very successful ME alumni with significant industry and business experiences. In addition several faculty were interviewed using the LiveScribe™ Pen. We analyzed the text of these interviews, using an affinity algorithm, to extract keywords and themes regarding innovation characteristics. Several exemplars emerged and an innovation rubric was developed. During the second innovation award competition, the judges improved on the framework. However they resorted to four key dimensions (differentiability, chances of market success, level of need satisfaction, and creativity) in their judging. These dimensions provide us great insight into developing a new measure for innovation. We will further refine these dimensions using a Delphi study (Murray 1975). A questionnaire will be developed and administered to faculty in other schools that teach design within and beyond Purdue, as well as industry experts in design to evaluate and improve our dimensions of measurement for innovation.

TASK 3: - Redesigning the design learning experience: In the following semester, we will implement the metrics developed in Task 2 and also perform course assessments via a mid-term and end-of-course questionnaire, and correlate these with team performances. The courses that will be used are Senior Design Projects (ME463), Industrial Design (AD30500), and freshmen perspectives in Design Innovation in Engineering Education (Atman et. al. 1999). We will also provide instructional observation and intervention throughout the course, through bi-weekly instructor meetings. In order to execute this the instructors should all have a shared understanding of innovation-in-design projects. Currently this shared understanding does not exist. In addition, graduate students in a course taught in Communication (COM 674 Collaboration and Innovation), will conduct research studying the team dynamics and interactions of design students in our courses. In this way, we will develop new approaches for capturing team interactions in order to generate the data that will help to characterize processes of innovation (Lane, 2009). Translating the "aha" moment into an innovation might require a well-functioning team or organization (Kiesler 2008 and Schunn 2008).

Assessment Methods:

In addition to the development of innovation metrics listed above we will also perform assessments through the course via a mid-term questionnaire and end of course questionnaire. Spearman correlations will be used to compare the team effectiveness as well as team performances. Our questionnaire will consider the measures of success, types of communication difficulties in multi-disciplinary teams and correlate these successful design outcomes as judged by innovative designs as ranked by experts in from industry and academia. We will use methods similar to the one used by Titus and Ramani (2008, 2009) for studying the decision making of over 60 First Robotics teams and Dong (2004a, b)

Thus by introducing frameworks for design innovation and using multidisciplinary design projects we enable new dimensions of design that can be studied. By looking at the resulting design as a communication intensive process we will analyze the data collected as well as provide real time feedback along many dimensions. Finally we use metrics for each stage of the design and understand the nature of innovation among the teams. The five levels of assessment levels that will be performed include: (1) Participation, (2) Satisfaction, (3) Learning, (4) Application and (5) Impact. We will formulate questions and type of data that will be collected in each category to see if the innovation framework and opportunity definition experiences impact their perspectives, points of view and capacity to innovate.

Broader Impacts:

- Design Innovation Lecture Series: invited speakers, lectures will also be offered as a technical elective for senior students. They will be used to seek faculty doing research in design relevant to design education, translation of research to education, industry speakers in design areas (seek input from them for design projects for senior students)

- Design Workshops: It is imperative we use the conversation around "design innovation" in undergraduate student design projects as a means to break the barriers in communication between different design viewpoints.
- Design Interest Group Advisory Board will be formed: This will indirectly start the conversation for programs in design.
- Sustainability: Some of the results will be embedded in the learning of the instructors and retained within the design faculty. This in turn can be used to further develop a sustainable pipeline for projects including through industry.
- Future Program in Design: Design Interest Group (DIG) will be a cross-disciplinary research and education interest group that will discuss the development of innovation and design issues in student learners. We will also discuss collaborative "design spaces" for the future development. The impact of design space and prototyping was clearly demonstrated in a NSF sponsored Design Workshop at the Hasso Plattner Design Institute at Stanford University.

Expected Results:

Topics and issues related to forming projects for senior design students that cut across the curriculum will be evaluated and a framework for enhancing projects that have high innovation potential will be developed. A precursor to the final design projects around "problem definition for projects," will be developed as a 1-credit course prototype. Our hypothesis is that this precursor will enhance the quality of the design projects, scope for innovation, and the students' commitment and intrinsic drive towards innovation. We will also develop detailed metrics for design project evaluation for "innovation awards." The Innovation Award will be used as a discussion topic around which we can transform the student mindset and innovative design thinking among faculty.

Based on the results of this pilot study we will use the preliminary findings to write NSF proposals to both the Science of Innovation Program and EECI. The PI has already discussed the proposal with the Science of Innovation Program and they are looking forward to one. In addition the team will also prepare a larger proposal to EECI program since its recent focus in on innovation with a particular emphasis to meet the changing needs of our society and economy. Further the PI has developed strong relationships with Kaufmann Foundation as well that will help in broader outreach and funding as well.

Finally, Purdue's positioning for a program in design will be improved. Currently the community is fragmented and needs to come together.

Schedule and Budget:

We will start discussions in our group soon after funding is announced. Most of the planning will occur in the summer of 2010. We have budgeted $1500 for each of the faculty for either summer salary or travel to present the results of this preliminary study ($12 K total). We will execute on the project in the Fall and Spring of 2010 in design project samples across disciplines. The preliminary results will then be used for proposals that will be prepared in the end of Fall for NSF EECI deadline in January and this September for the NSF SCIIP programs. We also have included a budget for a graduate student who will design the preliminary experiments, collect the data and analyze it ($15 K). We hope we will be able to submit the first paper discussing innovation metrics in design projects at the end of the year. Several other individual papers from each of the areas of the Co-PI's will follow. We will conduct a design workshop in the fall semester and one in the spring semester ($3 K budget). In addition we will have monthly Design Interest Group meetings which will broader the participation across campus. Invited speakers travel and accommodation has a budget of $10 K. We will write to the head of each school for cost sharing for invited speakers and sometimes overlap with design seminar series (multi-disciplinary) for seminar course requirements. The total budget will be $40 K. Each category includes overheads also. A formal budget will be submitted if the proposal is funded.

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Professional Preparation:	Purdue University	Mechanical Engineering	BSME, w/ Highest Distinction, 1972
	Purdue University	Mechanical Engineering	MSME, 1974
	Purdue University	Mechanical Engineering	Ph.D., 1977

Appointments:

2008 -	Guest professor, Shanghai Jiao Tong University, China
2007 -	Founding Director, GlobalHUB.org, Engineering Virtual Organization (NSF EVO)
2005 - 2008	Founding (Interim) Director, Global Engineering Program, Purdue
1999 -	Professor and William E. and Florence E. Perry Head, Mech. Engineering, Purdue
1999 -	Professor of Electrical and Computer Engineering, by courtesy, Purdue University
1995 - 1999	Associate Dean for Research, College of Engineering, Arizona State University
1992 - 1999	Professor (affiliated), Electrical Engineering Department, Arizona State University
1995	Acting Chair, Mech. and Aerospace Engineering Dept., Arizona State University
1993	Alexander von Humboldt Fellow, Universität Karlsruhe, Germany
1992	Visiting Professor, Chemical Engineering Dept., Tech. Univ. of Delft, Holland
1989 - 1992	Vice-chair (Aero), Mech. and Aerospace Engrg. Dept., Arizona State University
1988 -	Professor, Mechanical and Aerospace Engineering, Arizona State University
1982 - 1987	Associate Professor, Mech. and Aerospace Engineering, Arizona State University
1977 - 1981	Assistant Professor, Mech. and Aerospace Engineering, Arizona State University
1974 - 1975	Visiting Researcher, Technical University of Denmark, Copenhagen
1973 - 1977	Teaching and Research Assistant, Mechanical Engineering, Purdue University
1970 - 1977	Engineering Employment, Hughes Aircraft Company, Boeing Aircraft Co., and Atlantic Richfield Research Labs.

Honors and Awards:

Hon. George Brown Award for International Scientific Cooperation, U.S. Civilian Research & Development Foundation (CRDF), Washington D.C., 2008.

Fellow, Amer. Soc. of Mech. Engineers (ASME), cited for *Research & Dev. and Education*, 2007.

Achievement Award, International Network for Engineering Education and Research (iNEER). Citation: *For development of programs for education of global engineers through comprehensive international experiences with international design team collaborations*, 2006.

Team Award, College of Agriculture, for Biosensor Detection Team, with additional participation from Elec. and Comp. Engineering, Basic Medical Sciences, Veterinary Medicine, and Food Science, 2006.

Team Excellence Award, Purdue College of Engineering, for Global Engineering Alliance for Research and Education, with participation from Foreign Languages & Literature in addition to Engineering, 2004.

Alexander von Humboldt Fellow, 1993.

Governor's Recognition Award (ASU Center for Solid State Electronics Res.), State of Arizona, 1993.

Professor of the Year, Teaching Award given by ME Student Honor Society Pi Tau Sigma, 1982.

College of Engineering Award for Significant Accomplishment in Research, 1980, Arizona State University.

Howard Hughes Doctoral Fellowship, 1974-1976, National Science Foundation Graduate Fellowship, 1973-1977, Purdue Rhodes Scholar Nominee, 1972.

Publications (most closely related to the proposed project):

1. E. D. Hirleman, D. Atkinson, E. A. Groll, J. Matthews, L. Xu, B. Allert, W. Hong, A. Albers, S. L. K. Wittig, Z. Q. Lin, and L. F. Xi, "GEARE: A Comprehensive Program for Globalizing Engineering Education," paper 2004-1195, 10 pages, *Proc. of the 2004 Amer. Soc. for Engineering Education Annual Conference*, 2004.
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Synergistic Activities:

1. Director, GlobalHUB, an NSF-funded Engineering Virtual Community (EVO) of scholars, practitioners, and students that advances global engineering and engineering education.
2. Steering Committee and Local Arrangements, *Curricular Innovations for Global Engineering Competency*, Tenth Annual Colloquium on International Engineering Education, Purdue University, West Lafayette, Indiana, November 1-4, 2007. Served on Steering Comm. for 4 previous Colloquia.
3. US Chair, Joint ASME-CMES Mech. Engineering Educ. Conference, Beijing, China, Mar 31-April 4, 2006. One of two Co-chairs (one from US, one from China) of conference with 300 attendees. Plenary presentations by: the Minister of Education of China; the President of the Chinese Acad. of Engrg. and the Chair of the Accreditation Taskforce of the Chinese Academy of Engineering.
4. Course Instructor, "Strategies to Reach Global Engineering Professional Competence", 8th International Colloquium on International Engineering Educ., Atlanta, Georgia, November, 2005.
5. Session Chair, NSF Workshop on Redefining Mechanical Engineering, responsible for session *Micro/Nanotechnology and Mechanical Engineering*. Results available as report *New Directions in Mechanical Engineering* which established recommendations for integrating emerging technologies into engineering curricula. www.asme.org/education/enged/me2002/pdf/newdirectionsreport.pdf .

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(i) Professional Preparation

California Polytechnic State University San Luis Obispo, CA	Mechanical Engineering	BS, 1986
University of Washington, Seattle WA	Materials Science and Engineering	MS-MSE, 1994
University of Washington, Seattle WA	Education, Education Leadership and Policy Studies	PhD, 2001

(ii) Appointments

2005 – present	Assistant Professor, School of Engineering Education – Purdue University
2003-2009	Lead, Institute for Scholarship on Engineering Education, Center for the Advancement of Engineering Education (CAEE)
2003 – June 2005	Assistant Director for Research, Center for Engineering Learning and Teaching – University of Washington, Seattle, WA
2001-2003	Research Scientist, Center for Engineering Learning and Teaching – University of Washington, Seattle, WA
2000-2001	Pre-Doctoral Research Assistant, Center for Engineering Learning and Teaching – University of Washington, Seattle, WA
1997 – 2000	Local Evaluator, Engineering Coalition of Schools for Excellence in Education – University of Washington, Seattle, WA
1991 – 1997	Graduate Research Assistant, Engineering Coalition of Schools for Excellence in Education – University of Washington, Seattle, WA
1987 – 1991	Senior Design Engineer, Olin Interconnect Technologies, Santa Clara, CA

(iii) Publications

Significant publications related to proposed work

Adams, R.S., Mann, L., Jordan, S., and Daly, S. (2009). "Exploring the boundaries: language, roles, and structures in cross-disciplinary design teams." In J. McDonnell and P. Lloyd (eds), *About Designing: Analysing Design Meetings*, Chapter 16. London: Taylor and Francis Group.

Adams, R.S., Mann, L., Forin, T., *Daly, S.,* and Jordan, S. (2008). "Ways of experiencing cross-disciplinary practice in engineering education." Research in Engineering Education Symposium, Davos, Switzerland.

Adams RS, J Turns and CJ Atman (2003). "Educating effective engineering designers: The role of reflective practice". *Design Studies*, Special Issue on Designing in Context, **24** (3), pp. 275-294.

Cardella, M.E., Atman, C.J., Turns, J., and Adams, R. S. (2008). "Students with Differing Design Processes as Freshmen: Case Studies on Change." *International Journal of Engineering Education*.

Atman, C.J., Adams, R.S., Cardella, M.E., Turns, J., Mosborg, S. and J. Saleem (2007). "Engineering Design Processes: A Comparison of Students and Expert Practitioners." Journal of Engineering Education, 96(4).

Synergistic publicatios

Turns, J., R. S. Adams, J. Martin, M. Cardella, S. Mosborg & C. J. Atman (2006). "Tackling the Research-to-Practice Challenge in Engineering Design Education: Insights from a User-Centered Design Perspective," *International Journal of Engineering Education* (invited paper).

Atman, C.J., Yasuhara, K., Adams, R.S., Barker, T., Turns, J., and Rhone, E. (2008). "Breadth in Problem Scoping: A Comparison of Freshman and Senior Engineering Students." *International Journal of Engineering Education*.

Adams, R., Fleming, L., and K. Smith (2007). "Becoming an Engineering Education Researcher: Intersections, Extensions, and Lessons Learned among Three Researchers' Stories." Proceedings of the International Conference on Research in Engineering Education (ICREE), Honolulu, HI.

Adams, R.S., C. Allendoerfer, P. Bell, H. Chen, L. Fleming, L. Leifer, B. Maring and D. Williams (2006). "A Model for Building and Sustaining a Community of Engineering Education Research Scholars." Proceedings of the Annual *American Society for Engineering Education* Conference, Chicago.

Safoutin, M., Atman, C. J., Adams, R., Shuman, T. R., J. Kramlich, and Fridley, J. (2000). "A design attribute framework for course planning and learning assessment," *IEEE Transactions,* Special Issue on Assessment, May.

(iv) Synergistic Activities

Scholarly research on engineering learning; bridging learning and teaching; engineering learning systems: (1) **NSF – EEP / EHR (CAREER)** "Intentional Serendipity, Cognitive Flexibility, and Fluid Identities: Cross-Disciplinary Ways of Thinking, Acting, and Being in Engineering" to investigate cross-disciplinary inquiry and

develop a scholarship of teaching and learning community around cross-disciplinary pedagogy, $495,830 (8/1/08 – 7/31/13), (2) **NSF – EHR/REC (ROLE)** "An engineering design expertise continuum: Filling it in and linking it to practice" to create knowledge on design expertise and demonstrate a research-informed approach to design education in the context of informal educational settings (co-op education) with C. J. Atman (PI) and J. Turns, $508,196, (9/1/01 – 9/31/05); (3) **NSF – EHR/EEP CLT** "Center for the Advancement of Engineering Education" – research on pathways for becoming interdisciplinary engineering education researchers; (4) **NSF – EEP** "The Teaching Challenges of Engineering Faculty: Insights from a Model Instructional Development Program," with J. Turns (PI), A. Linse and C. J. Atman, $374,972, (9/1/02 – 12/31/05); (5) **NSF-CCLI** "Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students" (aspect of project includes evaluating impact of program experiences on participants knowledge of impact and ways to improve engineering education), $963,976 (7/1/08-6/30-11).

Educational innovations and curriculum development: (1) **NSF – DLR** "Multidisciplinary Engineering", Haghighi (PI) – planning grant to develop an integrated program on multidisciplinary engineering; (2) **GE Fund** "Toward Enhancing Engineering Design Education: Bringing Research Results into the Classroom," with C J. Atman and J. Turns, $50,000, (01/01-12/01), (3) Graduate courses in Engineering Education (Design Cognition and Learning, Problem Solving for Diverse Learners, Introduction to Engineering Education, History and Philosophy of Engineering Education), (4) Undergraduate courses (Multidisciplinary Engineering Professional Seminar), and (5) Community of practice workshops (FIE 2005, FIE 2007).

Building capacity and community in engineering education research: (1) **NSF – EHR/EEP CLT** "Center for the Advancement of Engineering Education," Atman (PI) - Lead for Institute for Scholarship on Engineering Education – a program in which faculty and graduate students engage in year long research projects around engineering student learning (particular goals of this program were on broadening participation in STEM education research and contributing to the scholarship on issues related to STEM participation), (2) **Stepping Stones Project** with Sally Fincher - a program in which faculty in Sweden engage in a year long research project around conceptions of engineering from a Swedish perspective, and (3) **NSF-CCLI** "Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students" – a program that focuses on a set of sustained educational experiences to build capacity in engineering education research, $963,976 (7/1/08-6/30-11).

Broadening participation: (1) Leadership role on a NSF funded summer bridge programs to support women and minorities in pursuing STEM majors, collaborations between colleges of engineering and education for K-12 teacher preparation, and collaborations between K-12 educators and undergraduate engineers to develop and implement engineering curriculum in K-12 classrooms and (2) a NSF funded project (ECSEL Coalition) with a focus on teacher education and pathways for integrating engineering into K-12 contexts.

(v) Collaborators & Other Affiliations

(a) Collaborators (past 48 months):

Cheryl Allendoerfer (U Washington), Cynthia Atman (U Washington), Philip Bell (U Washington), Geroge Bodner (Purdue), Keith Bowman (Purdue), Lori Breslow (MIT), Sean Brophy (Purdue), Willie Burgess (Purdue), Monica Cox (Purdue), Mats Daniels (Uppsala U), Denny Davis (Washington State U), Hiedi Diefes-Dux (Purdue), Sally Fincher (U Kent), Lorraine Fleming (Howard U), Kamyar Haghighi (Purdue), Carol Handwerker (Purdue), Dan Hirleman (Purdue), Inez Hua (Purdue), PK Imbrie (Purdue), Lisa Lattuca (Penn St), Larry Leifer (Stanford), Wendy Newstetter (Georgia Tech), Loring Nies (Purdue), Alice Pawley (Purdue), David Radcliffe (Purdue), Marika Santagata (Purdue), Sheri Sheppard (Stanford), Joe Sinfield (Purdue), Karl Smith (Purdue), Sheryl Sorby (Michigan Tech), Reed Stevens (U Washington), Ruth Streveler (Purdue), Johannes Strobel (Purdue), Jennifer Turns (U Washington), Aman Yadav (Purdue)

(b) *Graduate Advisors (University of Washington)*:

Steven Olswang, Edward Taylor, Nancy Beadie, Gerald Gillmore, Cynthia J. Atman

(c) Thesis Advisor for:

Purdue: Shanna Daly, PhD in 2008; Shawn Jordan, PhC; Tiago Forin

Postdoctoral Researcher: Llewellyn Mann (2007-2008)

Total Graduate and Post Doctoral Students Directed: 4

LORRAINE G. KISSELBURGH

Assistant Professor, Department of Communication
Purdue University * 100 N. University Avenue * West Lafayette IN 47907-1366
Tel (765) 494-8294 (w) * Fax (765) 496-1394 * email: lorraine@purdue.edu

PROFESSIONAL PREPARATION

2008	Ph.D., Purdue University
2004	M.S., Purdue University
1979	A.B., University of Southern California, graduated *cum laude*

APPOINTMENTS

2008-	Assistant Professor. Department of Communication, Purdue University, 2008-present
2008-	*Affiliate Faculty*: Discovery Learning Center; Center for Educ & Res in Info Assurance & Security; Regenstrief Center for Healthcare Engineering
2005-08	Graduate Research Assistant, Purdue University (appointments in Department of Communication; Discovery Park, Discovery Learning Center; Center for Education and Research in Information Assurance and Security; Discovery Park, Purdue Homeland Security Institute)
2006	Graduate Teaching Assistant. Department of Communication, Purdue University
1997-04	Director of Office of Information Technology. College of Liberal Arts, Purdue University
1993-96	Manager of Academic and Administrative Computing. College of Liberal Arts, Purdue
1982-92	Information Systems Coordinator. College of Liberal Arts, Purdue University
1981-82	Graduate Teaching Assistant. Department of Computer Science, Purdue University
1979-80	Graduate Teaching Assistant. Department of Health & Kinesiology, Purdue University

SELECTED HONORS & RECOGNITION

2005-09	Five Top Paper Awards
2008-09	Service Learning Faculty Fellow. Purdue University
2007-08	Purdue Research Foundation Fellowship. Purdue University
2007	Oxford Internet Institute Summer Doctoral Programme Participant. University of Oxford
2006	Alan H. Monroe Graduate Scholar. Department of Communication, Purdue University
2004	Violet Haas Award on behalf of women, Council on the Status of Women, Purdue

SELECTED RECENT PROFESSIONAL ACTIVITIES

Over 30 presentations at professional conferences since 2004

Co-organizer, Serious Games Research Forum, Purdue University, October 2007

Leadership and participation on multiple university and college-level committee regarding information technologies, gender equity, and facilities and strategic planning

PUBLICATIONS

Five publications related to this proposal

Kisselburgh, L.G. (forthcoming). A social justice perspective of engineering work and career discourses. In C. Baillie, A. Pawley, & D. Riley (Eds.), *Engineering and social justice: In the University and beyond.* West Lafayette: Purdue University Press.

Walthall, C.J., Devanathan, S., Kisselburgh, L.G., Ramani, K., & Hirleman, D. (2009). A framework for evaluating wiki as a medium for communication within engineering design teams. *Proceedings of the ASME 2009 International Design Engineering Technical Conferences,* San Diego, CA.

Kisselburgh, L.G., Berkelaar, B.L., & Buzzanell, P.M. (2009). Collaborative research in global contexts: Institutional and ethical synergies. In *Proceedings of the 2009 Chinese Communication Association Convention and the Third Global Communication Forum* (pp. 90-100). Shanghai, China.

Kisselburgh, L.G., Berkelaar, B.L., & Buzzanell, P.M. (2009). Discourse, gender, and the meaning of work: Rearticulating science, technology, and engineering careers through communicative lenses. In C. S. Beck (Ed.), *Communication Yearbook 33* (pp. 259-299). New York: Routledge.

Berkelaar, B.L., Kisselburgh, L.G., & Buzzanell, P.M. (2008). Locating and disseminating effective messages: Enhancing gender representation in computing majors and careers. *Proceedings of the 2008 SIGMIS CPR Conference.* Charlottesville, VA.

Five other publications

Putnam, L.L., Kisselburgh, L.G., Berkelaar, B.L., Buzzanell, P.M., Mastronardi, M., Jackson, M., et al. (2009). 21st century STEM careers: Communication perspectives and research opportunities. In L. Harter, M.J. Dutta, & C. E. Cole (Eds.), *Communication for social impact: Engaging communication theory, research, and practice* (pp. 47-62). Cresskill, NJ: Hampton Press.

Kisselburgh, L.G., & Dutta, M.J. (2009). The construction of civility in multicultural organizations. In P. Lutgen-Sandvik & B.D. Sypher (Eds.), *Destructive organizational communication: Processes, consequences, and constructive ways of organizing* (pp. 121-142). New York: Routledge.

Kuhn, T., Golden, A.G., Jorgenson, J., Buzzanell, P.M., Berkelaar, B.L., Kisselburgh, L.G., et al. (2008). Cultural discourses and discursive resources for meaning/ful work: Constructing and disrupting identities in contemporary capitalism. *Management Communication Quarterly, 22,* 162-171.

Zelaznik, H.N., Hawkins, B., & Kisselburgh, L. (1987). The effects of movement distance and movement time on visual feedback processing in aimed hand movements, *Acta Psychologica, 65,* 181-191.

Zelaznik, H.N., Hawkins, B., & Kisselburgh, L. (1983). Rapid visual feedback processing in single-aiming movements, *Journal of Motor Behavior, 15,* 217-236.

RESEARCH AREAS

Collaboration in virtual and online environments; Privacy, identity, and social networking in online environments; Gender in technological organizations and careers; Organizational communication, leadership, and diversity; Difference, marginalized voices and populations.

SYNERGISTIC ACTIVITIES

- Collaboration with S. Matei, S. Lee, and D. Braun on collaboration in large-scale wikis
- Collaboration with C. Hoffmann on gender & social interaction in games-based STEM learning
- Collaboration with D. DeLaurentis and S. Brophy on influences of gender on collaboration and competition in games-based learning in engineering education
- Collaborations with Discovery Learning Center (Sypher), CERIAS (Spafford), PHSI (Dietz)
- As Director of Information Technology, designed technology infrastructure for 2 campus buildings, 9 University and 26 School instructional computing labs; facilitated largest use of university computer labs of academic school in University; administered $600,000 annually in funding support for information technology; played key role in developing major campus systems and services: University instructional computing labs, classroom technology, Multimedia Instructional Development Center, and Teaching, Learning & Technology.

ADVISEES, COLLABORATORS, AND OTHER AFFILIATIONS

- Graduate Student Advisees: Prashant Rajan, Christopher Charles, Victoria Hawes.
- Graduate Advisors: Howard Sypher and Patrice Buzzanell, Purdue University
- Non-Purdue Collaborators: Noshir Contractor, Northwestern University; Tim Kuhn and Michele Jackson, University of Colorado, Boulder; Linda Putnam, UC Santa Barbara

KARTHIK RAMANI
Professor, Purdue University
School of Mechanical Engineering
School of Electrical and Computer Engineering (by Courtesy)

PROFESSIONAL PREPARATION:

6/87-6/91	Stanford University, Stanford, CA Ph.D. in Mechanical Engineering, Design Division
3/85-8/86	The Ohio State University, Columbus, OH M.S. in Mechanical Engineering
9/80-1/85	Indian Institute of Technology, Madras, India Bachelor of Technology in Mechanical Engineering

APPOINTMENTS:

1/08 – 6/08	Visiting Professor, Computer Science, Stanford University
1/08 – 6/08	Visiting Scientist, Intelligent Systems Group, PARC (Formerly Xerox PARC)
8/07 – 12/07	Fellow, Institute of Pure and Applied Mathematics, UCLA
8/07 – present	Professor (by Courtesy), School of Electrical and Computer Engineering
8/04-present	Chair, Manufacturing Area, School of Mechanical Engineering
8/01-present	Professor School of Mechanical Engineering, Purdue University
6/00-12/00	Invitational Guest Research Scientist, NIST, Washington, DC
7/97-7/01	Associate Professor, School of Mechanical Engineering, Purdue University
7/91-7/97	Assistant Professor, School of Mechanical Engineering, Purdue University
Summer 93	Summer Faculty Intern, Dow Plastics, Advanced Materials
6/87-6/91	Research Assistant, Design Division, Stanford University
Autumn 89	Teaching Assistant, Mechanical Engineering, Stanford University
Summer 89	Summer Intern, Delco Products, Advanced Composite Systems
9/86-6/87	Visiting Scholar, Center for Design Research, Stanford University
3/85-8/86	Research Assistant, Mechanical Engineering, The Ohio State University
Spring 85	Teaching Assistant, Mechanical Engineering, The Ohio State University

PROFESSIONAL HONORS:

Most Highly Cited paper in the Journal of Computer-Aided Design for 2007 and 2006 (Won the award for the second time from Elsevier)
Thomas French Award, The Ohio State University, 2007.
Research Excellence Award, Schools of Engineering, Purdue University, 2007
Innovation of the Year Award, MIRA Award, State of Indiana, 2006.
Discovery in Mechanical Engineering, Purdue University, 2005.
University Faculty Scholar, Purdue University 2002
Society for Manufacturing Engineers, Outstanding Young Manufacturing Engineer, 1999
Ruth and Joel Spira Award for Outstanding Contributions to the Mechanical Engineering Curriculum, Purdue University 1997
Ralph R. Teetor Educational Award, Society of Automotive Engineers 1996
National Science Foundation CAREER Award 1996
National Science Foundation Research Initiation Award 1993
Dupont Young Faculty Award 1992
SAMPE Student Award 1991
Best Academic Record Award for Junior and Senior Year, Indian Institute of Technology, Madras, India, 1984-85

Related Editorial and Advisory Boards:
Advisory Board to National Science Foundation – Industrial Innovation and Partnerships (IIP) 2007-10.
Editorial Board, Journal of Computer-Aided Design and ASME Journal of Mechanical Design

Publications related to the proposal:

1. Lee, A., Anderson, D., and Ramani, K., (2003), "Toying" to Learn for 21st Century Product Development Environments", ASEE Annual Conference and Exposition, June 22-25, 2003, Nashville, TN, CD-ROM, Session 1625, Paper 1061.
2. Ramani, K., and Henderson, D., "Using Advanced CAD Software in Teaching Design," International Journal of Engineering Education, Vol. 11, No. 2, pp. 98-102, 1995.
3. Titus, N., Schunn, C., Walthall, C., Chiu, G., Ramani, K., "What Design Processes Predict Better Design Outcomes? The Case of Robotics Design Teams", Seventh International Symposium on Tools and Methods of Competitive Engineering, Izmir, Turkey, 2008.
4. C.W. Chung, J.-K. Choi, K. Ramani and H. Patwardhan, "Product Node Architecture: A Systematic Approach to Provide Structured Flexibility in Distributed Product Development", *Concurrent Engineering Research & Application*, 13 (3), pp. 219-232, (2005).
5. Walthall, C.J., Devanathan, S., Kissleburgh, L., Ramani, K., Hirleman, D., "A framework for evaluating wikis as a medium for communication within engineering design teams," Submitted to ASME 2009 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, San Diego, CA, IDETC/CIE 2009.

Other Related Publications:

6. Zhanjun Li , Victor Raskin , and Karthik Ramani, Developing Engineering Ontology for Information Retrieval, Transactions of the ASME Journal of Computing and Information Science in Engineering, Vol. 8, No. 1, March 2008.
7. Ramani, K. and Henderson, D., "Use of PRO/Engineer and ANSYS in Undergraduate Engineering Education," Symposium on Changes in Undergraduate Engineering Education, SAE International Congress and Exposition, Milwaukee, Wisconsin, SAE Technical Paper Series 941748, pp. 1-4, September 12-14, 1994.
8. Ramani, K., Babu, M., Joglekar, N., and Ganiji, A., "Systems and Methods for Collaborative Shape Design," 7,337,093, issued February 26, 2008.
9. Jiantao, P., and Ramani, K., Implicit geometric constraint detection in freehand sketches using relative shape histogram, eurographics workshop on sketch-based interface modeling (2007), Association of Computing Machinery (ACM), pp.107-113.
10. Noel, T., Schunn, C., and Ramani, K., "Empirically assessing the contribution of design activities to successful design outcomes," in review (second round), Journal of Engineering Design.

Related Experiences and Synergistic Activities:

Dr. Ramani's research lies at the intersection of design studies, computer support for early design, shape analysis, computational ontologies, and searching. His publications (70 Journal papers) and (8 patents) are in design and manufacturing, and information sciences. He teaches in the area of computer-aided design/prototyping as well as product and process design in a distance course. A major area of emphasis in his group is design representations, computer support for early design, shape representations for search, sketching and implicit constraints in sketches, and sketch-based design. He is also currently serving the National Science Foundation Industrial Innovation and Partnerships 2007-10 and Sub-committee on Industry University Relations in 2007-08. He is also in the organizing committee of the Association of Computing Machinery (ACM) Solid and Physical Modeling Symposium 2008 and IEEE solid modeling international. He was the co-founder of Imaginestics that helped commercialize and build a business model around visual search. Imaginestics won several awards being the worlds first commercial visual search engine for parts in the manufacturing supply chain. The citation of the 2007 College of Engineering wide only research excellence award was: "For his achievements in discovery, learning, and entrepreneurship, and for his innovative research in information and shape sciences, the college of engineering is proud to present the Research Award to Karthik Ramani." He also won the innovation of the year award from the State of Indiana. He has supervised 20 Ph.D. Students and 20 M.S. students.

Thesis Advisor: Masters: Professor Kenneth Waldron (Now at Stanford University), Doctoral: Mark Cutkosky (Design) and Alan Miller (Manufacturing/Materials)

Collaborators: Victor Raskin (Computational Linguistics, Purdue), Shreeram Abhyankar (Mathematics, Purdue), Chris Hoffmann , Daisuke Kihara, (Computer Sciences, Purdue), Eswaran Subrahmanian (NIST), Chris Schunn (Univ. of Pittsburgh), Offer Shai/Yoram Reich (Tel Aviv University), Minhyong Kim (University of London), Albert Albers (Karlsruhe), Wen Jiang (Biology, Purdue), Eric Saund (PARC), Lorrain Kissleburgh (Communications, Purdue).

Curriculum Vitae

Steve Visser
2472 Gala Court
West Lafayette, IN 47907
svisser@purdue.edu

765-494-2295 office
765-491-9633 cell

Education

1988	University of Illinois at Champaign-Urbana MFA in Industrial Design
1982	Northwestern College BA in Fine Arts, Sculpture

Academic Appointments

2006-Present	Professor Industrial Design Patti and Rusty Rueff Department of Visual and Performing Arts Purdue University
1996-2006	Associate Professor Industrial Design Patti and Rusty Rueff Department of Visual and Performing Arts Purdue University
1996-1997	Fulbright Scholar Won a scholarship to teach and research at the University of Art and Design Helsinki. Teaching included courses in *Industrial Design*, *Materials and Processes* and *Compliant Mechanisms*. Research focused on creative endeavors with computer aided industrial design. Helsinki, Finland August 1996-August 1997
1990-1996	Assistant Professor Industrial Design Department of Visual and Performing Arts Purdue University
1989-1990	Visiting Assistant Professor Industrial Design Department of Creative Arts Purdue University
1986-1988	Teaching Assistant University of Illinois at Champaign-Urbana

Professional Positions

2005-present	DesigNapkin Co-Founder West Lafayette, IN
1990-2005	Steve Visser Design Industrial Design Consultant West Lafayette, IN
1988-1989	Hari and Associates Industrial Designer Skokie, IL

Awards and Honors

2007	**Honorary Professor** Nanjing University of Science and Technology, Nanjing China
2005	**Regional Competition: Indiana Venture Idol** *Winner: Coolest Idea* (see Design Competitions and Exhibitions)
2004	**National Design Competition: ID magazine** *Honorable Mention* (see Design Competitions and Exhibitions)
2003	**Taiwan International Design Competition** *Award of Excellence* (see Design Competitions and Exhibitions)
2003	**International Eyewear Design Competition: Opus Design Award** *Award Winner* (see Design Competitions and Exhibitions) Japan
2001	**International Eyewear Design Competition: Opus Design Award** *Award Winner* (see Design Competitions and Exhibitions) Japan
2001	**National Design Competition: Herman Miller Office Supply Creation** *Honorable Mention* (see Design Competitions and Exhibitions)
1999	**Malaysian Polytechnic Curriculum Development Project** Malaysia (see Grants)
1997	**Fulbright Scholar** Finland (see Fellowships and Residencies)
1995	**National Design Competition: Idea95 Industrial Designers Excellence Award** *Silver Winner* (see Design Competitions and Exhibitions)
1993	**Neste Forma Finlandia 3 International Plastic Design Competition** *2nd Place* (see Design Competitions and Exhibitions) Finland

Nancy Clement
1925 Elmwood Ave.
Lafayette, IN 47904
765.447.3847
www.nancyclement.com

Education

Continuing Education – Executive Master of Arts in Philanthropy Studies, School of Philanthropy, Indiana University, Indianapolis, IN,
Classes Completed: 2008 Nonprofit Human and Resource Management, Nonprofit Law
2009 Nonprofit Economy and Public Policy
Master of Science, 2005 College of Technology, Purdue University, West Lafayette, IN,
Bachelor of Science,1989 College of Technology, Purdue University, West Lafayette, IN,

Work Experience:

Current:
$(I4SE)^2$ Consultant, Initiatives for Social Entrepreneurship – Innovations for Social Enterprise
Purdue University, Interim Director – Social Entrepreneurship Initiative
(Formerly known as EPICS Entrepreneurship Initiative)

Prior:
Brunner Engineering & Manufacturing - Quality Control Analysis

Westat Social Research and ABT & Associates
Subcontractor to the U.S. Department of Education and Social Research.
Field Research Supervisor
Chapter 1 reading program – 7 year longitudinal study
Kentucky Educational Study – data gathering team.
US Census – data gathering team

Tri-R Enterprises Inc. President - Independent Business Owner

Research

Inspiring Social Entrepreneurs – Growing global social capital through education and experience in leadership development – Cleaner, healthier, global population

Networks for Social Entrepreneurship and Social Enterprise - Addressing Childhood Obesity through For-Profit, Non-profit and Community partnerships.

Legal, Human, Economics, and Resource Issues – Co-Venturing and Venture Philanthropy
A Case study of the Greyston Foundation.

Teaching & Mentoring

2009 Maymester – EARTH University Costa Rica – Social Entrepreneurship section of the course titled: *Developing Global Curricula: An Experimental Learning Approach to Education in Sustainability and Entrepreneurship.*

Students for the Global Idea-to-Product Competition
Student skill sessions-patent and market database searching techniques and effective presentation
Innovation Realization Lab (IRL) MBA & PhD student teams

Initiatives: Continuous expansion of I2P Competitions 2004-2009

April 4, 2009 *National Idea-to-Product Competition for Social Entrepreneurship.* Participation is by invitation only-observation is open to the public.
April 3, *2009 SEEC North American Workshop – Social Entrepreneurship Education, Research, Business Partnerships.* Open to the Public.
March 7, 2009 *Purdue Idea-to-Product Competition for Environmental & Social Entrepreneurship.* Purdue Students only.

Published Most Recent Conference Proceedings
posted on-line at http://www.purdue.edu/innovate/src/news-publications.php

N.I. Clement, - ***"Social Entrepreneurship Initiatives & Social Enterprise Innovations – A Case Study for Change Agents, Social Entrepreneurs, Philanthropist, Economics, Government and Legal Policies.*** 6th Annual Satter Conference of Social Entrepreneurs, November 4-6 2009

N. Clement, ***"Social Entrepreneurship Initiatives at Purdue Universities"***—moderator and presenter for 2009 Global Consortium of Entrepreneurship Centers Conference, Rice University, Houston, TX. October 15-17, 2009.

N. Clement, R.M.Lang Jr., ***"Low-Profit Limited Liability Company (L3C) A New Tool for Implementing University Research via Social Entrepreneurs"***—paper presentation for 2009 NCIIA Conference, "Innovation Unlimited: Advancing education, investing in change" Washington DC. March 19-21, 2009.

N. Clement, E.J. Coyle, ***"Creating Social Entrepreneurship Networks"*** panel presentation. ***"The Social Entrepreneurship Initiative"*** paper presentation for 2008 NCIIA Conference "Getting to the Point: Idea, Process, Products" Dallas TX, March 20-22, 2008.

N. Clement, E.J. Coyle ***"Fostering Awareness of Global and Social Issues through Entrepreneurship Education and Innovative Commercialization Policies"***– Worldwide University Network (WUN) – University of Leeds, England, December 10-11, 2007 and Chicago, IL October 2007.

Grants

Social Entrepreneurship and Education Consortium's North American Workshop
PI - National Collegiate Inventors and Innovators Alliance (NCIIA) – Social Entrepreneurship: Education, Research and Partnerships.

Developing Global Curricula: An Experiential Learning Approach to Education in Sustainability and Entrepreneurship, Co-PI, US Department of Agriculture, Cooperative State Research, Education and Extension Service 2007. Costa Rica – EARTH University

Center for Assistive Technology, Co-PI, Indiana Family and Social Services Administration, Division of Disability and Rehabilitative Services 2007

Partnerships for Innovation, National Science Foundation-0650249 University of Texas-Austin, Co-Contributor 2008 Idea to Product Competition for Social Entrepreneurship.

Awards and Recognition

2006 F.L. Hovde Outstanding Faculty Fellow Award for Purdue University
2006 Frank Murphy Outstanding Faculty Fellow Award for Windsor Halls