Purdue's Engineer of 2020
2011-2012 Seed Grant Program
Purdue University

Project Title: Validation of an Assessment Instrument to Examine Innovative Behaviors in Engineers.

Total Budget Requested: $40,000

Target Attribute(s) to be studied/implemented: Through this effort, the investigators intend to study the following Purdue Engineer of 2020 attributes in an innovation context by validating a recently developed assessment instrument:

a. Abilities
    i. Communication
    ii. Decision-making
    iii. Synthesize engineering, business and societal perspectives
    iv. Recognize and manage change
b. Knowledge areas
    i. Multidisciplinarity within and beyond engineering
    ii. Integration of analytical, problem solving and design skills
c. Qualities
    i. Innovative
    ii. Adaptable in a changing environment
    iii. Entrepreneurial and intrapreneurial
    iv. Curious and persistent learners

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A. PROJECT DESCRIPTION

Introduction

The Grand Challenges identified by the National Academy of Engineering (NAE, 2008), which include, among others, restoring and improving urban infrastructure, developing personalized medicine, and engineering the tools of scientific discovery, stand as evidence of the increasing complexity in societal needs that will likely be encountered by the engineer of the future. The solutions to these ill-structured, systemic and complex problems will inevitably require new, bold ways of thinking that must be instilled in future engineers by the leading academic institutions that prepare them for such endeavor.

To address these increasingly complex challenges, many (e.g., NAE, 2004; CRTF, 2007) believe that future engineers will require attributes such as the ability to effectively synthesize business, technical and societal insights (Jonnasen et al. 2006), the ability to operate using inter-disciplinary and trans-disciplinary approaches to work (Klein, 1990; Klein, 1996; Klein, 2004, Kline, 1995), and the ability to innovate at the intersection of perspectives (Johansson, 2006) - attributes that have been synthesized and expanded upon in *The Engineer of 2020.Visions of Engineering in the New Century* (NAE, 2004). Thus, the engineering mindset must shift from a historical "technical determinism," which drives a bias towards solutions that are technologically incremental in nature (Radcliffe and Jolly, 2003), to a holistic mindset that encompasses the attributes sought in the Engineer of 2020.

Naturally linked to the attributes likely required by future engineers are the attributes of professionals often classified as *innovators*, who strive towards the development of novel solutions to problems faced in an array of contexts, including technology and business. The mindset of these *innovators* is typically studied in relation to design (e.g., Hauser et al., 2006; Steiner, 1998; Radcliffe, 2005) and entrepreneurism (e.g., Cliff et al., 2006; Dyer et al., 2008), and can likely aid engineers in addressing future societal challenges. At an actionable level, this innovative mindset encompasses the recognition, assessment and pursuit of opportunities, by constantly challenging performance dimensions, observing and learning from parallels to problems already addressed in other contexts, experimenting for smart failure, and discovering rather than planning the path to success (Anthony et al., 2008; Sinfield, 2010).

To transfer the innovator's mindset to the context of the engineer, and enable curriculum and pedagogical transformations that foster the development of related attributes, corresponding assessment methods need to be developed, implemented, studied and validated. In this arena, much progress has come from exploring curriculum transformations (e.g., Oakes et al., 2000; Sinfield et al., 2010a), as well as pedagogical transformations (e.g., Yadav et el., 2007; Garcia, 2009; Garcia et al, in review). Nonetheless, there is a gap in the methods used to assess the impact of these educational innovations on the mindset of engineering students, which this project intends to address.

Objective and Focus

Building on a prior Engineer of 2020 Curriculum Development Grant titled "Seeking the Innovator's DNA in Engineering Students" (Sinfield et al., 2010b), the **focus** of the project described herein is to further develop, test and validate an assessment tool to measure innovative behaviors in engineering students, as shown in Figure 1. Through a prior grant, a 54 item instrument was created to assess nine innovative behaviors in engineering students. Of these 54 items, half were designed to assess whether an engineer **acts** as an innovator, and the other half were designed to assess whether an engineer **thinks** as an innovator. This project, for which IRB approval is currently being sought, will validate this assessment tool by further developing the initial question bank, testing the instrument through focus groups, performing one pilot test, and a final validation test, as described by Fowler (2009).

While many instruments have been proposed to assess multiple attributes sought in the Engineer of 2020 (e.g., Duval-Couetil et al., 2010 Cox, et al., 2009; Davis et al., 2005; Lang et al., 1999), the instrument developed through the Curriculum Development Grant is unique, due to its focus on innovative behaviors. Hence, the tool enables extensive opportunities to assess innovative behaviors in current student and faculty populations, and the impact of educational innovations on these behaviors.

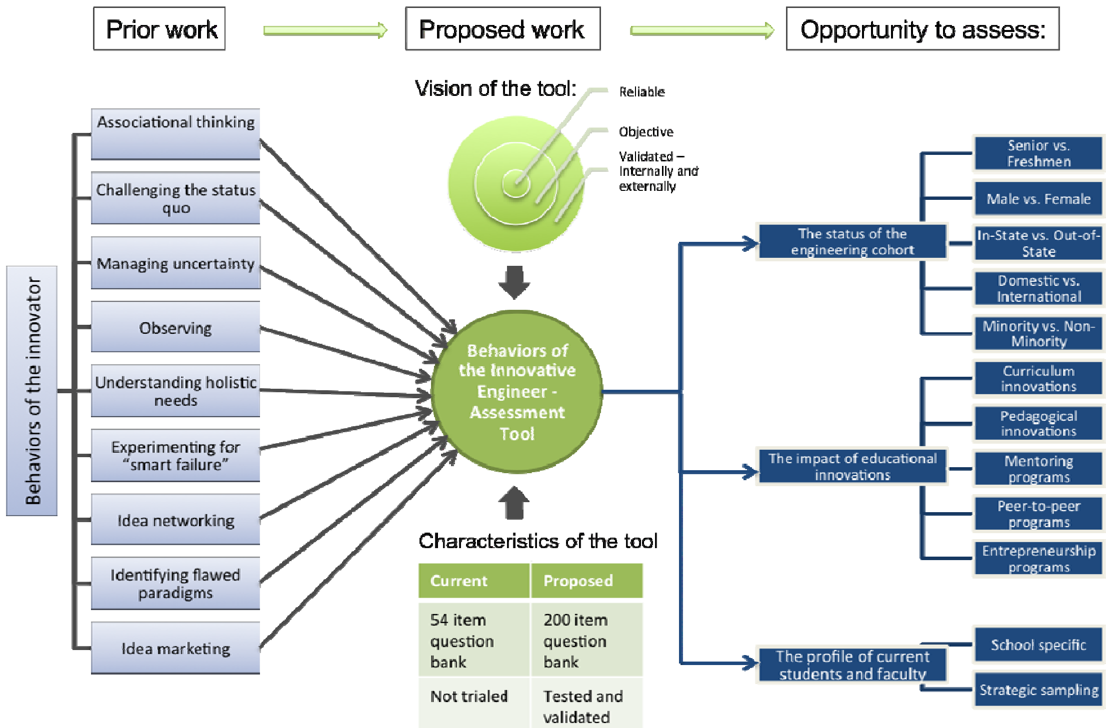


Figure 1: Innovative Behaviors Assessment Tool - Project Summary and Longer-term Potential Impact

The Innovative Behaviors of Engineering Students

The behaviors assessed by the current 54-item instrument come from an extensive review of the literature on innovative behaviors in a variety of contexts, such as business (e.g., Dyer et al., 2008) and engineering (e.g., Radcliffe, 2005; Duval-Couetil, 2010), and from the PIs' first-hand work in practice. For example, Dyer et al. (2008) identified five primary traits as evidence of the "innovator's DNA" in entrepreneurs. These traits were not readily linked to the context of the engineer and through the aforementioned Curriculum Development Grant, these were transferred to an engineering context. In addition several other attributes were identified across the literature leading to the below outlined list, with the aim of measuring them via the proposed instrument:

a) Associational thinking – Finding cause-effect patterns in complex systems by noticing connections between events and/or trends that at first are seemingly unconnected (Baron, 2006; Gavetti, 2005).

b) Challenging the status quo – Asking "what if" questions, particularly those that challenge the status quo (Dyer et al., 2008; Porter and McIntyre, 1984; Samuelson and Zeckhauser, 1988; Roca et al., 2005; Burmeister and Schade, 2006; Dyer et al., 2008).

c) Managing uncertainty – Methodically pursuing the path to low-risk, high-return projects by managing the risk-value relationship of assumptions (Anthony et al., 2008; Sinfield, 2010).

d) Observing – Informing and assessing hypotheses "as you go" through constant and intense observation (Dyer et al., 2008; Anthony et al., 2008; Johansson, 2006).

e) Understanding holistic needs – Considering functional social and emotional aspects of a challenge, by asking "why" instead of "what" to surface underlying assumptions that other engineers might not perceive as such (Anthony et al., 2008; Sinfield, 2010).

f) Experimenting for "smart failure" – Pursuing first-hand iterative learning via active experimentation of a mental, organizational, or physical nature, to uncover rather than plan the path to success (Dyer et al., 2008; McGrath and MacMillan, 1995; Sinfield, 2010).
g) Idea networking – Building diverse social networks to obtain and test ideas, particularly those that come from the intersection of fields (Johansson, 2006; Dyer et al., 2008).
h) Identifying flawed paradigms – Recognizing when to employ deliberate (i.e., linear or methodical) or emergent (i.e., non-linear or exploratory) strategies (Garcia, 2009; Mintzberg and Waters, 1985).
i) Idea marketing – Communicating to build buy-in for ideas, and to successfully implement the byproducts of engineering (e.g., Rogers, 1963; Carr, 1999; McKee et al., undated; Moore, 1991).

The PIs believe that these innovative behaviors are strongly linked to the abilities, knowledge-areas and qualities sought in the Purdue the Engineer of 2020 (CRTF, 2007). Specifically, the abilities linked to this effort include: communication, decision-making, synthesizing engineering, business and societal perspectives, and change management and recognition. The knowledge areas associated with this effort include: open-ended design and problem solving skills; multidisciplinarity within and beyond engineering; and the integration of analytical, problem solving and design skills. The qualities linked to the assessment tool include being: innovative; adaptable in changing environments; entrepreneurial and intrapreneurial; and curious and persistent learners.

For each of the innovative behaviors described above, the prototype instrument intends to assess the levels of awareness or practice at which a student thinks and/or acts as an innovator in a two dimensional descriptive space. This helps differentiate, for instance, those engineers who are aware of innovation best practices but who choose not to follow such practices from those who unknowingly act as serial innovators. Thus, by using the innovative-behaviors instrument and the think-act matrix, researchers can also assess the impact of pedagogical approaches (e.g., lecture, case study) on such behaviors.

Project Approach

To achieve the stated objective, emphasis will be placed on five primary activities, described by Fowler (2009) as fundamental to the validation of an instrument:

- Further develop the initial question bank - The question bank developed in the prototype instrument needs to be expanded from 54 questions to approximately 200 questions because students (and/or professionals) will most likely take the assessment test more than once. Therefore, the instrument needs to rely on a broad question bank to measure the innovative behaviors using different combinations of question items.

- Focus group testing of the assessment tool prototype - The aim is to receive initial feedback from groups of students (graduate and undergraduate) and faculty. These focus groups will help to ensure that the wording, overall protocol, and instructions used in the assessment tool are clear and that they appear to measure what the test actually intends to measure (Fowler, 2009). The recruitment for these focus groups will be through the PIs network of contacts, and the size of these focus groups is targeted at 6 - 10 participants in each of the three sessions (i.e., undergraduates, graduate students, and faculty).

- Pilot test – Following the focus groups, one pilot test of the assessment tool will be conducted to refine the instrument. This pilot test will help identify items that need to be deleted, due to being redundant, unclear and/or irrelevant. Recruitment for the pilot test will be conducted using snowball sampling methods (e.g., professors asking students and/or students asking other students), (Tashakkori and Teddlie, 2003), the PI's network of contacts, and, if authorized, by using the College of Engineering listserves. The target sample size for the pilot test will range from 300 - 500 respondents.

- Final validation – After the pilot test, a final test to validate the tool will be conducted. Recruitment efforts will be through the College of Engineering listserves, snowball sampling and (potentially) incentives that motivate students to participate in this final test. The data collected for this final test will be stratified (see possible stratification groups in the broader impact section), with a target sample size of 800 - 1000 respondents. This data set will be randomly separated in two groups: a training set and a validation set to conduct a random sub-sampling cross validation.
- Exploratory archetype search – With the final validation data set, an initial pattern exploration for innovator archetypes among engineering students will be conducted. This initial exploration implies studying the validation data set to assess innovative behavior levels (e.g., low associational thinking, high experimenting) in current student populations. This initial effort will enable, in future stages of related research, the development of composite test scoring reports by using statistical techniques such as unit weighting, factor analysis and factor score regression weights.

Team expertise

The topic of this proposal lies at the intersection of engineering, innovation and educational assessment, thus requiring a cross disciplinary team with specific competencies in these areas. The PI brings expertise in engineering, and a thorough professional background in innovation and business. The Co-PI brings expertise in educational assessment as the Assessment Director for the College of Engineering.

Method Evaluation

The effectiveness of the innovative-behaviors instrument will first be qualitatively assessed through focus groups and then statistically assessed by performing statistical analyses through several testing stages, as described in the project approach above. Through this complementary evaluation approach, the investigators aim to ensure the validity (Howitt and Cramer, 2005), reliability (Allen and Bennet, 2008; Howitt and Cramer, 2005), and objectivity (Tashakkori and Teddlie, 2003) of the assessment tool.

First, focus groups will ensure the clarity and quality of communication of the assessment tool (Fowler 2002), as well as initiate the efforts to validate the instrument by asking participants how well the tool describes their self-reported innovative behaviors. Then statistical analyses in the piloting phase will identify items that are redundant and/or irrelevant by using structure equation models and factor analysis (i.e., techniques for the study of factors/clusters of covariance among variables – here innovative behaviors) as described by Kaplan (2008), Warner (2008) and Washington et al. (2003). Also, emphasis will be placed on using the ideal number of question items per innovative factor (ranging from 4 – 10 question items per factor), and in collecting the ideal number of responses (targeted between 300 and 1000 respondents, depending on the testing stage).

Outcomes and Broader Impact

The primary outcome of the work proposed herein is a unique and ready to use instrument that measures innovative behaviors in engineering students. This instrument is to be disseminated in refereed journals as well as throughout the College of Engineering. There is a broad spectrum of opportunities in which this assessment tool can be utilized as outlined in Figure 1, including the following:

First, the behaviors assessed through the proposed instrument are strongly linked to a subset of the attributes desired in the Engineer of 2020, which the proposed assessment tool may help measure across different subgroups of the engineering cohort. Particularly, there is potential for comparison within and between various engineering cohort subgroups, to answer some of the key questions shown in Table 1.

Table 1: Opportunities for Cohort Studies

Assessment group	Key Question
Senior vs. Freshman students	Are engineering programs helping or hindering the development of innovative skills?
Male vs. Female students	Do men or women more naturally display certain innovative attributes?
In-State vs. Out-of-State students	Do people who have different backgrounds aid with these behaviors?
Domestic vs. International students	Do international students come with some of these behaviors?
Specific school vs. Rest of college	Is a specific school somehow cultivating these skills better than others?
Minority vs. Non-minority students	What is the difference between minority and non- minority students?
Prior entrepreneurship vs. non prior entrepreneurship training	Does entrepreneurship training help cultivate these key behaviors?

Second, this project is part of a larger innovation initiative in which the PI intends to investigate the most effective means to instill the patterns of innovation success (e.g., Anthony et al., 2008) in engineering graduate students, by using educational interventions such as mentoring and peer-to-peer programs (Sinfield, 2010). Thus the tool may help to partially assess the impact that these interventions have on enabling innovation abilities required by engineers to address the Grand Challenges of Engineering.

Finally, the instrument can be used for strategic and stratified sampling in engineering education research. The tool can help establish a baseline of innovative skills for engineering education studies, in which samples range from students with relatively lower innovation behaviors to those with relatively more advanced innovation behaviors, according to the previously described think-act descriptive space. Researchers seldom have means to assess such a baseline and with the validated tool, researchers can design experiments to test the impact of pedagogical innovations by using strategically selected samples.

The proposed work will also be disseminated throughout the College of Engineering. The assessment tool is unique to engineering contexts and its development will likely merit publication in engineering education journals. Additional publications can also come from the studies in which the tool is used at a practical, comparative level, in the search for innovation archetypes in engineering students.

Prior Seed Grant Support

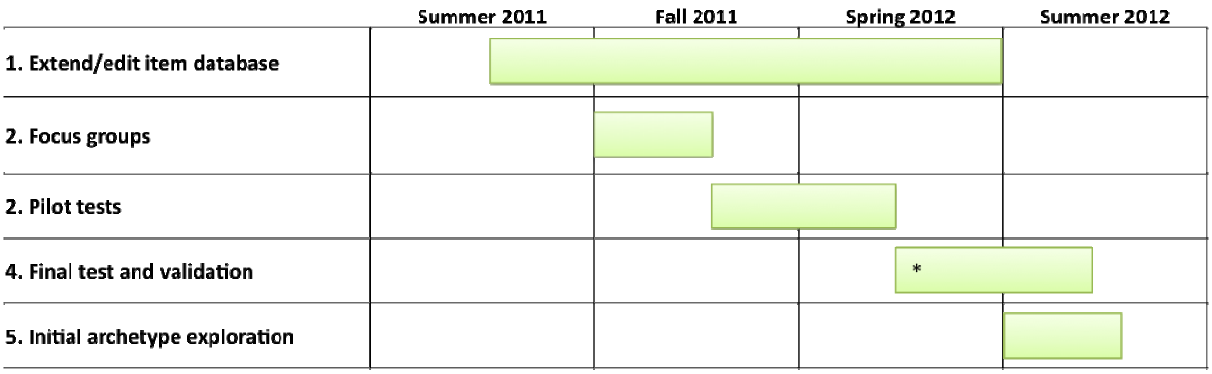
In addition to the Curriculum Develop Grant off which this project intends to build, the PI has received prior Seed Grant support through a project titled “The Engineer as an Entrepreneur: Using Case-Driven, Problem-Based Learning to Develop Adaptive Expertise,” and a Curriculum Development Grant titled “Incorporating Entrepreneurial Lessons from the Kentlands Development Case into CE512.” Both of these efforts generated multiple benefits to the Engineer of 2020 initiative.

The “Engineer as an Entrepreneur” project developed a series of case-based instructional modules that leverage entrepreneurial contexts to convey key lessons that will help engineering students develop many of the attributes sought in the Engineer of 2020. Through this effort, one peer-reviewed paper was submitted to the Journal of STEM education (Garcia et al., in review). Also, one proposal was submitted to the National Science Foundation (NSF), and, even though this NSF proposal was not funded (but highly recommended) resubmission is planned for the upcoming February NSF call for proposals. Also, the efforts conducted through this Seed Grant provided the intellectual foundation for a larger innovation initiative for which funding is currently sought through several means, particularly, NSF and the Kauffman Foundation. In addition, this work has fostered a strong collaboration between the PI and several members of the School of Engineering Education and College of Education.

The “Kentlands Development Case” project incorporated a case study created in the “Engineer as an Entrepreneur” project into CE 512 – a graduate course in Urban Planning taught by Prof. Jon Fricker. This case study and related teaching materials are currently being trialed and assessed this Spring (2011).

B. TIMELINE AND IMPLEMENTATION STRATEGY

The activities outlined in this program will be pursued over the course of 1 year as described below:



*The post-assessment and evaluation of this tool will continue as part of a larger innovation initiative

The activities outlined in this project are one of the first phases in a broader effort to study the most effective means to instill an innovative mindset in engineers and thus preliminary discussions for these activities will start as soon as funding is available. Since the focus of the project is to validate the question items developed under a previous Curriculum Development Grant, the question item database will be continuously expanded and edited throughout the course of the project.

An initial expansion of the current question item database will begin during mid Summer 2011 and will signify the commencement of the project. During early Fall 2011, the focus group testing will be conducted as a first step towards the validation of the assessment tool. After incorporating the feedback received from the focus groups into the assessment instrument, the instrument will be piloted until mid Spring 2012. Once the data from this pilot test is collected (projected for early Spring 2012), the statistical analyses of such data will represent the midpoint of the project. Following the pilot testing stage, the assessment instrument will be modified to incorporate the lessons learned through the pilot testing stage, and then tested in a final validation stage. The project will have as a final milestone, the development of a report that describes an initial archetype exploration of the innovative behaviors present among the student population that completes the instrument and the results of the study will be codified and disseminated via a journal article.

C. PERSONNEL REQUIREMENTS
Please indicate the portion of FTE that each faculty member will dedicate to the project

Faculty member	Summer 2011	Fall 2011	Spring 2012
Sinfield	1 week		
Beaudoin*	1 week		

*Note that Dr. Beaudoin requires no financial support directly through this grant given her role in the College of Engineering.

D. BUDGET
The budget worksheet is provided to assist you in developing your budget. You may fill this out and paste it directly into your proposal.

Faculty/Staff Member Funding *Please indicate the funding (dollars and time) you are requesting for the grant for this project)*			
	Grant funds requested		
Faculty/Staff Name:	% Time	Fringe Benefits	$$
Sinfield	1 week summer	$730.11	$2,365.77
Subtotal Faculty/Staff Funding		$ 730.11	$2,365.77

Graduate Students				
	Grant funds requested			
Type of position	% Time	Insurance + Fee Remit	Fringe Benefits	$$
Research Assistant (PhD)	100% 12 months	$9,748.55	$1,925.54	$22,929.17
Subtotal Grad Student Personnel		$9,748.55	$1,925.54	$22,929.17

Undergraduate Student Funding *Please indicate the student resources (funding and time) you are requesting from the grant for this project.*			
	Grant funds requested		
Type of position	Hrs/week	Fringe Benefits	$$
Subtotal Undergrad Student Personnel			

Equipment $ Software Funding *Please list all specialized equipment and software required for the project. (Do not include standard computer equipment and commonly-available software, e.g. Microsoft Office, Microsoft Windows). Mark whether any of the equipment or software is provided by the department. (Note*

that only 10% of the funds can be used to purchase equipment and it needs to be dedicated to the goals of the project.	
Name of Equipment	Funds Requested
Subtotal Equipment	$0.00
Name of Software	
Subtotal Software	$0.00
Other miscellaneous items (Computer media, cables, etc)	
Phone use and photocopying	$300.00
Subtotal miscellaneous	$0.00
Other expenses	
Survey incentives	$1,000.00
Travel	$1,000.00
Subtotal other expenses	$2,000.00

E. BUDGET JUSTIFICATION

Personnel:
Investigators: One week of summer salary is requested for the PI to support the proposed level of commitment to this project.

Graduate Students:
Funding is requested to cover the stipend, fringe benefits, insurance and fee remits for one year for one full time PhD student.

Miscellaneous
$300 is budgeted for miscellaneous supplies and expenses (e.g., photocopying, phone line costs).

Other supplies and expenses
$2,000 is also budgeted for survey incentives ($1,000) and travel ($1,000) that will be associated with efforts to disseminate project findings.

F. REFERENCES

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G. PI Biosketch

JOSEPH V. SINFIELD

A. Professional Preparation

Bucknell University	Civil Engineering**,** B. Sc. **(**Summa Cum Laude)	1992
Massachusetts Institute of Technology	Civil and Environmental Engineering, M. Sc.	1994
Massachusetts Institute of Technology	Civil and Environmental Engineering, Sc. D.	1997
Massachusetts Institute of Technology	Civil and Environmental Engineering, Post-doc	1997-1998

B1. Academic Appointments

Assistant Professor of Civil Engineering Purdue University May 2004 -present

- Perform research and teach at both graduate and undergraduate levels in two areas: 1) development and optimization of sensors for use in the natural environment, with emphasis on geoenvironmental applications of optical spectroscopy, including bioremediation and waterway contaminant monitoring, macro-nutrient evaluation in agriculture, sensor bio-fouling countermeasures, and fluorophore suppression, and 2) Innovation management, technology commercialization, and entrepreneurship

B2. Non-academic Appointments

Innosight, LLC (Watertown, MA) Jan 2004 **-** present

- Senior Partner - Facilitate executive training and provide council to leaders of established firms and start-ups on innovation, entrepreneurial leadership skills, growth strategy, business model innovation, and innovation process design in a broad range of commercial sectors; co-developed disruptive opportunity assessment tools, jobs-to-be-done market research methodology, and overall approach to develop and commercialize concepts in new markets

McKinsey & Company (Chicago, IL/Boston, MA) Dec 1998 – Jan 2004

- Management Consultant - led multiple teams of diverse and highly talented individuals in efforts to advise leaders of Fortune 100 companies on issues of growth, technology investment, innovation management, and go-to-market strategy. Selected engagements:

  Technology investment
  - helped an $11 billion IP services provider upgrade its business model and network to deal with industry transition from copper-line to fiber-optic technology through an $850M acquisition
  - devised an aggressive growth strategy for a $150 million fledgling manufacturer of fiber optics and copper-line test and measurement equipment founded on the acquisition of new technologies

  Innovation management
  - helped a $2.4 billion manufacturer of network power equipment refine its offering to address shifts in the telecommunications infrastructure that dramatically altered power requirements
  - assessed the technological and economic impact of a step-change in engine emissions standards on the viability of a $13 billion industrial equipment manufacturer's engine business

  Research and development
  - devised a flexible product development plan to help a manufacturer of professional-level cameras move down-market and serve general consumers by leveraging low-cost digital technology
  - launched a biopharma contract solutions business to help a chemical company manage an industry move from chemical synthesis of active pharmaceutical ingredients to biological manufacturing

Haley & Aldrich Company, Inc. (Cambridge, MA) May 1994- Jan 1995

- Geotechnical Engineer - performed design calculations, reviewed site exploration data, carried out on-site inspections, prepared project reports.

Germaine & Associates (Cambridge, MA) Jan 1995 - Apr 1997

- Consulting Engineer - conducted advanced soils tests and radiographic investigations.

C. Selected Publications

Five related publications

- Anthony, S.D., Johnson, M.W., Sinfield, J.V., Altman, E.J., **The Innovator's Guide to Growth – Putting Disruptive Innovation to Work**, Harvard Business Press, 2008; (Translated into Japanese (October 2008), Mandarin (December 2008), Polish (March 2010), and Spanish (August 2010)).
- Anthony, S.D., Johnson, M. W., Sinfield, J.V., **Sloan Management Review**, "Institutionalizing Innovation," Vol. 49, No. 2, pp. 45-50, Winter 2008.

- Anthony, S. D., and Sinfield, J.V. “Product for Hire: Master the Innovation Lifecycle with a Jobs-to-be-Done Perspective”, **Marketing Management**, March/April, pp. 17-24, 2007.
- Sinfield, J., Anthony, S. “Constraining Innovation: How Developing and Continually Refining Your Organization’s Goals and Bounds Can Help Guide Growth”, **Strategy & Innovation**, November – December, Vol. 4, No. 6, p. 1, 6-9, 2006.
- Sinfield, J., Thomson, D., and Carter, C. “Blueprint to a Billion: From Disruption to Dominance”, **Strategy & Innovation**, July – August, Vol. 4, No. 4, p. 1, 6-10, 2006.

Five other recent publications

- Sinfield, J.V., Colic, O., Fagerman, D. and Monwuba, C. “A Low-cost Time-resolved Raman Spectroscopic Sensing System Enabling Fluorescence Suppression,” **Applied Spectroscopy**, v. 63, n. 2, 201-210, 2010.
- Sinfield, J.V., Fagerman, D. and Colic, O. “Evaluation of Sensing Technologies for On-the-Go Detection of Macro-Nutrients in Cultivated Soils,” **Computers and Electronics in Agriculture**, v, 70, n. 1, 1-18, 2010.
- Dunston, P.S., Sinfield, J.V., Lee, T.Y., **ASCE Journal of Construction Engineering and Management**, “Technology Development Decision Economics for Real-time Rolling Resistance Monitoring of Haul Roads,” Volume 133, Issue 5, pp. 393-402, May 2007.
- Sinfield, J.V., Hemond, H.F., Germaine, J.T., Johnson, B., and Bloch, B., “Contaminant Detection, Identification, and Quantification Using a Microchip Laser Fluorescence Sensor,” **ASCE Journal of Environmental Engineering**, v.133, n. 3, 346-351, 2007.
- Sinfield, J.V., “A Structured Approach to Technology Assessment”, **Strategy & Innovation**, September – October, Vol. 3, No. 5, pp. 1, 10-13, 2005.

D. Synergistic Activities

Activities to Promote Entrepreneurship and Innovation

- Purdue University Committee for SURF Program (2008-present)
- Purdue Discovery Park Leadership Team – 2004 - 2006
- Task Force on Entrepreneurship Education Programs – Chair – 2006
- Purdue Discovery Park Task Forces on Industrial Relations and Conflict of Interest – 2005
- Task Force to develop DP Office of Industrial Collaboration – Co-chair 2005

Activities to Engage Industry

- Innovation advisory board member: Wacker Chemie, GmbH (2007); Infineum [Exxon-Mobil/Shell JV] (2007-2008); Black & Veatch (2010); Purdue Civil Engineering Advisory Council (2008–)
- Byline author for multiple contributions in periodicals such as Marketing Management, BusinessWeek On-Line, Forbes.com, Financial Executive, IndustryWeek

Activities to Instill Innovative and Entrepreneurial Attributes in Engineering Students

- Created three new courses on entrepreneurship, strategy and communications in the engineering program, two of which are approved for Purdue’s Certificate in Entrepreneurship
- PI on Grants funded through Purdue’s Engineer of 2020 Program
  - Curriculum Development Grant “Seeking ‘The Innovator’s DNA’ in Engineering Students” funded through Purdue’s Engineer of 2020 program (2010)
  - Curriculum Development Grant “Incorporating Entrepreneurial Lessons from the Kentlands Development Case into CE51200: The Comprehensive Urban Planning Process (2010)
  - Seed Grant “The Engineer as an Entrepreneur: Using Case-Driven, Problem-Based Learning to Develop Adaptive Expertise” (2008-2009)

E. Collaborators and Other Affiliations

(i) Collaborators: R. Adams, S. Brouder, C. Christensen (Harvard), D. Abraham, A. Bobet, P. Dunston, J. Frankenberger, H. Hemond (MIT), C. Johnston, G. Miles, M. Santagata, A. Varma, A. Yadav

(ii) Graduate and Thesis Advisor: J.T. Germaine and H.H. Hemond, MIT

(iii) Graduate Advisor (Research): Chike Monwuba, Hao Bai, Freddy Solis – Doctor of Philosophy Candidates; Seungwoo Paik, Xiwen Shi – Master of Science Candidates.

Total number of graduate students directed: 17

G. PI Biosketch

Diane L. Beaudoin, Ph.D.

Director of Assessment
Joint appointment College of Engineering Purdue University and
Network for Computational Nanotechnology Purdue University
MSEE, Room 308H
501 Northwestern Avenue
West Lafayette, IN 47907
Tel: (765) 494-9246
Email: **beaudoin@purdue.edu**

Professional Preparation:

B.S., The University of Texas at Austin, Chemical Engineering, May 1990.

Ph.D., North Carolina State University, Chemical Engineering, December, 1996.

Scholar, Institute for the Development of Excellence in Assessment Leadership, 2007.

Appointments:

Purdue University, Director of Assessment, Network for Computational Nanotechnology and College of Engineering, April 2008 - present.

Purdue University, Assessment Consultant, College of Engineering, April 2007 – April 2008.

Purdue University, Assessment Consultant, School of Chemical Engineering, March 2006 – April 2007.

Arizona State University, Lecturer, Department of Chemical, Bio and Materials Engineering, January 1996 – May 1999.

Publications:

Madhavan, K. P. C., Beaudoin, D., Shivarajapura, S. Adams, G. and Klimeck, G., “nanoHUB.org serving over 120,000 users worldwide: its first cyber-environment assessment,” IEEE Nano, August 2010.

Madhavan, K. P.C, Klimeck, G., Beaudoin, D., Adams, G. Shivarajapura, S. and Radcliffe, D., “Bridging engineering practice and learning through cyber-environments,” ICLS Chicago, 2010.

Beaudoin, D. L., Davies, D., Bryers, J. D., Cunningham, A. B. and Peretti, S. W., “Mobilization of a Broad Host Range Plasmid from *Pseudomonas putida* to an Established Biofilm of *Bacillus azotoformans* Part I: Experiments”, Biotechnology and Bioengineering, Vol. 57, pp. 272-279, 1998.

Beaudoin, D. L., Bryers, J. D., Cunningham, A. B. and Peretti, S. W., “Mobilization of a Broad Host Range Plasmid from *Pseudomonas putida* to an Established Biofilm of *Bacillus azotoformans* Part I: Modeling”, Biotechnology and Bioengineering, Vol. 57, pp. 280-286, 1998.

Beaudoin, D. L. and Ollis, D. F., "A Product and Process Engineering Laboratory for Freshmen", Journal of Engineering Education, Vol. 84, pp. 279-284, 1995.

Invited Workshops:

"Really Engaging Your Faculty and Industrial Advisory Boards," 3 hour workshop, ABET Symposium, Las Vegas, April 15, 2010.

"Coordinating and Planning a Multi-Program Accreditation Visit," 90 minute workshop, ABET Symposium, Las Vegas, April 16, 2010.

Synergistic activities:

Assessing the use and impact of nanoHUB technologies used by the Network for Computational Nanotechnology (NCN).

Student learning outcomes assessment for undergraduate engineering education.

Accreditation of undergraduate engineering programs.

H. Current and Pending Support - Sinfield

Investigator: Joseph V. Sinfield	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Geoenvironmental Influences on Raman Spectroscopic Monitoring of Chlorinated Solvents

Source of Support: National Science Foundation

Total Award Amount: $151,308 Total Award Period Covered: 8/1/2009 - 7/31/2011

Location of Project: Purdue University

Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 2 weeks

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Investigator: Joseph V. Sinfield	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Engineering the Pore Fluid of Sands with Highly Plastic Nano-Particles for Liquefaction Prevention

Source of Support: National Science Foundation

Total Award Amount: $179,998 Total Award Period Covered: 8/1/2009 - 5/31/2011

Location of Project: Purdue University

Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 1 week

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Investigator: Joseph V. Sinfield	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Non-destructive evaluation of the Condition of Subsurface drainage in pavement using GPR

Source of Support: Indiana Department of Transportation/ JTRP

Total Award Amount: $198,853 Total Award Period Covered: 1/1/2010 - 6/30/2012

Location of Project: Purdue University

Person-Months Per Year Committed to the Project. Cal: Acad: 7.5% Sumr: 2 weeks

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Investigator: Joseph V. Sinfield	Other agencies (including NSF) to which this proposal has been/will be submitted. None
Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support	
Project/Proposal Title: **Enabling high- and low-molecular weight AUV-based chemical analysis: Complementing mass spectrometry with multichannel time-resolved fluorometry aboard the NEREUS/Odyssey vehicle**	
Source of Support: National Oceanic and Atmospheric Administration, MIT Sea Grant Program	
Total Award Amount: $75,000 Total Award Period Covered: 02/01/09 – 01/31/11	
Location of Project: Purdue University	
Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 0	
*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.	
Investigator: Joseph V. Sinfield	Other agencies (including NSF) to which this proposal has been/will be submitted. None
Support: ☐ Current X Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support	
Project/Proposal Title: **Engineering Education Incubator (e2i): A Network for Educating Future Engineering Innovators, Entrepreneurs and Leaders**	
Source of Support: National Science Foundation	
Total Award Amount: $10,000,000 Total Award Period Covered: 8/11/2011 - 8/10/2016	
Location of Project: Purdue University	
Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 1 week	
*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.	