Purdue's Engineer of 2020
Seed Grant Funding for 2008-2009
Purdue University

Project Title:
"Creation of an Instrument to Measure Selected Attitudes in Purdue's Engineer of 2020"

Target Attribute(s) to be studied/implemented:

- Leadership
- Recognize and manage change
- Synthesize engineering, business, and social perspectives

PI Information:

Name: Monica F. Cox
Email: mfc@purdue.edu
Department: Engineering Education
School: College of Engineering
Campus address: 701 West Stadium Avenue, ARMS 1329
Phone number: 496-3461
Fax: 494-5819
Department Head Name: Kamyar Haghighi
Department Head email: haghighi@purdue.edu.

Project Description

Introduction

Given that the half-life of an engineer's knowledge is estimated to be less than five years[1] and that competition to recruit top engineering students to graduate school is increasing globally, an understanding of the norms of the engineering profession along with the attributes and skills needed by engineering graduates already has been a focus of national leaders,[2] policy organizations,[1,3,4] industry,[5,6] and academia.[7] From an academic perspective, studies have explored which of the Accreditation Board for Engineering and Technology's criteria a-k are most important to supervisors of engineering graduates.[8-10] Koehn and Parthasarathy[11] found that the perceived importance of the outcomes differed across civil engineering seniors, alumni, and practitioners; and other researchers found that engineering professionals do not give equal precedence to all of the criteria. Despite these studies, comparisons between industrial supervisors and academicians are missing.

From an industrial perspective, the Boeing Corporation created a survey that maps to ABET's 2000 Criterion 3- Program Outcomes and Assessments[5] and quantifies industry's response to the attributes needed of undergraduate engineers entering the aerospace industry. Researchers such as Davis, Beyerlein, and Davis[6] expanded this study by creating an engineering profile for engineers engaging in professional practice. Developed for use by students during the first five years following their graduation with a baccalaureate degree, this profile was created from ten holistic characteristics predetermined by the research team. Missing however, from both studies is a research methodology beginning with exploratory, qualitative methods.

In response to these limitations, this proposal examines *three attributes* of Purdue's Engineer of 2020 (i.e., leadership, recognize and manage change, and synthesize engineering, business, and social perspectives), targets *engineering* undergraduate students, and uses a *mixed methods* approach to understand how to prepare these students effectively for careers within academia *and* industry. More specifically, we will detail a research and learning plan that involves the development and implementation of a tool that examines undergraduate students' embodiments of the selected attributes. Results from this assessment will be used to inform the development of instructional strategies related to the three attributes.

Research Objectives

The goal of this research plan is to construct an assessment tool to measure Purdue's status regarding the following attributes: "leadership," "recognize and manage change," and "synthesize engineering, business, and social perspectives." Our research objectives are as follows:

- To identify, within academia and industry, observable outcomes that Purdue's Engineer of 2020 should demonstrate for the three targeted attributes; and
- To design, develop, and validate an assessment instrument of the identified outcomes.

Theoretical Framework

The project's theoretical foundations are Instructional Theory, and, its derivate, Instructional Systems Design (ISD). Literature differentiates learning theories from instructional theories because, although closely related, they are not the same.[12] Robert M. Gagné, the most famous proponent of instructional theory, states that "instructional theory does not in itself try to state what the processes of learning are or how they work… The province of an instructional theory is to propose a rationally based relationship between instructional events, their effect on learning processes, and the learning outcomes that are produced as a result of these processes."[13] Purdue's Engineer of 2020 is aligned with the creation of instructional events, their effects, and their outcomes; therefore we consider the use of Instructional Theory to be pertinent.

Since Instructional Theories imply design and development of instruction, they are in many instances also referred to as ISD Models. ISD Models, created originally by engineers and psychologists such as Gagné, share the following landmark aspects:[14]

- A Systems approach to education that involves an analysis and breaking down of content into specific behavioral objectives devising the necessary steps to achieve those objectives, setting up procedures to try out and revise step, and validating the program against attainment of the objectives.

- Gagne's Conditions to promote learning in five domains of learning outcomes. These include verbal information, intellectual skills, psychomotor skills, attitudes, and cognitive strategies

A condition of special interest is Gagné's "attitude" domain. An attitude is defined "as a mental state that predisposes a learner to choose to behave in a certain way."[13] We consider that many of the attributes of Purdue's Engineer of 2020 belong to the attitude domain, specifically the ones of our interest. With more than 40 models of ISD, the selected model for this project is Dick & Carey[15] (Figure 1) because of its simplicity and applicability. The scope of this project is on two specific "blocks" of the model that focus on (1) Assessing needs to identify goal(s) and (2) Developing assessment instruments.

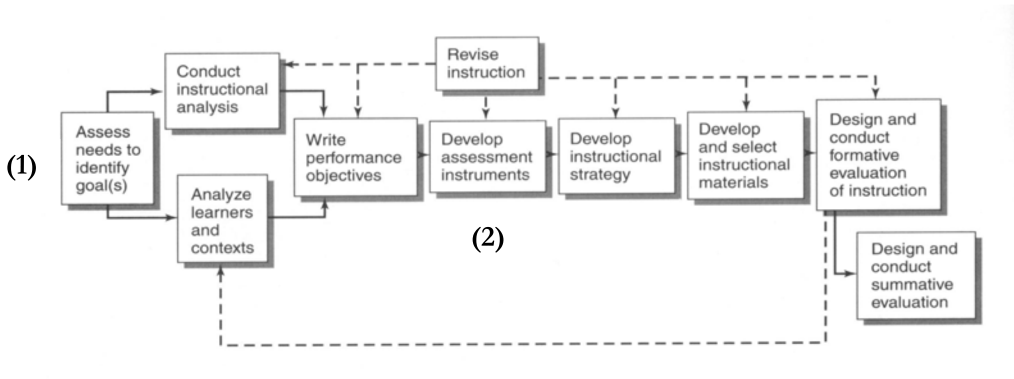

Figure 1. Dick and Carey Model for Instructional System Design[15]

Evaluation Plan: Approach, Methods, Expected Results, and Assessment Methods

The evaluation plan is based on a mixed-methods research design. The initial phase is exploratory in nature and therefore could be better informed with a qualitative method of inquiry. The second half is a survey design which could be better informed by a quantitative method of inquiry.[16] The project is arranged in two phases that respond directly to two research questions. The two phases of the project are depicted on Figure 2 and are described in subsequent sections.

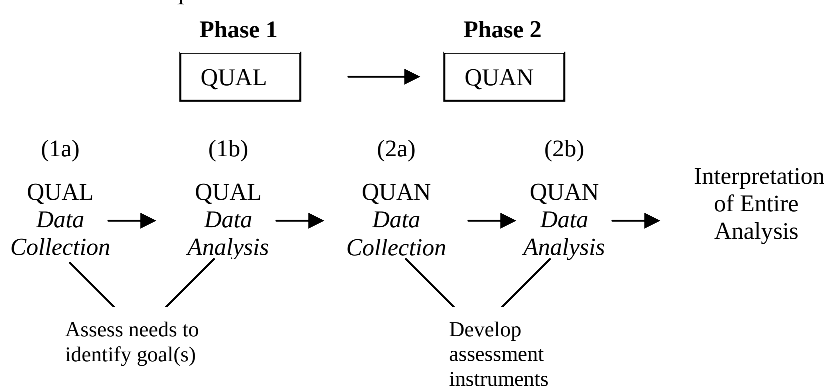

Figure 2: Schematic of the Proposed Research Plans as related to Theoretical Framework
Both qualitative (QUAL) and quantitative (QUAN) research methods will be used.

<u>Phase I. What Do Engineering Experts Within Academia and Industry Identify as the Outcomes for Selected Attributes of Purdue's Engineer of 2020?</u>

Within Phase I, we will conduct focus groups with both engineering industry and academic professionals to identify outcomes of three targeted attributes that Purdue's engineering students must embrace. Outcomes are defined as what the students should be able to do when they exhibit "leadership," "recognize and manage change," and "synthesize engineering, business, and social perspectives."

Qualitative Data Collection (1a)

A stratified sample of approximately 12 engineering experts will be recruited to participate in this study (6 from industry and 6 from academia). This sample was selected based upon the work of Creswell.[16] The research team will work closely with Mr. Bob Davis, the Assistant Head of Purdue's Department of Engineering Education, former head of two departmental Industrial Advisory Boards, and an engineering professional with 39 years of industrial experience, in the recruitment of industrial experts who vary relative to occupational background, age, disciplinary are of expertise, gender, race, ethnicity and current job responsibility. Similarly, engineering academicians will be recruited through faculty directory searches within Engineering Departments in the College of Engineering. E-mails will be sent to faculty within these departments to solicit their participation in the study. Efforts will be made to select participants who also vary relative to occupational background, age, disciplinary are of expertise, gender, race, ethnicity and faculty rank.

To identify the outcomes of three attributes of Purdue's Engineer of 2020 needed by engineers within industry and academia, focus groups will be organized, one for the academic group and one for the industry group. Focus groups provide a powerful investigative tool since they evolve in an environment in which consensus is continually built within the group and relies on negotiation of understandings[16]. Initial exploratory questions based upon *The Engineer of 2020*,[15] *Rising above the Gathering Storm*,[17] and related literature will be asked.

Both focus groups will be digitally recorded (with permission from the participants) and the facilitator will take reflective notes during the interviews. Prior to conducting the focus groups, exploratory questions will be piloted to approximately three people who meet the selection criteria. These three people will not be included in the sample, however. After reviewing the pilot data, a final list of questions will be generated.

Qualitative Data Analysis (1b)

After transcribing the focus groups' data, a general sense of the results will be obtained by continuous reading and re-reading of the data and an examination of the reflective notes. We will note significant comments; organize the statements into segments; pool the segments together and assign codes for both the academic and industrial focus groups. From here, we will test the codes and categorize the codes based on repeated patterns. Codes from the academic focus group's data will be placed in an Academic Subscale, and codes from the industry focus group's data will be place in an Industry Subscale. Differences and similarities in patterns for both subscales will be examined, and quantification of this data will occur within the next phase of the research.

<u>Phase II. Is the Instrument that is Developed Based upon the Responses of These Experts a Reliable and Valid Measure of The Outcomes of the Three Attributes?</u>

The qualitative analysis within Phase I of the research will be used in the design, development, and validation of an assessment tool that represents both the academic and industrial perspectives of the selected attributes of Purdue's Engineer of 2020. This tool will expand engineering education's repertoire of valid and reliable assessment tools that examine student's acquisition of leadership skills, their recognition and management of change, and synthesizing of engineering, business, and social perspectives.

Quantitative Data Collection (2a)

The academic and industrial subscales created within Phase I of the research will provide the basis for a web-based Likert scale survey that will be piloted to a stratified sample of undergraduate engineering students and Purdue University. This web-based version of the survey will be used to guarantee a quick turnaround in the collection of data and to reduce overhead in the distribution of the survey instrument. Students will not be able to identify explicitly the subscales within the survey. A demographics survey will be distributed to the sample of students so we may obtain general demographics information (e.g., age, gender, and ethnicity) and additional information such as the number of years students have been enrolled in their undergraduate program along with their disciplinary backgrounds.

Before distributing the survey to a larger engineering population, it will be piloted to a sample of 20-30 undergraduate engineering students representing diverse populations. With the assistance of the Registrar's Office, the population of this study will be undergraduate engineering students enrolled as full-time and part-time students at Purdue University. Sampling of students for the study will vary by age, disciplinary area, gender, race, and ethnicity. Students will be asked to participate in the research via e-mails. Results of this piloted survey will be used to improve subscale questions, the survey format, and scales as needed.

Quantitative Data Analysis (2b)

Once data have been collected, the methods to reduce response bias will be addressed. Descriptive statistics (e.g., mean scores on the Academic and Industrial subscales) will be run using a statistical software package such as SPSS, and differences across diverse groups will be examined. Factor analysis will be used to confirm the classification and goodness-of-fit statistics of the academic and industrial subscales. The internal consistency (reliability) of the subscales will be examined using Cronbach's alpha statistic and other appropriate methods.

Timeline and Implementation Strategy

Semester	Activities
Fall 2008	Phase I Begins • Hire graduate student researcher(s) for the project • Create solicitation materials for the study • Recruit engineering experts from industry and academia • Pilot exploratory focus group's questions • Finalize the list of questions for focus groups • Conduct focus groups with experts • Compile expert's responses; Begin transcriptions; • Create the academic and industry subscales for the survey • Identify and report differences and similarities in expert's responses Phase 1 Ends
Disseminate Phase I findings to Departments in the College of Engineering	
Spring 2008	Phase II Begins • Transfer subscale items to a web-based survey • Identify and recruit a small sample of students to pilot the instrument • Analyze pilot data • Revise tool based upon pilot data • Calculate descriptive statistics • Confirm the classifications of the academic and industrial subscales • Determine the internal consistency/reliability of the tool Phase II Ends
Disseminate Phase II research activities to Departments in the College of Engineering	
Summer 2008	Interpretation of entire analysis
Disseminate cumulative findings within the Departments of the College of Engineering	

Internal and External Dissemination Plan

The results of this study will serve as the basis for the development of seminars and workshops, the inclusion of undergraduates in summer and academic-year research projects, and the creation of a new course aligned with the attributes targeted within this proposal. First, the research team will invite faculty, staff, and students to engage in interactive workshops addressing students' acquisition of the three attributes. The research team will give a research presentation of current results and will invite interested parties to engage in conversations about the dissemination of the tool developed within this study. These conversations will provide feedback for wider dissemination of the tool among undergraduates within the College of Engineering. Second, the research team will recruit undergraduate researchers from Purdue's Louis Stokes Alliance for Minority Participation (LSAMP), the Summer Undergraduate Research Fellowship (SURF), and the Discovery Park Undergraduate Research Internship (DURI) programs to engage in research throughout the summer and the academic year. Student researchers will present their findings to peers and faculty within the College of Engineering and across the University via poster presentations and papers. Finally, building upon a graduate level "Leadership, Policy, and Change" course developed by the PI, this research will implement instructional strategies within "Leadership, Policy, and Change" short courses or an Engineering Education course taught to undergraduate engineering students.

Intellectual Merit, Broader Impacts, and Future Funding

This project is significant because it explores in-depth insights that experts in both academia and industry identify related to leadership, recognizing and managing change, and synthesizing engineering, business, and societal perspectives. This proposal is grounded in instructional theories and models and results in the development of a tool that assesses undergraduate engineering students' acquisitions of the three targeted Purdue Engineer of 2020 attributes. Although several of the Purdue 2020 attributes have been explored via existing centers and initiatives, this research is innovation because of its exploration of leadership and change-- topics that are not explicitly taught or researched at the undergraduate level within the College of Engineering.

This research engages a variety of stakeholders (i.e., engineers in industry, engineering faculty, engineers in academia; and undergraduate students) in an empirical study of undergraduate engineering education. The proposed tool may be used to collect data which might be parsed by a variety of variables (e.g., gender, ethnicity) in an effort to note the similarities and differences in the current states of Purdue's Engineer of 2020 attributes. Building upon the diversity of the PI's research group (4 underrepresented female students and 2 Caucasian males), special efforts will be made in mentoring underrepresented populations within undergraduate research projects for the duration of the award.

The PI has a demonstrated capacity to conduct research and secure externally research funding. This seed grant would complement her NSF CAREER award (NSF #0747803) that will identify, within academia and industry, the norms, skills, and attributes that doctoral students must embrace to succeed in academic and industrial engineering careers. Seed grant and CAREER findings will be coupled in the development of large-scale, multi-university research grants that explore the relationships between engineering students' professional development experiences at all educational levels and their acquisition of attributes such as those listed within Purdue's Engineer of 2020.

References

1. National Academy of Engineering. (2004). *The Engineer of 2020: Visions of Engineering in the New Century.* Washington, D. C.: The National Academies Press.

2. Wulf, W.A. (1998). The urgency of engineering education reform. *The Bridge*, *28,* 1, 4-8.

3. National Academy of Engineering (2005). *Educating the Engineer of 2020: Adapting Engineering Education to the New Century.* Washington, D. C.: The National Academies Press.

4. Lawson, W.D. (2004). Professionalism: The golden years. *Journal of Professional Issues in Engineering Education and Practice, 130,* 1, 26-36.

5. Lang, J.D., Cruse, S., McVey, F.D., & McMasters, J. (1999). Industry expectations of new engineers: A survey to assist curriculum designers. *Journal of Engineering Education, 87*, 43-51.

6. Davis, D.C., Beyerlein, S.W., & Davis, I.S. (2005). Development and use of an engineering profile. *Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition*, Session 3155, 15 pgs.

7. Accreditation Board for Engineering and Technology (ABET) (2003). *Criteria for accrediting programs in engineering.* Baltimore, MD: Accreditation Board for Engineering and Technology.

8. Evans, D.L., Beakley, G.C., Crouch, P.E., & Yamaguchi, G.T. (1993). Attributes of engineering graduates and their impact on curriculum design. *Journal of Engineering Education*, *83,* 203-211.

9. Benefield, L.D., Trentham, L.L., Khodadadi, K., & Walker, W.F. (1997). Quality improvement in a college engineering instructional program. *Journal of Engineering Education*, *86,* 203-211.

10. Koen, P.A., & Kohli, P. (1998). ABET 2000: What are the most important criteria to the supervisors of new engineering undergraduates? *1998 Proceedings of the American Society for Engineering Education Conference.*

11. Koehn, E., & Parthasarathy, M.S. (2005). Practitioner and employer assessment of ABET outcome criteria. *Journal of Professional Issues in Engineering Education and Practice, 131,* 4, 231-237.

12. Smith, P. L. & Ragan T. J. (1999). *Instructional Design* (2nd ed.). New York: John Wiley & Sons.

13. Gagne, R. (1985). *The Conditions of Learning* (4th ed.). New York: Holt, Rinehart & Winston.

14. Reiser R. A. (2001). A History of Instructional Design and Technology: Part II: A History of Instructional Design. *Educational Technology, Research and Development, 49(*2), 57-67.

15. Dick, W., & Carey, L. (1996). *The systematic design of instruction.* New York: Harper Collins Publishers.

16. Creswell, J. W. (2007). *Educational Research: Planning, Conducting, and Evaluating Quantiative and Qualitative Research* (3rd Ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

17. NRC (National Research Council). (2006). *Rising above the gathering storm: Energizing and employing America for a brighter economic future.* Washington, D.C.: National Academies Press. Available online at: http://www.nap.edu/catalog/11463.html.

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

Faculty member	Fall 08	Spring 08	Summer 09
Monica F. Cox			25%

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	$$
Monica F. Cox	25	712.00	2024.00
TBD Post Doc	100%	13028.00	33750.00
Subtotal Faculty/Staff Funding		$ 13740.00	$35774

Graduate Students				
	Grant funds requested			
Type of position	% Time	Insurance + Fee Remit	Fringe Benefits	$$
Subtotal Graduate Student Personnel		$ 0.00	$ 0.00	$ 0.00

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 Undergraduate 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)	
Subtotal miscellaneous	$0.00
Other expenses	
Other Supplies & Expenses	$486.00
Subtotal other expenses	$486.00

Budget Justification

This requested budget totals $50,000 for the one year period beginning August 21, 2008 and ending August 21, 2009. These dates align with the start date of the PI's CAREER study.

<u>Faculty/Staff Member Funding</u>
Monica F. Cox is requesting $2024 for one week of summer salary at 25% of her time, and $33,750 for the hiring of a post-doctoral research assistant at 100% time. (The remaining money

to hire the post-doc will be pulled from the PI's start-up funds.) Fringe benefit expenses for Dr. Cox are $712, and fringe benefits for the post-doc are $13028.

Supplies and Expenses

The project team is requesting $486 for supplies and expenses. This includes compensation for focus group participants and for the purchase of books and other supplies to record and analyze data.

Current and Pending Support

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: **Monica F. Cox**

Other agencies (including NSF) to which this proposal has

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

Project/Proposal Title:

CAREER: An Examination of Graduate Education's Role in Preparing Engineering Students for Careers in Academia and Industry

Source of Support: National Science Foundation

Total Award Amount: $540,047 Total Award Period Covered: 08/18/08-08/17/13

Location of Project: Purdue University

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.5

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

Project/Proposal Title:

Course Innovations as a Basis for Engineering Graduate Student Professional Development in Teaching

Source of Support: National Science Foundation

Total Award Amount: $149,961 Total Award Period Covered: 6/1/07-11/30/08

Location of Project: Purdue University

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.5

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

Project/Proposal Title:

Expansion of "How People Learn" Metrics in Engineering Classes

Source of Support: National Science Foundation

Total Award Amount: $190,340 Total Award Period Covered: 3/1/07-8/31/09

Location of Project: Purdue University

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.5

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

Project/Proposal Title:

REU Site: Design, Application, Analysis, and Control of Interfaces (DAACI)

Source of Support: National Science Foundation

Total Award Amount: $294,363.00 Total Award Period Covered: 3/1/07-2/29/10

Location of Project: Purdue University

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.5

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future Support:

Project/Proposal Title:

GSE/RES: Examining Engineering Perceptions, Aspirations and Identity Among Young Girls

Source of Support: National Science Foundation
Total Award Amount: $449,953 Total Award Period Covered: 1/1/08-12/31/10
Location of Project: Purdue University
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.25

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

NSF Form 1239 (10/99) USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support
(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: **Monica Cox**

Other agencies (including NSF) to which this

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

Project/Proposal Title:
Capacity Vitalization of Megacities

Source of Support: National Science Foundation
Total Award Amount: $18,500,000 Total Award Period Covered: 8/1/08-7/31/13
Location of Project: Purdue University
Person-Months Per Year Committed to the Project. Cal: Acad: 1.5 Sumr: 1

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

NSF Form 1239 (10/99) USE ADDITIONAL SHEETS AS NECESSARY

MONICA F. COX

Assistant Professor of Engineering Education
Department of Engineering Education, Purdue University
400 Centennial Mall Drive
SSA1, Room 6
West Lafayette, IN 47907-2016

Phone: (765) 496-3461
Fax: (765) 494-5819
E-mail: mfc@purdue.edu

a. Professional Preparation
Spelman College, Mathematics (*cum laude)*, B.S, 1998
University of Alabama, Industrial Engineering, M.S., 2000
Peabody College at Vanderbilt University, Higher Education Administration, Ph.D., 2005

b. Appointments
Assistant Professor, Engineering Education, Purdue University, W. Lafayette, IN, 2005-present

c. Publications
(i) Closely Related:

1. Smith, K., Douglas, T.C., & Cox, M.F. (In Press, 2007). Supportive Teaching and Learning Strategies in STEM Education. Book chapter in *New Directions in Teaching and Learning: Creating a Culture/Climate that Supports Undergraduate Teaching and Learning in Science, Technology, Engineering, and Mathematics.*
2. Cox, M.F., & Cordray, D.S. (Accepted for Publication, October 2008). Assessing Pedagogy in Engineering Classrooms: Quantifying Elements of the "How People Learn" Model Using the VaNTH Observation System (VOS). *Journal of Engineering Education.*
3. Cox, M.F., Andriot, A., & Follman, D.K. (In Review). Engineering Students' Motivations for Engaging in Undergraduate Research: Extrinsic or Intrinsic?. *International Journal of Engineering Education.*
4. Harris, A.H., & Cox, M.F. (2003). Developing an Observation System to Capture Instructional Differences in Engineering Classrooms. *Journal of Engineering Education*, *92*, 4, p. 329-336.
5. Cox, M.F., & Harris, A.H. (2004). A Comparison of Bioengineering Faculty Members' Teaching Patterns at One Research University. *2004 Proceedings of the American Society for Engineering Education*, p. 2057-2061.

(ii) Other:

1. Duncan, D., Oware, E., Cox, M.F., & Diefes-Dux, H. (2007). Program and curriculum assessment for the Institute for P-12 Engineering Research and Learning (INSPIRE) summer academies for p-6 teachers. *2007 Proceedings of the American Society for Engineering Education.* (Nominated for Best Paper).
2. Cox, M.F., Diefes-Dux, H.A., & Lee, J. (2006). Development and Assessment of an Undergraduate Curriculum for First-Year International Engineering Students. *2006 Frontiers in Education Conference Proceedings.*
3. Diefes-Dux, H.A., Follman, D., Adams, R., & Cox, M.F. (2006). Community Building and Identity Development through Graduate Coursework in Engineering Education. *2006 Proceedings of the American Society for Engineering Education.*
4. Cox, M.F. (2006). VaNTH Observation System Component Assessment. *2006 Proceedings of the American Society for Engineering Education.*

d. Synergistic Activities

1. **Assessment & Evaluation Director for Preschool-12th grade and Undergraduate Research Programs in Engineering (June 2006-present)**- Dr. Cox has interacted with students representing approximately 30 universities and with engineering faculty and student mentors at Purdue to explore the roles of research upon engineering students' intrinsic and extrinsic motivations within Purdue's Summer Undergraduate Research Fellowship (SURF) Program. She is currently interacting with 11 students within the Design, Application, Analysis, and Control of Interfaces REU program and is exploring engineering students' identity. As Director of Assessment for Purdue's Institute for P-12 Engineering Research and Learning, Cox is assisting in the development of validated student- and teacher-centered assessment tools and instruments that will measure engineering thinking within P-12 learning environments.
2. **Engineering Education (ENE) Graduate Program (August 2006-present)–** Dr. Cox serves on departmental Graduate and Recruitment Committees. Cox developed ENE 695A – Seminar in Engineering Education which focused on community building by giving graduate students an opportunity to interact with one another and with members of the engineering education community at local and national levels. Cox also co-developed and taught ENE 695C – Problem Solving and Design for Diverse Learners and ENE 695 I- Leadership, Policy, and Change in Science, Technology, Engineering, and Mathematics (STEM) Education.
3. **Undergraduate Student Research Mentorship (Jan. 2006-present)** – Dr. Cox has supervised four engineering undergraduates (4 women and 3 underrepresented minorities) within assessment projects involving the creation of tools to analyze classroom data, the creation of instruments to assess levels of community within students' undergraduate research experiences, and the validation of P-12 assessment tools. Two of these researchers currently are enrolled in graduate engineering programs.
4. **VaNTH Engineering Research Center Researcher and Student Leadership Council Chairperson (Oct. 2000-Aug. 2005) -** Dr. Cox collaborated with Dr. Alene Harris to revise the VaNTH Observation System, an observation system that has been used within bioengineering classes at Vanderbilt University, Northwestern University, the University of Texas-Austin, and the Massachusetts Institute of Technology to observe the presence of "How People Learn" framework elements. Cox also used the electronic classroom observation system to collect biomedical engineering classroom data, edited the classroom observation system's training manual, trained observers to use the VaNTH Observation System (VOS), and helped to develop a VOS observer training CD/DVD. Dr. Cox also organized engineering outreach activities for pre-college and college students across four research universities. Organizations at two of these universities became chartered student organizations, and the number of students participating in engineering outreach increased during Cox's tenure as Chairperson.

e. Collaborators & Other Affiliations

(i) Collaborators and Co-editors (co-editors marked with *):

Adams, Robin (Purdue); Bransford, John (University of Washington); Brophy, Sean (Purdue); Brown, Cordelia (Purdue); Capobianco, Brenda (Purdue); *Cordray, David (Vanderbilt); *Diefes-Dux, Heidi (Purdue); *Follman, Deborah (Purdue); *Harris, Alene (Vanderbilt University); *Husman, Jenefer (University of Arizona); Johnson, Mark (Purdue); Oakes, William (Purdue); Smith, Karl (Purdue); Smith, Mark J. T. (Purdue); Yalvanac, Burghan (Texas A&M University)

(ii) Graduate Advisors:

David S. Cordray (Co-Chair), John M. Braxton (Co-Chair), Thomas R. Harris, Ellen B. Goldring, Kenneth K. Wong, Alene H. Harris (Ph.D. Committee, Vanderbilt University)

Thomas W. Merritt (Chair), Robert G. Batson, Jenefer Husman (M.S. Committee, University of Alabama)

***Total Graduate and Post Doctoral Students Directed*: 6**

***Total Undergraduate Students Directed*: 5**