

School of
engineering education
strategic plan

2009 2014

LEARNING *to Make a* DIFFERENCE



This document sets out the strategic plan of the School of Engineering Education (ENE) at Purdue University.

It presents our guiding vision, our mission, and the values we strive to operate by. We have four major goals and a set of implementation strategies aimed at accomplishing these goals over the period 2009-2014.

Although we expect the fundamentals—our vision, mission, values, and goals—to remain constant, we fully affirm that this plan is a living document, one that can change in its specifics as circumstances warrant (see “Ensuring Successful Implementation”).

ENE’s strategic plan was developed over a 12-month period beginning in Fall 2007, a critical point in the history of this new School. The process involved extensive consultation with our internal and external stakeholders and pivoted on the Strategic Advance held in January 2008, which engaged the School and its stakeholders in a process of appreciative inquiry. Our strategic plan’s development coincided with the development of the strategic plans for Purdue University and for the College of Engineering.

We look forward to the realization of ENE’s plan with tremendous enthusiasm, and we invite your input and participation as we all—ENE faculty, students, staff, and stakeholders—work to bring that future about. ■

School of engineering education strategic plan

Introduction

The call for a transformation in how engineers are educated is well known and documented. The need for change—American students' declining interest in engineering as a major, their low retention rates in engineering, the need for a diverse workforce, the effects of rapid technological change and globalization—has been highlighted by the American Society for Engineering Education, the National Research Council, the National Academy of Engineering, and the National Science Foundation. ABET's adoption of Engineering Criteria 2000 and the Engineer of 2020 paradigm reflects further support for profound innovation in engineering education. Historically, however, engineering institutions' lack of a suitable academic infrastructure and of a framework for systemic, sustainable, and innovative transformation has hindered reform.

In that context, Purdue took on the challenge of initiating a transformation of engineering education to a research-based discipline rather than one based on tradition or on unproven methodologies. In 2003, the College of Engineering formed the Engineering Education Working Group, which championed a shift from the traditional culture of engineering education to the solid intellectual ground of a valid academic discipline practiced by an energized, scientific community of scholars. Its resulting October 2003 white paper ("Toward the Future: Engineering Education at Purdue, A Vision for Preeminence") proposed to revamp the Department of Freshman Engineering—the home department of all first-year Purdue engineering students, who follow a common curriculum before choosing an engineering discipline in which to major—into a new Department of Engineering Education (ENE). This new academic unit would retain and expand on its predecessor's mission of service to first-year students, add a graduate program dedicated to the discipline of engineering education, and incorporate the Division of Interdisciplinary Engineering, which served undergraduate students whose interests cross disciplinary boundaries. In April 2004, Purdue's board of trustees approved the creation of the new Department of Engineering Education. In February 2005, the Indiana Commission of Higher Education approved Engineering Education's three graduate programs: a master of science degree, a master of science in engineering education degree, and a doctoral degree—the first programs of their kind in the world. Purdue's board of trustees elevated the department to the status of School in February 2008.

The School of Engineering Education, housed in the new Neil Armstrong Hall of Engineering, provides an institutional home for academics eager to shape and define the field, conferring legitimacy to their work and an equal footing from which they can interact with colleagues College-wide, across Purdue, and beyond. The School's creation provides a focus for engineering education work at Purdue, pulling it in from the margins and offering faculty the rights, privileges, responsibilities, and opportunities similar to those of other engineering faculty, and has enabled Purdue to attract and inspire a critical mass of nationally and internationally recognized faculty and gifted doctoral students whose scholarly work will guide how Purdue and, eventually, other institutions engage and educate engineering learners at every segment of the PreK-20 continuum.

Purdue's reach extends as well to the NAE's Center for the Advancement of Scholarship on Engineering Education (CASEE), of which it is a founding associate. Given the School's pioneering path, the *CASEE Chronicles* (Research and Development, 2005-06) describes Purdue as "uniquely positioned to redefine engineering higher education in the 21st century...striding confidently into new areas of investigation, exploring new methods of inspiring learning, and reaching out to its local, national, and global communities."

Our Vision |→ A MORE INCLUSIVE, SOCIALLY CONNECTED, AND SCHOLARLY ENGINEERING EDUCATION

We envision engineers who, in collaboration with others, help communities globally to achieve their aspirations in creative yet responsible and sustainable ways. The education of these engineers is informed by sophisticated knowledge about how people learn to engineer. It attracts and develops a diverse range of people and is suited to addressing complex socio-technical issues. This vision implies that we radically rethink the boundaries of engineering and the purpose of engineering education.

Our Mission |→ TRANSFORMING ENGINEERING EDUCATION BASED ON SCHOLARSHIP AND RESEARCH

The School of Engineering Education (ENE) at Purdue is a vanguard institution in the creation of field-defining knowledge that globally impacts how engineering is taught and learned such that engineering is broadened and enriched through more inclusiveness.

Our mission rests on three pillars, as outlined below.

Re-imagine Engineering and Engineering Education

The transformation of engineering begins when we challenge the fundamental assumptions behind engineering education and strive to create engineering programs that:

- a) *Diversify engineering*: Open up engineering to a more diverse range of people by making their first experience of engineering (from PreK to 16) the most rewarding it can be;
- b) *Embed creativity, innovation, and social responsibility*: Create an understanding of the essential nature of engineering as creative and as contributing to a better world; and
- c) *Enrich the student experience*: Determine what information, advice, preparation, pedagogies, and learning experiences attract, retain, and grow global engineers.

Create Field-shaping Knowledge

Our mission is grounded in a unique infrastructure and capability that enables us to be a pathfinder based on systematic research, policy development, and assessment. We reshape the research agenda by asking questions that challenge fundamental assumptions about engineering education across both the span of life and the different modes of participation in engineering. We influence the direction of and resource allocation for engineering education scholarship nationally and internationally.

Empower Agents of Change

Our mission is sustained by a cohesive identity and sense of common purpose that empowers members of the School (graduate students; professional, administrative, and clerical staff; advisors; and faculty) to be leaders, advocates, and change agents over their lifetime. This is

built upon a shared understanding of the vision, mission, goals, priorities, and capabilities of the School and of the national and global landscape of engineering education, constituting a continuous platform for members of engineering education community to engage, inform, and influence each other.

Our Values |→ **IN APPROACHING THIS MISSION, WE RECOGNIZE OUR INTERDEPENDENCE ON A BROAD RANGE OF STAKEHOLDERS. THESE INCLUDE:**

- + all our students, their families, and the community we serve;
- + the wider global community;
- + the engineering profession;
- + employers of engineers;
- + groups who support our discovery (research) and engagement activities;
- + our advisory councils (E2IAC, E2A2C, and INSPIRE);
- + Purdue University;
- + the College of Engineering; and
- + all members of the School (students; professional, administrative, and clerical staff; recruiters; advisors; and faculty).

As members of the School, we are committed to fostering a collegial, cooperative, and supportive work environment where ideally we have “no bad days.”

Our guiding tenets to achieve this are:

→ **Students first (in *all* we do)**

→ **Integrity, respect, and trust in our dealings**

→ **Balancing work with other commitments**

→ **Being socially conscious in what we do and how we do it**

→ **Strategic thinking, excellence, and accountability**

Goal 1 | ➔ EMPOWER OUR PEOPLE

Empower all members of the School (students; professional, administrative, and clerical staff; recruiters; advisors; and faculty) each to contribute to the success of our integrated, multifaceted mission while achieving their individual professional goals.

IMPLEMENTATION STRATEGIES

- a) Identify and recruit the most talented people to contribute diverse and complementary abilities to the work of our School. This strategy includes developing clear descriptions of the roles and functions for all future School positions and being strategic in targeting and attracting the most appropriate people;
- b) Develop and equip the members of our School to achieve individual and School goals. This strategy includes providing the time and other necessary resources; establishing a system of Personal Development Plans for staff, faculty, and students as appropriate that interfaces simply and effectively with existing School processes; and providing easier access to training and development opportunities and to career mentoring;
- c) Recognize and reward achievement across all aspects of the work of the School and maximize opportunities for recognition by external bodies. This strategy includes strategically and proactively encouraging staff, students, and faculty to plan for future awards, not just respond to opportunities that arise;
- d) Enhance mechanisms and channels for internal communication. This strategy might include developing the School web site as one means of internal (as well as external) communication of activities and achievements;
- e) Assist people across our School to learn about the work of others so as to facilitate synergies in achieving our mutually supportive objectives. This strategy includes creating more informal, “whole of school” events to celebrate success and revisiting this strategic plan and its implementation;
- f) Actively identify positions of leadership within the local and global engineering education communities and encourage and support School members to secure these positions. This strategy might include inviting members in key positions external to the School to mentor/advise others regarding opportunities and strategies;
- g) Devolve leadership to faculty, staff, and students in School committees and projects together with authority to make decisions within established guidelines, and empower individuals to exercise responsibility while being held accountable and to ensure wide representation on School committees.

Goal 2 | ➔ SET THE PACE

Offer a full suite of undergraduate and graduate programs that set the global standard in engineering education grounded in and contributing to cutting-edge scholarship and research.

IMPLEMENTATION STRATEGIES

- h) Create a transformative first-year experience for all concerned (recruiters; students; their families; School, College, and other faculty; professional and administrative staff; and advisors) that fosters diversity, creativity, innovation, technical growth and social responsibility, making maximum use of the Ideas to Innovation Learning Laboratory and the other facilities of the Neil Armstrong Hall of Engineering. This strategy will give the students a much better feel for what engineering is all about and also allows the students to become much more engaged in engineering at an earlier point, which should improve retention rates.
- i) Fully implement the PhD program as a coherent learning experience for students based on the PhD “roadmap” and including effective recruitment strategies, admission and assignment of students, “steady state” courses, the online student manual, the readiness assessment, a re-articulation of the overall outcomes expected of our graduates, the use of portfolios, and possible career pathways graduates might pursue;
- j) Develop the IDE/MDE programs including (i) achieve accreditation for the Multidisciplinary Engineering program and develop a continuous improvement process for it; (ii) create concentrations within IDE and MDE for an engineering education program focused on industrial trainers and (iii) promote the IDE/MDE programs as pathways to diverse engineering careers to meet individuals’ aspirations;
- k) Create a BS in Engineering Education aimed primarily at preparing K-12 teachers;
- l) Create a Certificate and a Master’s in Engineering Education;
- m) Make maximum use of innovative programs, courses, and facilities (School and beyond) as a laboratory for research on learning engineering for the purpose of improving student outcomes.

Goal 3 |→ TACKLE THE BIG (RESEARCH) QUESTIONS

Create a world-renowned interdisciplinary research concentration at Purdue that addresses the big questions and challenges facing STEM education, with particular emphasis on engineering.

IMPLEMENTATION STRATEGIES

- n) Analyze the “big questions” facing engineering education and identify strategies and priorities for specific research studies that will bring about systemic and sustainable improvement in engineering education. Such “big questions” include: “Why does engineering still not reflect the demographics and multiple perspectives of our community, in spite of numerous programs aimed at diversifying it?”; “What is fundamental knowledge in engineering, and what are the best ways to acquire it?”; “Why is reform of engineering education in response to societal needs so slow, patchy, and not self-sustaining?”; “What can be learned from other cultures, intellectual traditions, and knowledge about learning globally in tackling these questions?”
- o) Identify and foster a limited number (~3) of thematic research clusters in the School, with dynamic, overlapping membership, that bring particular perspectives to the “big questions”;
- p) Consolidate, integrate, and strategically expand the many past and current research projects on student experience in the first-year program around the “big questions”;
- q) Prioritize and focus the research work of INSPIRE in the P-6 domain;
- r) Develop collections of research data that can be used by multiple researchers, including our graduate students;
- s) Place a priority on interdisciplinary research that creates synergies among the expertise existing across the School while also building bridges to complementary research expertise elsewhere;
- t) Partner with colleagues across the STEM disciplines, the liberal arts, and the social sciences to form interdisciplinary teams to undertake research into complex sociotechnical problems critical to engineering and engineering education.

Goal 4 |➔ GROW THE COMMUNITY

Identify and build strategic global partnerships and collaborations to elevate our research capabilities and those of the wider engineering education community, while simultaneously facilitating the sharing of experiences across the global community of engineering education scholars.

IMPLEMENTATION STRATEGIES

- u) Develop targeted partnerships that allow us to contribute in other contexts (e.g., industry training, whole engineering curriculum, minority-oriented schools, etc.);
- v) Actively foster the development of emerging communities to advance and diversify the state of the art of engineering education research;
- w) Create platforms that allow the members of the wider engineering education community to share experiences and that facilitate intradiscipline partnerships and collaborations by allowing people with shared and complementary interests to connect;
- x) Develop innovative ways to support the exchange of field-defining knowledge in engineering education (e.g., take a leading role in the Research on Engineering Education Symposium series and facilitate a five-year follow-up review of the Engineering Education Research Council initiative);
- y) Publish a series of “pathfinder” books (plus accompanying Web 2.0 resources) that define the state of knowledge and emerging ideas in engineering education in a way that cuts across the traditional lifecycle view of engineering education (i.e., P-12, baccalaureate, graduate, continuing professional development);
- z) Develop a highly respected journal on P-12 engineering education (or STEM) research.

Ensuring Successful Implementation

While particular goals and implementation strategies have champions, notably the relevant ENE School committees, all members of the School are responsible for the success of this plan.

Achievements towards attaining our goals are monitored continually and reported on annually to the School each March, to our advisory councils, and to the College of Engineering. These reports are made available for the global engineering education community.

The metrics used to measure our success against the plan and the targets we set are reviewed and, as necessary, refined annually.

Each year the priorities among the implementation strategies are reviewed and adjusted as necessary, taking available resources into account. □



Purdue's School of Engineering Education includes the First-Year Engineering Program; Interdisciplinary Engineering; the world's first PhD program in engineering education; and INSPIRE, the Institute for P-12 Engineering Research and Learning.

Our PhD program, along with INSPIRE, provides not only rigorous research capabilities for investigating how engineering is best learned and taught but also interconnections with our First-Year Engineering and Interdisciplinary Engineering programs so that new pedagogy can be implemented with our own undergraduate students, who in turn spark research questions among our faculty and graduate students.

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