

# FIE 2017: Reviewing the Past, Predicting the Future

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**Abstract** – At FIE 2002, 13 engineering educators assembled to address a variety of topics and predict the “Future of Engineering Education.” Larry Shuman organized and moderated the session [1]. Topics included the changing demographics and economics of the country, technological advances, the engineering pipeline, the state of the University and forces driving change, engineering as a liberal art, the accreditation process and faculty reward system, the role of technology in delivering engineering education, educating for higher levels of performance, research in engineering education, research applications, and outcomes assessment. This panel includes five of the original authors and some new contributors who are active in FIE. We will examine the predictions made in 2002, and ask where we were right, where we were wrong, what has come to pass, what is still in progress, and what concerns have faded from view. Many of the issues previously discussed are still hot topics 15 years later.

**Index Terms** – Engineering education, faculty reward system, technology enhanced instruction, personalized learning, the STEM pipeline.

## I. INTRODUCTION

At FIE 2002, 13 engineering educators assembled to address a variety of issues and predict the “Future of Engineering Education”. The published paper has over 200

citations so far according to Google scholar. Many of the issues raised in the 2002 paper are still timely today.

However, much has changed since 2002. Purdue and Virginia Tech established the first two modern Departments of Engineering Education. Other schools have followed suit, and many schools have established centers for engineering education research and innovation. Several major books have been published summarizing research in this area, and proposing new directions: Heywood’s *Engineering Education: Research and Development in Curriculum and Instruction* [2]; *Educating Engineers: Designing For The Future Of The Field* by Sheppard, et al. [3]; and the *Cambridge Handbook of Engineering Education Research* edited by Johri and Olds [4]. The *Journal of Engineering Education* has established itself as the premier publication in the area. *Advances in Engineering Education* allows authors to present their work in multimedia format. And the *IEEE Transactions in Education* continues its tradition of publishing cutting-edge research in engineering and computing education. The quality and level of rigor of engineering education research has increased substantially over the past 20 years.

## II. POTENTIAL TOPICS FOR DISCUSSION

What are the issues and trends that will define the next 15 years of engineering education? Each panelist will address one

or two of the topics listed below. We will also solicit feedback and comments from the audience.

**Enrollment trends:** what do we have to look forward to? Will we face ever-increasing enrollments? Or have to limit the number of students we accept? Do we have the resources to handle more students: classroom space, laboratories and equipment, computers and software, and faculty willing and able to teach? The answers may differ for large vs small engineering schools. Will graduate engineering education continue to be dominated by students from overseas, or will we be able to attract more domestic students into engineering?

**The engineering/science pipeline:** How can we effectively address the issues of attracting and retaining students, while insuring diversity and equity? Despite our best efforts, we have not been able to attract women and minorities to our schools and profession at an acceptable level. What is the role of K 12 outreach in addressing these problems? Once we have attracted students to engineering, how can we keep them? What is the role of first-year programs in ensuring the success of those students who decide to study engineering? And how can we address the Valley of Death (the deadly required 2<sup>nd</sup> and 3<sup>rd</sup> year courses) that discourage many of our students?

**Pedagogy of the future/classroom of the future:** how will learning and teaching change in the next decade? We know many “best practices” that promote effective learning (active learning, teamwork, project-based learning, flipped classrooms, technology enhanced education, differentiated instruction, and personalized learning). These have been implemented by faculty at many schools, but are not as widely used as they should be. Often educational innovations rely on a particular individual or team, and vanish when new instructors take over.

The most successful experiment on technology-based, personalized learning on large-scale has come from outside the academic community: the Khan Academy. What is its relevance for higher education? Does it provide a model for course structure and delivery in engineering education? What is the role of online asynchronous education for graduate and undergraduate students?

**The faculty reward system:** This has been a hot topic since the first FIE conference. What are the criteria for promotion and tenure? How are faculty rewarded for teaching well and developing innovative materials, courses and curricula? How can we stimulate change in our courses, curricula and delivery methods? Some faculty have significant impact outside the traditional academic channels. How can we reward such activities?

How will we reward the scholarship of teaching and learning? Clearly engineering education research will be rewarded at those schools that have departments or centers devoted to it? What will be the status of research on engineering education for faculty in traditional departments?

**Liberal arts and engineering:** Engineering as the New Liberal Arts; Eric Soulsby raised this issue in [1]. Have we made any progress? Has the engineering education community successfully promoted technological literacy? How prevalent are courses on engineering for non-engineers, especially future and current STEM teachers at the pre-college level? A related-issue is the role of ethics in engineering education: how do we insure that our students understand the importance of ethics to engineering practice.

**The structure and function of the University:** Universities and their faculties are undergoing significant disruptive change. Many years ago, Johnson [5] asked whether we are the last generation to enjoy a traditional academic career. He noted several disturbing trends that could undermine academic culture and values. In the last two decades, universities have hired fewer tenure-track faculty and more contingent faculty. What career paths are possible for faculty outside the tenure track? Is the vision of academic life and faculty roles presented by Kennedy [6] still relevant?

What’s going on now in American universities that will shape the future of engineering education? Will current trends (e.g., larger classes, fewer faculty who teach) result in a crisis in Higher Education? Or will we create innovative solutions (e.g., shared resources, greater use of technology, a new class of faculty,...) to maintain effective undergraduate education in engineering? What are the consequences of increased reliance on adjunct and temporary faculty, the creation of new positions designed to avoid the tenure track, with titles such as instructors, lecturers, senior lecturers, teaching faculty, contingent faculty, and so on?

Of course as a panel, the participants and audience can raise additional issues and take the discussion in other directions. There will likely be issues raised and problems discussed that we have not anticipated. We will document the results of this panel in a future paper.

### III. PANELISTS

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