

Impacting Society through the Responsible Development of Technologies and Systems

FIE 2016 Catalyzing Collaborative Conversations

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SUMMARY

In electrical and computer engineering (ECE), once simple technologies are evolving into highly complex systems intended to make work and life better, such as smart cars, homes, cities, farming, health, energy, etc. ECE professionals can no longer limit their role to creating hardware, software, and interfaces, but should consider the responsible development of technologies and systems [1]. Given that women often enter the field to become socially responsible engineers [2], responsible development of ECE technologies also has the potential added value of retaining women and broadening participation. In this session, we will explore socially responsible ECE education via NSF RED projects (https://www.nsf.gov/news/news_summ.jsp?cntn_id=135379).

The RED project at Colorado State began in 2015 and is titled “Revolutionizing Roles to Reimagine Integrated Systems of Engineering Formation.” The fundamental premise of our approach is that a department should take a holistic view of and collective responsibility for the educational experience. We no longer view an engineering program as a set of disparate courses taught by autonomous (and isolated) faculty, but as an integrated system where faculty work as a team. As part of this vision, we include three threads that are weaved throughout the entire curriculum, namely: “foundations,” for example, math and science; “creativity,” which includes design and research experiences; and “professionalism.” As part of our professionalism thread we introduce ethical considerations as a natural part of the engineering process and not separate from technical content. We seek to have students feel the impact of engineering on society, as opposed to read or hear about it, as is frequently the case in current engineering programs. We believe that by intertwining considerations of the impact of a technology at the same time as that technology is introduced we can facilitate the formation of our students into socially responsible engineers.

The RED project at Iowa State started in 2016 and is titled “Reinventing the Instructional and Departmental Enterprise to Advance the Professional Formation of Electrical and Computer Engineers.” Recognizing that designing complex systems requires not only technical knowledge and skills but

also new ways of thinking and the development of social, professional and ethical responsibility, we are involving students, faculty, engineers and others in collaborative, inquiry-driven processes. Students will expand their analysis and design skills to create solutions that work for individuals and society, considering the socio-technical context toward responsible development. The change process is being driven by our cross-functional, collaborative instructional model for course design and professional formation, called X-teams. An X-team is comprised of process as well as content experts. Team members will use an iterative design thinking process to explore pedagogical approaches that (a) promote design thinking, systems thinking, professional skills such as leadership, and inclusion; (b) contextualize course concepts; and (c) stimulate creative, socio-technical-minded development of ECE technologies for future smart systems.

The RED project at Virginia Tech also began in 2016 and is titled “Radically Re-designing the Fan-in and Fan-out of an Electrical and Computer Engineering Department.” This project aims to transform the offerings of a traditional engineering department with a new curriculum model that emphasizes design and innovation approaches, leading to a new type of engineer – a design thinker who is innovative, flexible, and collaborative. This adaptive kind of engineering professional is in demand to address the world’s problems. We are pursuing a combination of approaches that includes providing multiple paths through the curriculum for students, giving them the freedom to choose a variety of concentrations. The multiple curricular pathways will be anchored in real world problems, forging new connections to K-12 education and to 21st century industries, including start-ups, design consultancies, and non-governmental organizations. The re-design process is focused on improving education in support of holistic professional development.

REFERENCES

- [1] Howard E. Michel, “Society Will Benefit from Smarter Homes,” President’s Column, *The Institute*, IEEE, December 8, 2015, <http://theinstitute.ieee.org/members/presidents-column/society-will-benefit-from-smarter-homes>
- [2] Susan S. Sibley, “Why Do So Many Women Who Study Engineering Leave the Field?,” *Harvard Business Review*, August 23, 2016.