# EVOLVING DIRECTIONS FOR ENGINEERING CURRICULA: SUSTAINABILITY, INNOVATION, MULTI-DISCIPLINARITY AND SYSTEMS THINKING

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***Abstract*** *¾ Engineering education faces many challenges as demands on practising engineering professionals intensify and diversify, and as potential students have more career choices than in the past. This paper outlines the context of developments in engineering education in Australia. Engineering graduates are rightly expected to have strong generic skills, and understanding of sustainability, systems thinking and the processes of innovation. These features demand multi-disciplinary perspectives, and may be met by broadening the curriculum. The curriculum must also maintain sufficient engineering science and technology to enable engineering graduates to formulate good technical engineering solutions and use advanced computing tools intelligently. The paper explores strategies at the University of South Australia to address the demands of students, employers and the profession. Strategies include the introduction of double degrees (that are also differentially attractive to women); work with prospective high-school students on engineering projects, greater pedagogical flexibility to accommodate diversity in preferred learning styles; and industry linked projects.*

*Index Terms ¾ engineering curriculum, sustainability, student-centered learning.*

## EXTENDED ABSTRACT

Professional engineering has provided the physical infrastructure of modern societies and underpins most economies through creation of many products and services, and manufacturing technologies and systems. Individuals, organisations and nations have progressively higher expectations of engineered systems' reliability and cost-efficiency. As natural resources and ecosystems are depleting and human-social systems are strained, concepts of sustainable development and "the triple bottom line", together with process and technology innovation are high on the agendas of engineering companies and organisations. Tomorrow's professional engineers must be educated to understand and work in these more demanding and multidisciplinary professional environments. New approaches are needed in curricula, and new mindsets may be necessary amongst engineering educators. It also remains a challenge to attract well motivated and able students into engineering programs.

Despite strong employer demand for engineers, student demand for engineering places in Australia has declined, especially in areas such as civil, manufacturing and electrical (power) engineering. Engineering programs are perceived to be hard, and engineering careers to be unrewarding, relatively low-status, and not people-oriented. Our program promotion strategies are intended to change these perceptions by engaging prospective students in real engineering problems, such as solar-car development and satellite systems, and in environments where the diversity of engineering work and careers can be experienced.

Many Australian universities have adopted processes to embed sets of generic skills – communications, teamwork, problem solving, ethics, etc. – into all their programs. Similar, but engineering-focussed criteria sets are used by the Institution of Engineers, Australia in program accreditation. The University of South Australia (UniSA) also actively engages students in understanding and recording how the defined set of generic skills are developed. These records assist students to develop their curriculum vitae and job applications.

So-called "double-degrees" have become common in Australia to satisfy students' demands for broader education and increase their career opportunities. Such programs are differentially attractive to women students. The programs should also improve graduates' capacities for multi-disciplinary thinking and team-work. UniSA's engineering degrees in civil, mining, mechanical, manufacturing, electrical and informaiton engineering are available with degrees in environmental management, management, accounting, applied science and computing. Material on innovation and commercialisation is also being developed.

Areas of sustainable engineering and systems engineering thinking are being introduced into our programs. Early year students are well motivated to understand complex systems and sustainability. Nevertheless it is a challenge to balance fundamental science, technology and engineering analysis, synthesis, design and practice. Good computing tools for mathematical modelling and simulation can facilitate learning in these areas, and also allow more student-centred and flexible pedagogical approaches. Industry-based projects also offer opportunities for multi-disciplinary approaches and rapid development of the broader understandings that are increasingly necessary for professional engineering practice.

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