# Design Projects in Undergraduate Engineering

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## Introduction

Design has been extensively embedded within the undergraduate Engineering programmes through a restructuring of the curriculum to increase small group, project based learning. Complementing this strategy, a selection of product design themed final year projects is offered to the students to encourage innovation and to foster creativity. Feedback from the students regarding the new curricula has been extremely positive and final year projects are delivering innovative products with commercial potential.

## Undergraduate Curriculum

The role of the engineer in industry has evolved, with today's engineering businesses seeking engineers with abilities and attributes in two broad areas - technical understanding and enabling skills. Institutions within the engineering community such as Engineers Ireland, the Accreditation Board for Engineering and Technology, the Royal Academy of Engineering and members of the CDIO (Conceive Design, Implement, Operate) initiative have highlighted a need for new approaches to learning and teaching of engineering within our academic institutions. Project based design courses have recently been implemented in both of the two engineering programmes offered by Trinity College Dublin. The projects are each carried out in small groups (typically four to six) and are virtually free of podium based teaching. Initially, the students are provided with a design brief, foundation level technical input and raw materials. The projects are developed around the principles of CDIO which represents best international practice for teaching design. The implementation of this methodology requires self-directed learning, teamwork and small group learning, culminating in the actual building and testing of a prototype. Some projects finish with a public competition which tends to generate huge excitement. The new courses have been seen to foster innovation and to provide a format that channels the student's creative skills in a coherent and structured manner. The detail of the courses, the learning outcomes, the resource overhead required as well as a discussion on the initial results from the programmes can be found in publications by academics from the School [1-6].

## Final Year Projects

The School of Engineering benefits from a fully equipped mechanical engineering workshop, a rapid-prototyping machine, specialist technicians in electronics, for example, and also a range of prototyping software such as Pro-Engineer, Ansys, Pro-Mechanica, Auto-CAD, Computerised Fluid Mechanics software etc. As a result, the students are well equipped to prototype design ideas within the timeframe of a final year project.

To date, some of these projects have been conducted in collaboration with industry and have resulted in useful contributions. In other instances, the student is required to develop a product design specification to address a particular "opportunity" and, using systematic design techniques, goes on to realise a detailed design for test and evaluation.

Some examples of these projects are given here, with more detail on some to be found in the literature [7,8]. The project illustrated in Figure 1, concerned the design of a measurement microphone. The design has high added value locating the amplifier and power supply within the tube reducing the size, cost and the number of cables required. The parts and labour unit cost for a batch of 80 is €30 compared to purchase price of €528 for similar product. Figure 2 relates to a project where a completely novel bicycle lock was designed. Cycling is particularly topical at the moment and an area of interest to students. Using design tools such as CFD and an ABS rapid prototyper, high quality novel wing mirror concepts were tested informed with fluid mechanics theory-figure 3. Also topical, universal design and energy/raw material sustainability were considered in the design of a solar powered drinks can compactor-figure 4.

In each of these cases, full working prototypes were made, operated and tested.

## Innovative Products

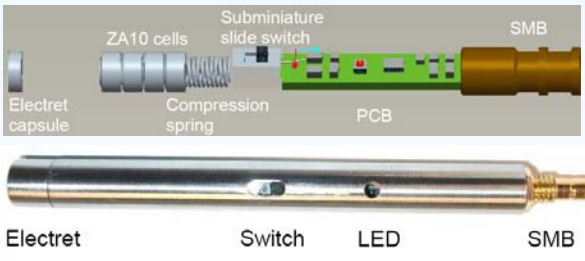


***Figure 1:*** **Low cost, high specification electret microphone**

***Figure 2:*** **Novel bike lock/stand design with high added value**

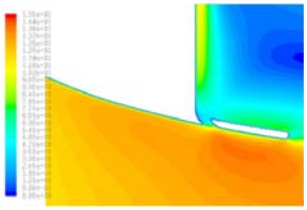

***Figure 3:*** **Computerised Fluid Mechanics and Rapid Prototyping used in design development for novel car wing mirror**

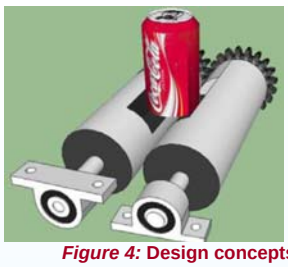


***Figure 4:*** **Design concepts for solar powered, universally designed drinks can compactor**

## Conclusions

Project based design engineering can foster innovation and creativity in students when cohesively included into undergraduate curricula. Mature designs with commercial potential can be piloted with a view to further development. Students can develop essential skills to support entrepreneurship and indigenous job creation. All of the above products have IP or business development potential.

## References

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