

2018-12-14

## Creating Holistic Engineers to Solve the Grand Challenges of the Future

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### Recommended Citation

Beagon, U. (2018) Creating Holistic Engineers to solve the Grand Challenges of the Future. *Engineers Ireland Yearbook 2018*.

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# Creating holistic engineers to solve the grand challenges of the future

**Úna Beagon writes that continued growth in construction depends on third-level institutions securing a talent pipeline of civil and structural engineers with suitable skill sets to bring about, maintain and operate large multidisciplinary projects**

The recession is over and construction activity in Ireland has experienced a welcome increase in recent years, with *The Irish Times* Dublin Crane Watch reporting a doubling of cranes in Dublin between 2016-2017 – and even a dedicated Twitter account, 'Dublin Crane Count', to update us.

To meet demands, there is a need for skilled engineering graduates in this sector. Student numbers in civil and structural engineering courses in Dublin Institute of Technology (DIT) have risen sharply in the last two years. This is a result of a continued and determined marketing effort and reassurance to students that there is a rewarding career ahead, despite the boom and bust cycles of the past.

The recession showed us that Irish engineers cannot depend on the Irish market alone and many companies looked to the UK and further afield to bring in work. Today's graduates have access to an international global marketplace where knowledge of standards, communication and social skills may be as important as the intellectual prowess gained by obtaining a degree itself.

Continued growth in this market will depend on the availability of a talent pipeline of civil and structural engineers with a suitable skillset to bring about, maintain and operate large multidisciplinary projects. The welcome announcement of the rail link to Dublin Airport, proposed for completion in 2027, gives an indication of the timeframes required of major infrastructural projects.

The role of the civil engineer will be critical in the achievement of these projects and it is now time to consider how academic institutions can prepare engineering students for the challenges ahead.

Global engineering problems also act as a driver for curriculum review. In 2000, the National Academy



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of Engineering (NAE) published a list to celebrate the accomplishments of engineers in the 20th century. The list highlighted such things as electrification, radio and television, computers, the internet, and water supply and distribution, among others. It is a list of inventions of things, where small groups of people worked on a narrow problem and came up with a solution to solve the problem. The inventions themselves resulted in grand societal changes and many of us could name some of the inventors today.

## Grand challenges for the 21st century

An investigation into 21st-century engineering problems culminated in a list of 'grand challenges'. Improvements for society at large form the core of the grand challenges, which range from providing clean water and engineering better medicines to securing cyberspace and managing the nitrogen cycle.

This list has a much broader remit than individual inventions. It challenges engineers to use their knowledge not only to create new inventions, but to design global systems and influence policies and procedures to cause societal changes.

The emphasis on large-scale activity will require multidisciplinary teams to work together across land and political boundaries. Policy makers, economists, politicians and social scientists will all be involved in the successful implementation of these changes. Engineers will no longer work in small teams; communication with broad social groups will become more critical than ever.

The skills required to achieve these aims compare well to the DIT Graduate Attributes, upon which our programmes are designed. Technical and practical classes, along with opportunities to develop interpersonal skills, are embedded through many different initiatives. These include practical, team-based projects such as the Bridge Design and Build Competition, collaborative projects with other disciplines and the use of assessments to highlight the importance of teamwork, negotiation and presentation skills, for example.

DIT civil-engineering students are also working on a joint project with students from Rochester Institute of Technology in the United States, with the aim of providing an opportunity to experience intercultural design teams, international design standards and a global outlook on common civil-engineering design problems.

## Retaining female engineering students

Retention of engineering students can also be a problem, particularly in first year. Female engineering students may be especially vulnerable as a result of feeling in the minority. The School of Civil & Structural Engineering created the Women in Engineering Network to address this problem. The group has three aims: to be a network for female

engineers (both students and staff), to mentor opportunities and to create a team of volunteers to visit girls' schools and highlight engineering as a career.

The demand for engineering graduates is increasing. Widening participation is a key aspect of student recruitment. Enhancing the numbers of female students, mature students and international students will provide a large talent pool to enable the economy to continue to grow.

The successful part-time programmes in civil engineering are aimed at mature students often already working in the engineering industry, either as technicians in consulting offices or as trades men on site. It is heartening to witness the academic and professional success of mature students who have joined programmes from alternative routes through the educational system. They see a bright future in engineering and value the importance of an accredited degree programme, as do we!

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