Mathematics education for 21st century engineering
[extended abstract]

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Mathematics Education for 21st century Engineering; extended abstract.
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Introduction.
Engineering industry has changed massively over the last 50 years. For analysis, IT based tools, CAE software and statistical packages have become the workhorses of engineers who, half a century ago would have used slide-rules and log tables. The mathematics curriculum for Undergraduate Engineers has, however, changed little. This presentation provided a summary of work-in-progress on a locally-funded project.
A literature survey was completed, which suggested that the issue was much broader than just defining an appropriate curriculum. Teaching methods have a huge influence on students’ ability to relate mathematics within engineering and design modules. Also, entry levels of understanding were found to be important and have been the subject of much previous research. The findings from literature informed the design of two surveys that gained responses from 100 students and 78 industrial engineers. The majority of students were studying either mechanical engineering or product design engineering and most of the industrialists were drawn mainly from the aerospace or automotive sector. The initial findings from the surveys were reported and are summarised below in respect of the appropriateness of the present curriculum for industry, teaching methods in year-1 mathematics modules and the appropriateness of qualifications such as the ‘A’ level.

Results.
Figure 1 compares, on the left, the expectations of students to need different aspects of the undergraduate mathematics curriculum in industry with, on the right, the percentage of students who actually used the same maths on industrial placements.

![Figure 1: The perceived usefulness of maths topics in industry.](image1.png)

Industrialists were asked to rate the importance of a similar range of topics and the results are displayed in figure 2.

![Figure 2: Industrialists perceived importance of maths topics.](image2.png)
80% of the student sample had arrived at university with good A level grades in maths/further maths while the minority offered the international baccalaureate, Scottish Highers etc. and students felt overwhelmingly well prepared in a number of the more fundamental aspects although not all, in the same aspects.

The surveys also solicited many free text comments. The three most common themes were:

1) Mathematics delivery should be more ‘engineering’ focussed using real world applications.
2) Coverage of statistical methods and computational analysis are particularly important but often underplayed.
3) Courses must retain a fundamental understanding of mathematical methods and the ability to interpret computed results.

Brief conclusions.

• Students arrived well prepared for selected topics but the variations across the topics points to a need for more innovative inclusive approaches as duplication can result in a lack of motivation.
• Both surveys show high level of satisfaction with the syllabus but hint at more emphasis in Statistics and Computational methods. (these, with mechanics are seen as the 3 most important topics).
• There is a very powerful need to connect teaching with ‘real world’ examples that demonstrate the usefulness and applications of the mathematics taught.

SEFI 2018
A more comprehensive report of this project will be presented at the annual SEFI conference in Copenhagen, September 2018.