Case Study of Industry Co-Designed Engineering Curriculum

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Background/Context

EngineeringUK (2018) estimates the UK at least 22,000 engineering graduate shortfall per year. The UK South East employers are reporting they are struggling to recruit and retain engineers. Compounded by the UK South East has limited higher education engineering provision. Canterbury Christ Church University has received £13.1M National and Local Government funding to develop Kent and Medway Engineering, Design, Growth and Enterprise (KM-EDGE) Hub. Develop a learning provision that produces 'Industry Ready' graduates for local and national engineering employers.

In the UK engineering learning outcomes are defined by the Engineering Council (2014), AHEP3.0, this has been developed in consultation with engineering accreditation institutions and engineering industry in the UK. As a result engineering degree programmes traditionally consist of core learning outcomes as defined by;

- AHEP3.0
- accrediting engineering bodies
- academic team's expertise and experience

Typically in the UK High Education Institutions (HEIs) engineering programmes will also be advised by Industrial Advisory Board to assist in ensuring the engineering curriculum meets industries' requirements. Industrial advisory boards typically consists of institution alumni engineering graduates, engineering firms CEOs, Senior Engineering Managers in industry. Programmes are discussed and minuted at Industrial advisory board meetings.

Literature Review

CDIO community has reported revising curriculum design to include common industry methods, practice and management to develop student readiness for industry, Sparsø et al (2011). Jørgensen et al (2011) adopted informal informed industry approach to curriculum programme development gathering requirements from research workshops with industry and academics. Törngren et al (2016) approach to industry informed curriculum is through industry visits and talks.

Good practice requirements engineering for systems development recommends interviewing professionals individually, (Sommerville and Sawyer, 1997). Hart (1987) highlighted knowledge elicitation with a collective of experts in the room leads to falsehoods in the knowledge gathered. Research into commercial practice requirement engineering found informal and semi-formal requirement engineering approach led to more satisfactory software solutions with greater customer fit, (Neill, 2003). Therefore adopting good systems engineering requirement practice to gathering industry requirements of engineering graduates and feedback on curriculum design is more likely to yield an informed industry curriculum.

Canterbury Christ Church University Method

The engineering programmes have been co-designed with the local South-East and international SME and large enterprises. This approach was adopted to ensure the programmes structures, content and learning outcomes fulfil local, national and international employers of mechanical engineering graduates, to assist curriculum achieves the EDGE Hub aims providing 'Industry-ready' engineering graduates.

The co-design process has involved employer feedback at each stage of the curriculum development as detailed below:

- Initial course identification and University in-principle approval to research and develop, Jan'18
  - Initial market research of local employment mechanical engineering opportunities for mechanical engineering, 314,000 job vacancies in South East are in manufacturing (Rhodes, 2018). Identification of over 40 local pharmaceutical/ food and drink/water utilities/ automation/automotive/aerospace suppliers to mechanical industry employers of mechanical engineers in Kent and Medway.
- Initial identification of the course design and structure – Jan'-Apr' 18;
  - Identification of contacts in South East employers through LinkedIn, Personal contacts, Colleagues personal contacts, University careers.
  - Met and interviewed contacts individually as to their requirements in mechanical engineering graduates, businesses aspirations and ambitions i.e. industry 4.0, data analytics, modelling, etc facilities, and engineering activities
- Check course design and partial module learning outcomes – Jun'18 –Sept'18

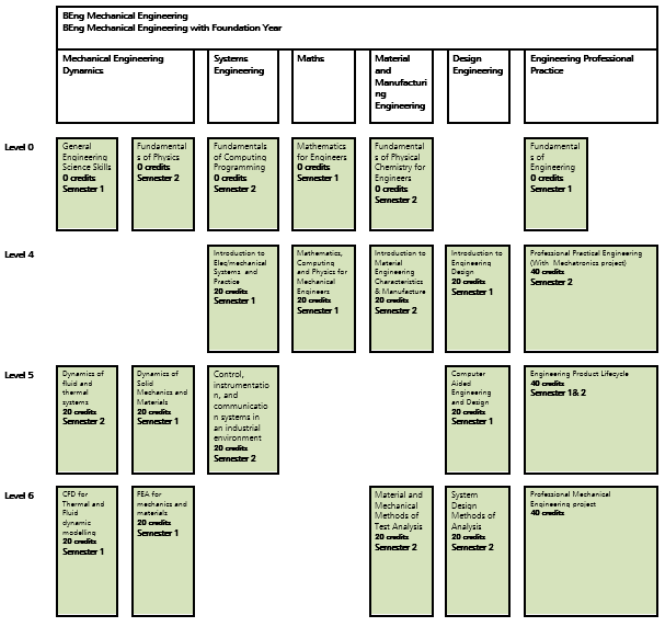

Figure 1: Example of Mechanical Engineering Programme Structure

- Shared via email and LinkedIn to contact the curriculum design, for example figure 1 and partial module learning outcomes ask for their reflections.
- Each contact shared their suggestions on the course design structure, additions and improvements to the learning outcomes.
- Also, further suggestions of indicative module learning and examples of where learning will be applied in a commercial context.

- Final programme development for University validation-Sept'-Oct'18;
  - Shared via email to industrial contacts the final programme design and module learning outcomes, asked for each contact's reflections.
  - Yielded positive feedback, contacts welcomed seeing the programme learning included; CAD proficiency, electronics and electrical learning, advance manufacturing, control and instrument analytics, health and safety, industry 4.0 , project management, etc

Result

The final programme structure, module learning outcomes and indicative content reflects all the feedback from employers at each iterative stage of the programmes design and development. The final programme designs now reflect the local industries' need for Mechanical Engineers. The programme was successfully validated 7th Dec'18 by University validation panel internal and external assessors.

Conclusion

The final industry co-designed programme approach enabled CCCU to create Mechanical Engineering programmes that are more specific for the South East employers' requirements and meet the EDGE Hub ambitions of developing CCCU engineering graduates to be 'industry-ready' engineers upon graduation.

References

Engineering Council (2014). The Accreditation of Higher Education Programme UK Standard for Professional Engineering Competence, Third Edition (AHEP), The Engineering Council, [on-line at] http://www.engc.org.uk/engcdocuments/internet/Website/Accreditation%20of%20Higher%20Education%20Programmes%20third%20edition%20(1).pdf

EngineeringUK (2018) Engineering UK 2018 Synopsis and recommendations, Engineering UK, [on-line at] https://www.engineeringuk.com/media/1576/7444_enguk18_synopsis_standalone_aw.pdf

Professional Engineering Competence, Third Edition (AHEP), The Engineering Council, [on-line at] http://www.engc.org.uk/engcdocuments/internet/Website/Accreditation%20of%20Higher%20Education%20Programmes%20third%20edition%20(1).pdf

Jørgensen, U., Lindegaard, H., & Brodersen, S. (2011). Foundations for a new type of design engineers–experiences from DTU meeting the CDIO concept. In *Proceeding of the 7th International CDIO Conference, Technical University of Denmark, Copenhagen, June 20* (Vol. 23, p. 2011).

Hart, A. (1986). *Knowledge acquisition for expert systems*. School of Computing, Lancashire Polytechnic, Preston.

Neill, C. J., & Laplante, P. A. (2003). Requirements engineering: the state of the practice. *IEEE software*, *20*(6), 40-45.

Rhodes, C. (2018) *Manufacturing: statistics and policy, Briefing Paper*, House of Commons Library, [on-line at] https://researchbriefings.files.parliament.uk/documents/SN01942/SN01942.pdf

Sommerville, I., & Sawyer, P. (1997). *Requirements engineering: a good practice guide*. John Wiley & Sons, Inc..

Sparsø, J., Bolander, T., Fischer, P., Hansen, T. K., Høgh, S., Nyborg, M., & Todirica, E. (2011, June). CDIO projects in DTU's B. Eng. in IT study program. In *Proceedings of the 7th International CDIO Conference, Technical University of Denmark, Denmark*.

Törngren, M., & Herzog, E. (2016, October). Towards integration of CPS and systems engineering in education. In *Proceedings of the 2016 Workshop on Embedded and Cyber-Physical Systems Education* (p. 6). ACM.