R3 Beaumaris 2 Friday 7 December 9.00-9.30

The academization of engineering education in the United States and the UK A neo-institutional perspective (0293)

Mike Klassen[1] [1]*University of Toronto, Ontario Institute for Studies in Education, Toronto, Canada*

Why do so few engineering professors actually practice engineering? The simplest answer is that they are academic researchers, and not actually practicing professionals. A more interesting sociological question that follows is: Given how few professors actually practice engineering, how then do engineering schools, faculty members and programs maintain legitimacy? What explains the academization of engineering education, defined as a shift from practice-oriented to science-oriented notions of engineering? This question has puzzled historians of engineering and has largely fallen between the cracks of two strands of sociology, that of professions and higher education.

The history of engineering education is marked by a persistent tension between the hands-on, practice-oriented "shop culture" of the apprenticeship model and the theoretical, science-oriented "school culture" more characteristic of early French and German higher technical education (Case, 2016; Seely, 1999b). The tension has manifest itself in the focus of the curriculum and the type of instructor that has taught engineering: research professor, or practitioner. While the pendulum has swung between the two extremes across time and nations, "school culture" has come to dominate engineering education globally in the latter half of the 20th century (Harwood, 2010). This culture is characterized by the curriculum being weighted towards theoretical content in mathematics, science and the engineering sciences that privilege the use of theoretical formulae to predict behaviours of systems, materials and physical devices. This curriculum is closely tied to the background of engineering professors, who are now mostly academic researchers with PhDs in their field, seeking to conduct and publish research in in order to produce knowledge and achieve tenure within their local institutions. Historians pinpoint the powerful influence of the Second World War the Cold War in turning the tides towards academization, particularly in the United States (Harwood, 2006; Seely, 1999a) but also in the United Kingdom (Divall, 1991). However, there is a lack of coherent sociological explanation for the social drivers of this change process, including national and institutional differences in the pacing, depth and direction of change (Harwood, 2010).

Drawing on neo-institutional theories of professions and education, this paper positions universities and professions as distinct social institutions - enduring normative structures with distinct logics, norms and patterns of behaviour - that depend on one another for legitimacy. Universities provide legitimacy to professions through authoritative knowledge and credentials on the one hand, while professions offer explicit legitimacy through professional accreditation and the promise of a protected labour market on the other. Using historical accounts to show the changing logics, structures and composition of engineering schools, I argue that academization of engineering education is explained best as the outcome of competing processes of institutionalization, in which the university has largely dominated. This is demonstrated by concrete changes in policy and practice that have rapidly spread throughout higher education systems in the last 50 years: dramatic increases in research funding, engineering aligning itself with science in the status hierarchy of disciplines, expanded graduate programs, requirements for

doctoral degrees among faculty members, and curriculum change towards the engineering sciences.

The major finding of this paper is that the university's institutional logics of authoritative knowledge and status through research were adopted and implemented by engineering schools in the US and UK alike, to the dismay of professional bodies that lacked the appropriate authority to legitimately intervene in internal affairs of the university. Scott's (2008) normative, regulative and cultural cognitive institutional pillars provide a language to connect Abbott's (2002) sociological arguments for disciplinary and departmental persistence with historians' empirical descriptions of changes to research funding regimes, faculty credential expectations, and in turn the curricula of both undergraduate and graduate engineering education.

The findings have implications for research on professional education more broadly: drawing on Halliday's (1985) concept of knowledge mandates, how do professions with stronger normative influence compared to engineering undergo academization? To what extent is engineering's rise to status and research funding a function of its relationship to science? This brings a new perspective to policy discourses that devalue knowledge and call for more 'practice' through generic competency development (Allais, 2014; Wheelahan, 2009). International mobility agreements spreading the use of practice-oriented accreditation requirements across countries signal the adoption of new institutional models which need to be better understood (Case, 2016; Lucena, Downey, Jesiek, & Elber, 2008). Neo-institutional studies of the changing logics, norms and scripts in engineering education offer a welcome change to the structural functionalist approaches implicit in much engineering education research (e.g. Patil & Gray, 2009).

References

Abbott, A. (2002). The disciplines and the future. In S. G. Brint (Ed.), *The future of the city of intellect: The changing American university* (pp. 205–230).

Allais, S. (2014). *Selling out education: National qualifications frameworks and the neglect of knowledge*. Rotterdam, The Netherlands: Springer.

Case, J. M. (2016). The historical evolution of engineering degrees: competing stakeholders, contestation over ideas, and coherence across national borders. *European Journal of Engineering Education*, 1–13.

Divall, C. (1991). Fundamental Science versus Design: Employers and Engineering Studies in British Universities, 1935-1976. *Minerva*, *29*(2), 167–194.

Halliday, T. C. (1985). Knowledge mandates: collective influence by scientific, normative and syncretic professions. *British Journal of Sociology*, 421–447.

Harwood, J. (2006). Engineering education between science and practice: Rethinking the historiography. *History and Technology*, *22*(1), 53–79.

Harwood, J. (2010). Understanding Academic Drift: On the Institutional Dynamics of Higher Technical and Professional Education. *Minerva*, *48*(4), 413–427.

Lucena, J., Downey, G., Jesiek, B., & Elber, S. (2008). Competencies Beyond Countries: The Re-Organization of Engineering Education in the United States, Europe, and Latin America. *Journal of Engineering Education*, *97*(4), 433–447.

Patil, A., & Gray, P. (Eds.). (2009). *Engineering education quality assurance: a global perspective*. New York: Springer.

Scott, W. R. (2008). *Institutions and Organizations: Ideas and Interests*. SAGE.

Seely, B. E. (1999a). The “Imbalance” of Theory and Practice in American Engineering Education: Reforms and Changes, 1920-1980. *Icon*, *5*, 40–63.
Seely, B. E. (1999b). The Other Re-engineering of Engineering Education, 1900–1965. *Journal of Engineering Education*, *88*(3), 285–294.
Wheelahan, L. (2009). The problem with CBT (and why constructivism makes things worse). *Journal of Education and Work*, *22*(3), 227–242.