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Personal View: Some Thoughts on Graduate Education for Engineers

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INTRODUCTION

IN THE 'good old days' the reasons for the provision of further education for engineering graduates were thought to be obvious: graduates had had insufficient time during their initial degree to specialize in a particular field; or else they wanted to 'do research'. The level of provision of finance and facilities made available to them to follow such higher degrees was usually determined by the students' desire to do the courses, and not by any assessment of the national need. For university departments, success was measured by their ability to fill the places on courses and studentships offered.

In these days of financial stringency, if nothing else, we have all at least been given the opportunity to pause and consider whether such provision is correct, and to question its basis. Indeed, if instead of considering the input, we refocus our attention onto the output of universities, then the constraint of maximizing this output according to society's—and particularly industry's—needs will give us a very different set of criteria by which to judge the success of higher education for engineers. Although complete control of university courses according to industry's needs is unhealthy, having due consideration for the requirements of industry is nevertheless vital.

If the push of students is to be supplemented by the pull of industry in dictating, for instance, postgraduate courses and their content, two well-established facts have also to be pondered:

- In science and engineering, recorded knowledge doubles about every 15–17 years. Thus all recorded knowledge throughout history up until 1975 has since then more than doubled, and will double yet again by 2010. This means that typical graduates will have only been exposed, at best, to about one-sixth of the knowledge they will need to use during their careers. (For some areas like medicine and law, the growth factor in knowledge is even greater, so that over a typical career in these subjects it is 15–20!) It is not surprising, therefore, that about one-third of the reading done by those at managerial level in industry is done for professional development, to ensure they keep up to date.
- When people with higher degrees are eventually employed, they will thereafter spend more than half their time communicating—either speaking and listening (about one-third) or reading and writing (about one-sixth). (The picture of the 'back-room boy' quietly beavering away, undisturbed and undisturbing, is quite wrong!)

From these facts—and from the author's personal observations in nearly 25 years of meeting young engineers joining industry—two things are clear. Firstly, education and training does not always equip graduates for the real world of work, where communication (public speaking and report writing) and other interpersonal skills are so important. Secondly, university education should not be seen as an end in itself, but rather as part of a continuing process.

For universities to survive and prosper as teaching institutions in the modern world, they must note these facts, and adjust their attitudes accordingly. Participation in the continuing education of graduates—theirs or others—and including in undergraduate and graduate training a strong element of communication skills will better ensure their success.

EPSRC'S EFFORTS

In many respects the considerations above have been seen and noted by government (through the EPSRC's Engineering Board's Education and Training Committee) as important, and in the existing Integrated Graduate Development Scheme (IGDS) and the new Parnaby D.Eng. courses these ends are largely being met. In the IGDS scheme, graduates (usually) in employment are seconded for weekly residential blocks of instruction provided by universities. About 15 of these modules are taken over two years; these, if passed and supplemented with a written report of a project conducted in the workplace, mean that the university

can award a master's degree. By this means up-to-date knowledge is fed directly into industry via young and active managers. On EPSRC's part this is a second use of the knowledge gained in research projects they have often funded anyway. It also means that continuing education is being targeted to those who will make the most of it, i.e. those who have convinced (or badgered!) management that they should join the scheme.

In the Parnaby programme, engineering graduates join so-called Parnaby Centres where groups of research students are twinned with industry. They undergo coursework that both fills and expands their knowledge of the specialized subject of the centre; they work in teams that encourage interpersonal communication skills; they spend a considerable amount of their four years in industry looking at real problems being tackled in real human environments, and they also carry out research projects. The work done has to be communicated verbally and in written form.

When first proposed the Parnaby scheme did not suit everybody. Process engineers (mainly chemical engineers) were strongly opposed to the proposal, and one can see why. The number of Ph.D.s available to the process industry is quite small, and indeed has lead to the situation where graduates of suitable subjects are paid so much by industry that there is no financial incentive to stay on at university, and long-term career prospects are not affected thereby. However, in the process industries it has to be admitted that many Ph.D.s moved from the research part of large organizations into factory environments. If they stayed there, the skills they then need are more akin to those provided by the Parnaby route. This, I am sure, will ultimately be realized.

CONCLUSIONS

Industry and universities must work together to ensure that continued education of graduates is appropriate, first for the individual's personal needs as he or she seeks to make the most of higher education for its own sake, and then to pursue a fulfilling career in the fast-changing world in which we live; and second for the good of the economy, the success of which ultimately governs educational provision anyway! Business-awareness lectures from industrial engineering practitioners would also be a good supplement to engineering courses at all levels, and should not be seen as a deflection from a proper university education, bearing in mind the existing vocational bias of engineering courses. Professional institutions have an equally important role in this area also, and have their own training schemes and participate fully in university–industry forums like EPSRC's Engineering Education and Training Committee.

The role of universities in wealth creation is to play their part in preparing wealth creators. Engineering faculties have a special responsibility in that the new technology that everyone now acknowledges is a key factor in wealth creation usually arrives with new people—often those fresh from university!

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