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Personal View: An Industrial View on Engineering, Education and Training

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I WOULD like to address the UK scene and open with a double question: 'Are the opportunities in UK engineering industries good enough for able students and are the students good enough for the opportunities?'

Currently the opportunities, in general, are not good enough or plentiful enough in UK engineering industries to attract able students. Unfortunately, the depressed state of British industry and the regular, continuing announcements of redundancies, rationalisation, restructuring—call it what you wish—drive able students either to seek more secure or more rewarding positions elsewhere or initiates in them an attitude that their periods of study have been a waste of time. Industry, on the other hand, has a problem finding suitable graduates to fill its vacancies adequately. This is a depressing situation for which both industry and academia are to blame.

We are creating more universities and colleges of various descriptions and are encouraging more and more youngsters into these institutions. This is good, but in doing so, I believe standards are being reduced and some of the courses tend to be gimmicky and superficial. Students are thus emerging from their further education in larger numbers than industry can accommodate and often without the fundamental understanding of their subject, without the ability to think originally, and without the commercial and communication skills that industry desperately requires.

These comments may sound extreme and many readers will claim that they are incorrect, citing many successes to support their claims. I accept that there are many successes and exceptions to my statements. However, I believe that what I have stated exists in many areas and that the trend of larger numbers of lower-calibre graduates is increasing.

The solution is simple—increase the status of the professional engineer (pay him/her well and somehow elevate him to a position of respect in the community) and hence attract more able students and raise the selection standards of engineering courses. This will improve the calibre of professional engineering, which in turn will strengthen the engineering industry and will create more opportunities.

Industry, academia, government and the engineering institutions all have a part to play in creating the conditions that will make this happen. Unfortunately, the implementation of this is not quite so simple for the following reasons:

- Industry tends to take a short-term view, resulting in salaries as low as it can afford (or get away with!); insufficient training and staff development; initial appointments with insufficient challenge and responsibility.
- Academia tends to produce students with expectations greater than their ability.
- The community does not give due respect to engineers, thinking of them as people in dirty overalls wielding spanners and grease guns, or people who fix washing machines, cars, etc.
- Engineers do not recognize the importance of communication skills (both internal and external communication) and, generally, do not recognize the importance of the commercial implications of their contribution to their company's business.
- Government policy lacks incentive and support for training, research and development, and investment for home and export business.
- Our engineering institutions do very little to improve the status of their membership.

No doubt some readers will contest these points and other readers would wish to add to them, but I believe these encapsulate the main problems.

I would like to describe some examples from my own industrial background to justify and clarify my statements and then to make some suggestions to alleviate the problems as I see them.

My background and experiences are from large engineering companies dealing mainly with large, multi-million pound, one-off projects involving design, manufacture and site construction. The examples will therefore not apply directly to large-volume, production-line industries but I would expect similar experiences to be encountered in these industries.

A typical project, say £100 M., comprises 5% engineering design, 15% project engineering/management, 30% bought-in equipment or subcontracts, 30% in-house manufacture, 20% site construction.

Firstly, the selling of such a project is a multidisciplined task requiring a combination of technical and commercial skills plus the ability to communicate with a range of client, finance house and, often, government departments.

During the negotiation stages of tendering, prior to contract award, clients usually put extreme pressure on contractors to reduce prices, improve deliveries, absorb additional items and costs, etc. This can be likened to a game of poker—it requires knowledge, calculated assessment of the client's position and that of the competition, plus, above all, an awareness of the risks to which individuals and companies may be exposed. These aspects of engineering are seldom included in undergraduate courses, but they cover the parts of engineering business which could attract the entrepreneurial engineers that industry needs.

Once a contract is won (or even in final stages of tender negotiations) a contract plan is created which will call for design to be completed in stages to permit:

- Material ordering.
- Selection of manufacturing processes.
- Issuing of manufacturing drawings and procedures to factories.

It is clear from the distribution of cost make-up that it is extremely important to specify correctly the equipment to be bought in and to design to facilitate manufacture. It is also very important that equipment is delivered on time and that manufacturing departments are free to run with no delays arising from late or modified engineering information.

Although the design and engineering content of a project may be relatively small in monetary value, it can have a very large and sometimes disproportionate impact on costs. There is invariably urgency at this stage of a project since delays will have a large cost impact if factory resources are not fully and efficiently utilized or changes in scheduling are required. Often engineering design staff seek the 'perfect' design solution and 'tinker' with their designs and calculations to achieve this; unfortunately, on many occasions this is detrimental to the project as a whole.

Once material is ordered or production has started it is usually very expensive to introduce changes. This supports the case that it is better to take a little longer in the design phase to ensure that design and production are optimized. However, more often than not, completion of design work takes place significantly late in the programme, causing disruption to project and company plans despite the availability of modern, powerful design tools such as computer-aided design and computer-integrated manufacturing systems and equipment. A conclusion which could be drawn from this is that detailed computer design and analysis are replacing practical thinking and pragmatic engineering decision making.

It goes without saying that design and manufacturing code requirements are met and that all work is in compliance with the client's and contractor's quality systems.

However, just as late or overdesigned engineering can be costly, so can misinterpretation of quality specifications, hence it is very important that engineers understand the cost and programme implications of quality assurance and quality control requirements.

The above points are all related to the execution of projects on time, within cost and to the correct quality. This is absolutely essential in today's highly competitive, international market. Little attention appears to be paid in the education and training of young engineers to the importance of producing designs that are fit for their purpose rather than being perfect in all respects.

A much better commercial awareness is thus required in our young engineers.

Whilst the above comments apply to all branches of engineering industry, there are additional problems associated specifically with the manufacturing sector.

For some years, manufacturing has been the poor relation in engineering and in business in general and has been unattractive to young graduate engineers. Efforts are currently being made by government and some industries to reverse this trend. One reason for this decline in manufacturing capability is possibly the very low manufacturing rates available in the Far East, Pacific Rim and Eastern Europe, encouraging companies to move their manufacturing bases to these areas. The direct consequence of this is that there is less investment in UK manufacturing industries and fewer career opportunities.

I believe this can be countered only by the introduction of advanced manufacturing processes and concentration on advanced engineering products rather than by trying to compete in the mature processes and products where other countries have the technical ability plus the advantage of very low labour rates.

This requires foresight and investment by industry together with communication to the marketplace and to the feedstock of industry, i.e. the young, able engineers and technicians, that manufacturing industry is on the move to develop new processes which will revitalize British manufacturing industry.

I believe that the messages emerging from my experiences are:

- More emphasis needs to be applied to commercial awareness of engineers during their university/college courses and during their training periods in industry.

- A good grounding in engineering fundamentals is essential and should not be replaced by superficial training/education.
- More emphasis should be applied to communication, negotiation and presentational skills.
- Attitudes to sales and project commercial matters need to be changed to encourage a more entrepreneurial spirit in more engineers.
- The engineering institutions in collaboration with industry should do more for their members by tightening the entry qualifications further, by encouraging legislation that will permit only certain levels of qualification to practise at professional and technician level and by rewarding these levels appropriately. Examples should be taken from the medical, law and accountancy professions.
- Every opportunity should be taken to encourage government to create incentives for training, development and investment in engineering industries.

It is not intended here to cover all aspects of concern in the education and training of engineers. I have made some fairly far-reaching claims and trust that readers will recognize similar experiences in their own fields.

I am sure many readers will disagree with many of my statements, but to these readers I make the plea 'please do not rule my statements out of court since they are not what you want to hear and believe!'

To overcome my concerns, academia and industry must continue to work together and to increase their collaboration to ensure students receive the basic education industry requires of them and that industry continues to train and develop young staff to regenerate the flagging British engineering manufacturing industry.

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