WHICH CAME FIRST – THE CUSTOMER OR THE ENGINEER?

The Royal Academy of Engineering Dinner for Visiting Professors in Principles of Engineering Design, 13th September 1999

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It seems to me, from an industrial – perhaps I should say commercial – point of view, that the quality of engineering design is particularly sensitive to the nature of the relationship between the customer and the engineer. Too often we hear that relationship characterised as simply a matter of the customer explaining the requirement, and the engineer meeting it. Of course, it's not nearly that straightforward. If it were there would be no dissatisfied customers and no frustrated engineers.

Rather, the relationship is always challenging, sometimes confusing, occasionally baffling.

The customer and the engineer. Which came first?

The process of solving that riddle can generate some useful insights into the principles of engineering design.

There are many starting points. One – my own preference – is to listen single-mindedly to the customer. Because if we do it's a racing certainty that we'll hear two messages from every customer, every time.

First, customers want perfection. No defects in the product of service. Ever.

An impossible dream? When we have still to perfect the humble toaster? By the way, how great an engineering design challenge can that be? To build a toaster which works not only on AC and DC, but on bread too. A toaster which has more than two settings – too soon and too late.

In fact, most everyday activities are substantially imperfect. Doctors' prescriptions, payroll processing, wire transfers, restaurant bills, and airline baggage handling all benchmark at around 6,000 errors per million opportunities for error. The evidence might suggest that we have become comfortable living and working in a society with a built-in 0.6 percent error rate.

And that's an uncomfortable thought next time we board a plane, isn't it?

Well, we can relax. If flying exhibited that error rate, the entire world fleet of aeroplanes would be wiped out in few weeks.

Since we demand a safe journey, the many inter-related products and processes are designed to yield a very low-defect rate in the overall service called flying. The odds are 2.5 million to one that the flight will be uneventful.

The air travel industry is on the way to achieving perfection. It's evidence that very, very low defect rates can be achieved – if we set about engineering design in the right way.

Customers expect perfection. And engineers should learn how to deliver it.

The second message we'll always hear is a demand for old products to be improved and new products to be introduced at an ever-faster rate.

In an increasingly competitive world, hearing that message can be a matter of survival. I remember when it wasn't always so.

In the quasi-monopolistic telecommunications market of the seventies, it took us – customers and engineers together – seven years to design and approve Britain's first push-button phone. And I remember industrial commentators noting that it had taken NASA only two years longer to put a man on the moon!

It's hard to overstate the importance of cycle time in achieving competitiveness in a rapidly globalising industrial economy. Indeed, the rate at which companies learn and then do, may become the last sustainable source for competitive advantage.

Discussing with customers their desire for perfection, ever-shortening cycle times and, indeed, anything else depends on an ability to communicate. Depends on one of the set of skills often regarded quite inappropriately as the poor relation in the family of knowledge – 'Key Skills'. Communication, application of numbers, problem solving, team working, information technology, and improving one's own learning and performance.

Industrialists used not to have the need for those skills uppermost in their minds. That's no longer the case. Modern, knowledge-driven industry depends crucially on Key Skills.

And we used to take it for granted that engineering graduates would possess those Key Skills in abundance. That's no longer the case either.

For example, the Institution of Electrical Engineers studied what might be done to make first-degree courses more sympathetic to industry. The conclusion, endorsed by industrialist and academics alike, was that there needed to be a sharper focus on the teaching and assessment of Key Skills.

So convincing was the study that the IEE has changed its criteria for the accreditation of degree courses. Universities now have to show that they teach Key Skills to a minimum specified level. How they teach Key Skills is left up to them, of course. But I expect most of them will choose to teach Key Skills by changing the way they teach technical skills. Weaving Key Skills into the fabric of the curriculum. Just as Key Skills thread through everyday life in industry.

But Key Skills are not the only prerequisite for excellence in engineering design. So, of course, are technical skills.

The teaching of technical skills is one of the things at which British universities have excelled over very many decades – perhaps even centuries. Universities have kept up with the relentless advance of technology – often leading that advance, indeed. But the pace grows ever faster. More and more has to be crammed into the curriculum. In the limit, and some would say we have reached it, courses will have to be lengthened, or content will have to be omitted, or both.

Incidentally, if we should doubt the rate at which technology is progressing and the rate at which that technological progress is impacting our society, consider this.

In America, after radio broadcasts began, it was 38 years before there were 50 million listeners, Television tool only 13 years to achieve 50 million viewers. The Internet had 50 million users in just 4 years.

So what next? Which technologies lie just over the horizon? Which of today's technical skills will be highly relevant? And which less so?

We can't be sure. Such is the pace of technological change that it would be a brave, perhaps rash, industrialist who thought it was possible to predict with any certainty the precise technical skills mix needed even five years from now.

For instance, the pace of change in the semiconductor industry is so great that Motorola's skills mix will have changed from 95% process engineering and 5% software engineering in 1990, to 40 % process engineering and 60% software engineering by next year.

And if we could forecast technological progress reliably, could Higher Education keep up with the rate of change across the board? In a recent survey of Information Technology skills[1] needs by a company called 'Information Builders', 80% of academics said 'It is difficult for us to teach the latest IT developments due the frequency with which these developments occur'.

So I suggest that the answer may be to focus increasingly on teaching broad technical skills, at least at first-degree level. I shrink from using the terms 'foundation technical skills' or 'generic technical skills' because they carry a connotation of relative simplicity when, in fact, they are complex and challenging. Indeed, the breadth of application of a technology is more likely to be an indicator of its sophistication than of its simplicity.

Broadly-based technological skills taught excellently, first at school and later in Higher Education and Further Education, provide the most promising starting point for a lifetime of learning.

Acquiring knowledge is one dimension of the Higher Education experience. Learning how to use it may be quite another. It may be that, in its exertions to keep up with the ever-quickening rate of change, Higher Education will need to keep a careful eye on the balance between its students' analytical skills – which I regard as a traditional strength of Higher Education in this country – and their creative skills, of which industry needs much more.

To put it another way. Logic operates within boundaries. Imagination moves the boundaries. Industry needs more graduates who can more the boundaries.

Fostering creative skills – freeing students' imaginations – is vital to industrial health. But there is more to it than that. Imaginative engineers are needed to keep up with imaginative customers. And the imaginative pace is quickening. To calibrate it, the IEE together with several other engineering Institutions organised a competition for children called "Today's Engineers Look to the Future". The children were invited to draw their idea of a technological future.

Five year-old Hayley envisaged a 'Cloud-buster'.

Paul, who's seven, imagined a drive-by-wire car.

Nicholas, also seven, envisaged the Virtual Reality Learning Suit. Here's how he described it:

"In my VR learning suit, I would be able to visit the swamp with the frogs, turtles and alligators in it. I can be right there with them. I can feel their skin and feed them – and still be in my classroom. I can anywhere in VR".

A child's-eye view of the future – yes. But to discount it for that reason would be wrong. Because the imagination does not dull with the advancing years.

Every year, Motorola commissions MORI to survey the attitudes of the British to technology. This year we asked people to envisage what life in Britain will be like ten years from now. We asked them questions about the home they will be inhabiting, the car they will be driving and the way they will be spending their work and leisure time. And we asked them to gaze into their own crystal ball to say what they hoped for the future, what they expected and how, and if, technology would deliver that.

The findings are extraordinary and encouraging. Two themes are particularly striking: first and foremost, the British public's buoyant optimism about technology and the future and, second, the sheer imaginative scope of their visions.

Imagine your day in 2009. You start with a leisurely breakfast, every bite calorie-free and specifically tailored to your nutritional requirements. Afterwards, there's no need to worry about cleaning-up because your kitchen does that automatically. Hop into your maintenance-free car and drive to work, dictating tasks to your intelligent electronic assistant along the way. Maybe you're in the office today or maybe working from your laptop on the beach, either way it's a short day, leaving plenty of time for a 20-minute workout which has the equivalent effect of two hours toil in the gym. In the evening you decide to visit your cousin in Guatemala. You can travel there instantaneously and still be home in time to programme your favourite dream for tonight's slumber.

That’s how the British imagine the future. We are in a mood to create a future of our choosing and while some of the predictions may sound far-fetched, none of us can really know what the future holds. While the rate of technological progress may deny us some of our choices, it will enable many other opportunities that we cannot yet imagine.

What we do know is that our lives today, and in the future, are built on choices.

And therein lies the real challenge for engineers. To bring to bear our skills, technical and non-technical, and our imaginations to design choices for the imaginative customers who constitute our society.

Oh, and which did come first, the customer or the engineer? Neither. Imagination did.

Ref

1. The IT Impact Survey 1998, Information Builders: http://www.ibi.com